HANDBOOK

for ICT Projects for RURAL AREAS

In memory of Prof Dr Ir. Suwido Hester Limin
(1955 - 2016)

Handbook for ICT PROJECTS for RURAL AREAS

ASIA-PACIFIC TELECOMMUNITY

APT serves as the focal organization for information and communication technology in the Asia-Pacific region. We promote the development of telecommunication & ICT in the region, with particular emphasis on developing countries.

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Let's SHARE together! Welcome to this new activity.

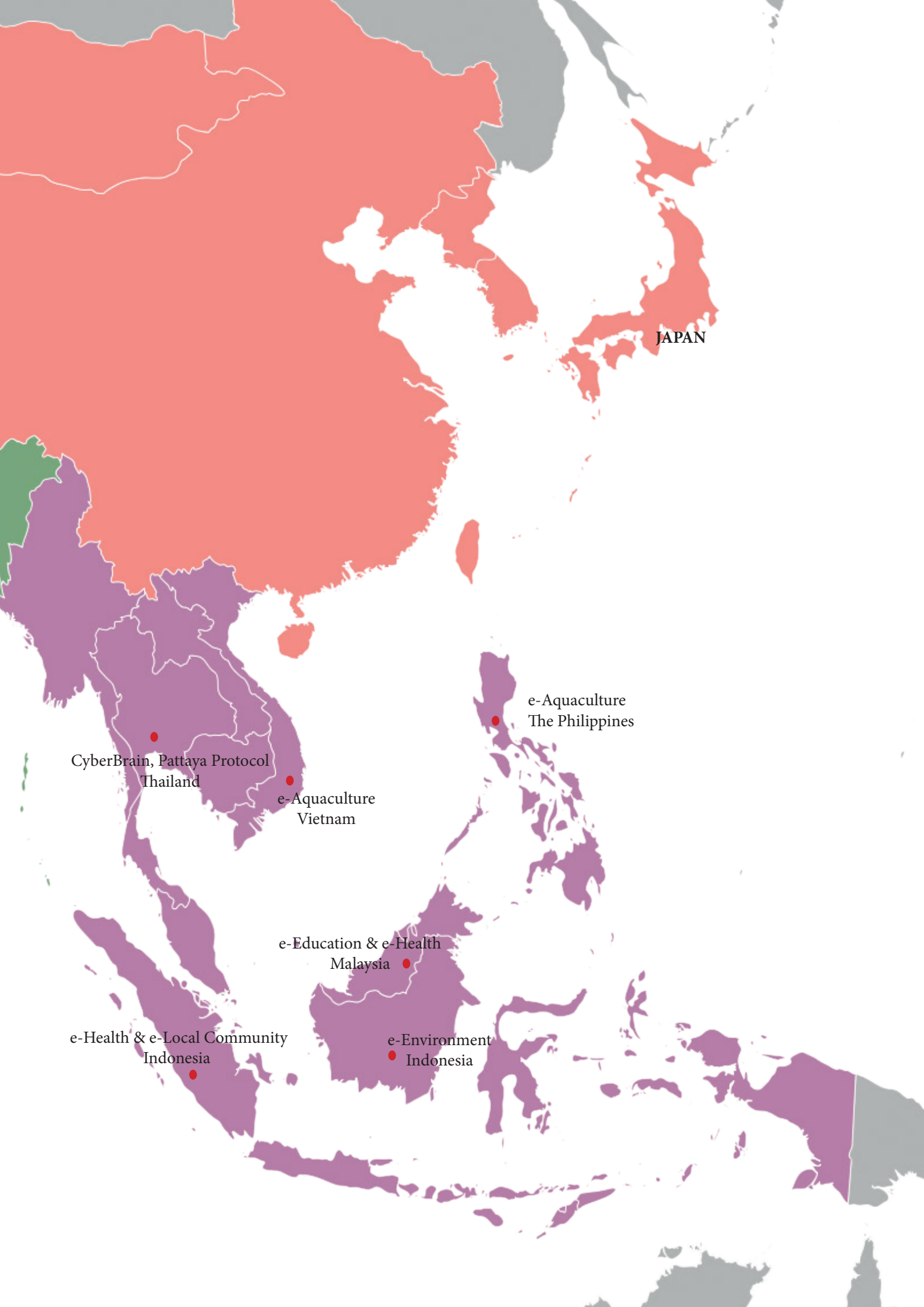
The role of SHARE is very simple but important; that is to bring Success and Happiness by Activating Regional Economy especially for communities living in rural locations within developing countries.

Success and happiness can be achieved through the improvement of the quality of lives and socio-economic status of rural communities. However, one very important question that must be asked is how can this improvement be achieved? Although many trials with high technologies have been conducted over the years, these attempts can be seen to have been made in vain, for the simple reason that these trials were driven by technologies instead of being people-centric. Little attention was paid to the thoughts and concerns of the beneficiary communities who were to continue creating value to these projects themselves. Considering that the lives, situations, environments and customs of everyone are all different, it is therefore our responsibility to design, adapt and operate technologies and systems to best fit the needs of each person and society in an easy and sustainable way. Our past experiences and observations have shown that easy and sustainable operation is the key success factor in rural areas.

What makes SHARE stand out from other ICT driven projects is the idea of collaboration instead of competition. SHARE members work closely together in sharing their experiences and results of the various projects initiated in their respective countries, highlighting how ICT solutions are applied in different situations. Through these shared know-hows, we can then move forward in achieving greater heights with the beneficiary communities that we will work together with in the future.

Let's SHARE our experiences and achieve our roles together!

Dr. Yuji Inoue
Executive Advisor, The Telecommunication Technology Committee
Chairman, Toyota Info Technology Centre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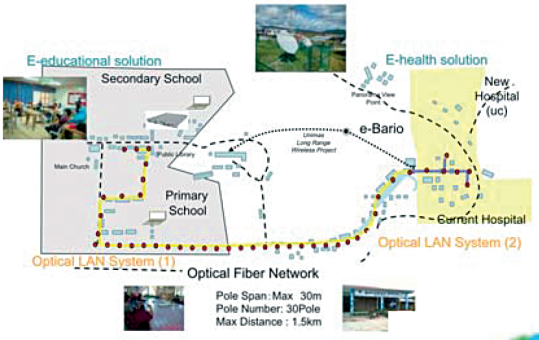

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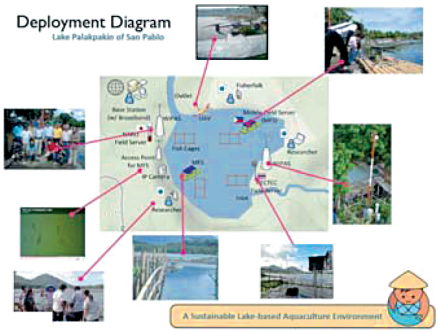

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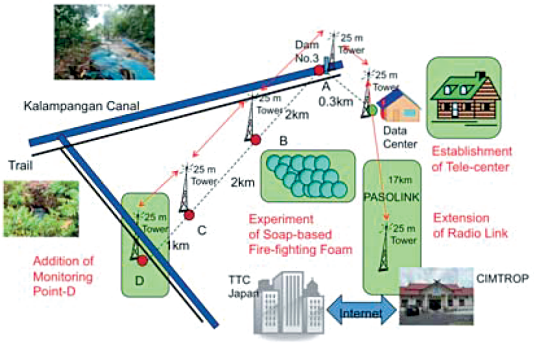

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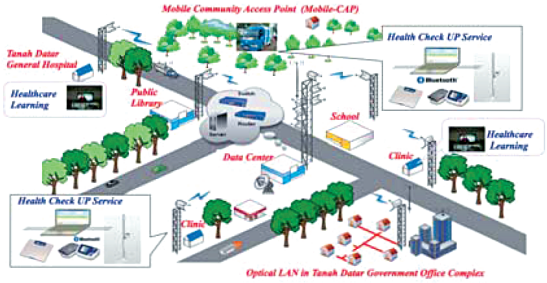

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The cumulative projects, which led to the writing of this handbook, would not have materialised without the support of many agencies and the guidance of special individuals. The authors would like to thank the Asia Pacific Telecommunity (APT) for providing the grant to write and publish this handbook. The work done and reflected upon in the handbook is an accumulation of years of experience, on various fields of knowledge, and interactions with numerous people across many countries in Asia Pacific. The authors are deeply grateful for the opportunities provided by Telecommunication Technology Committee (TTC) Japan and its working group on Bridging Standardisation Gap (BSG) by many of its gracious officers, especially, Mr Yoichi Maeda, Dr. Hideyuki Iwata, Mr Masatoshi Mano, and many others, over a period of many years, that have enabled the development of research in various remote and rural communities in South East Asia. The authors were also guided through the work of various experts in the field, namely Associate Prof. Dr. Asanee Kawtrakul, Dr. Anan Pussitigul, Prof. Dr. Gregory Tangonan, Associate Prof. Dr Nathaniel Joseph Libatique, Prof. Dr. Khairuddin Ab Hamid, the late Prof. Dr. Suwido Limin and the esteemed Dr. Yuji Inoue, the fore-father of SHARE. The authors would also like to thank all the universities which they represent – Kasetsart University Thailand, Ateneo de Manila University in the Philippines, Universitas Palangkaraya in Indonesia, Vietnam's Ho Chi Minh City University of Technology, University Malaysia of Computer Science and Engineering, and Universiti Malaysia Sarawak in Malaysia. Without the continuous support from the universities, none of the work with remote and rural communities in these countries would have been possible. The government agencies and local authorities in each country have also played a part in making these ICT rural communities across Asia Pacific happen.

The authors hope to share knowledge and lessons learnt from the various projects conducted in the Asia Pacific in the last ten years, through the contents presented in this handbook, and that this handbook will help to promote, improve and expand future implementations of ICT projects for rural communities all over the world.

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Professor Dr. Ir. Suwido Limin was longtime University of Palangkaraya professor who founded a firefighting brigade to fight in the field during the haze crisis in Central Kalimantan. In his life, Suwido was known to be very dedicated to peatland conservation. The Director of the Center for International Cooperation in Sustainable Management of Tropical Peatland (CIMTROP), he was also most vocal about the threat of forest fires and peatland issues in Central Kalimantan. Dr. Limin, an ethnic Dayak, also helped draft a regulation on indigenous rights in Central Kalimantan that has been submitted to the provincial government for approval.

EXECUTIVE SUMMARY

Introducing technology in general to groups of people who are marginalized by social, economic and geographical gaps is a complex task. Technology, particularly those that involve the communicative and collaborative features, can be a challenge for rural communities to adapt to, because the tools are designed, disseminated and targeted for those who already have an affirmative uptake to technology. For communities living in rural areas, the use of technology is often perceived to be a "want" rather than a "need", as local knowledge and social and economic practices that exist in communities living in rural areas are most often self-sufficient, inherited for generations, and readily transferable through mentoring.

Bridging the digital divide, or technological gap between urban and rural communities, is an effort that has been fronted by many nations, organisations and agencies alike. To date, there have been various projects implemented worldwide which aim to address this issue. ICT access has been identified by the International Telecommunication Union as being crucial in bridging the digital divide as a key foundation of development, particularly for rural development (ICTs Go Rural, n.d.). The creation of local capacity and competencies, and the stimulation of ingenuity and innovation, and consequently the boost of human skills and performance are critical factors in connecting rural communities to the advancements in global information and communication network.

The "Success and Happiness by Activating Regional Economy" (SHARE) collaboration is an example of such initiative. Fronted by the Telecommunication Technology Committee (TTC) Japan, SHARE has implemented various ICT projects in rural locations in Asia Pacific, particularly in Malaysia, Indonesia, Thailand, the Philippines and Vietnam. The main philosophy behind the SHARE initiative is simple but important, namely to bring about positive changes in the development of rural communities, increasing socio-economic standing and improving the quality of life of the rural folk through activating regional economies using various ICT solutions. The SHARE collaboration's strength is through its partnership with many countries. Collaboration is built with academics in local universities, and local government agencies that are able to directly influence change in rural communities in their respective countries.

A key observation that has been made from the implementation of the different SHARE projects is that, although ICT is imperative towards driving the initiative forward, a crucial factor in ensuring that these changes continue to develop is the commitment of the communities themselves. Input from the communities is vital to create value for the projects. It was also observed that each project benefits best when customised to suit the local needs, context and customs of each community. Every community is unique, and one implementation model does not fit all projects. Project initiators have had to design, adapt and operate technologies and systems that can best fit each person and society in a straightforward and sustainable way.

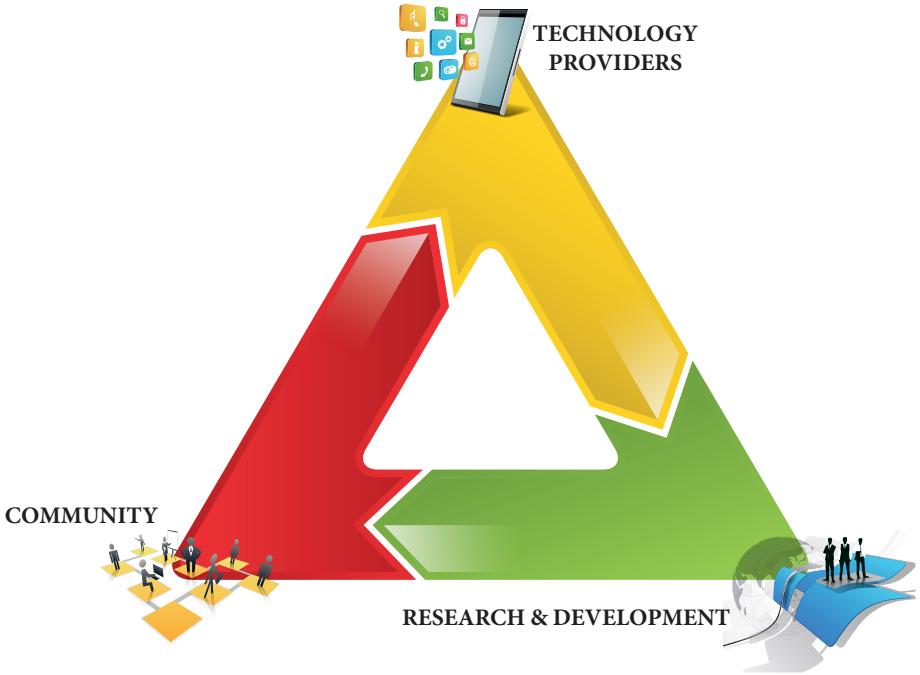
This handbook is intended to guide future initiatives to introduce ICT projects for rural communities. The handbook is written from an accumulation of experience of technologists and academics from six countries in Asia Pacific. The collaboration of ideas shared in the handbook provides a broad spectrum of concerns that have emerged through the planning and implementation of ICT-based projects, funded by Asia Pacific Telecommunity (APT), beginning 2008 to 2016. The research focus of APT to "promote the development of advanced ICT researchers and engineers in the Asia-Pacific region by the exchange of personnel through international collaborative research projects on advanced ICT" (J2-J3-TMP, 2016).

All projects have their own stories, and each story became a lesson learned. The handbook builds on the stories, and its intention is to empower others who are making their own journeys in introducing technology, particularly ICT, to rural areas.

The projects implemented were pilot initiatives, in that their duration was limited to only one calendar year. Impact on the rural communities may not have been as substantial as it is designed for; however the lessons learned from each project opened new ways of thinking and exploring ways to introduce ICT for rural areas. The handbook concludes with ideas that encompass the growth of scholarship about ICT for rural communities, paving the way for future projects in the field of community informatics.

INTRODUCTION

This handbook presents guidelines and fundamental requirements that can be used by project managers and teams who are keen on initiating ICT projects in rural areas. Contents are based on the experiences by the authors when rolling out ICT projects in remote areas within Asia Pacific. The handbook is an accumulation of ideas and experiences from SHARE projects, an initiative driven by Telecommunication Technology Committee Japan (TTC) Japan, in which four countries, namely Malaysia, Indonesia, Thailand and the Philippines, have rolled out various technology-based projects in rural locations and Southeast Asia. The book describes a narrative of guidelines, which are organised according to phases of development for a technology-enabled solution. The writing of the handbook takes into account the unique considerations for accommodating to local needs and competencies in remote and rural communities. The handbook is written from a project management approach. The contents are arranged in a sequence that would help a new or experienced project manager to visualise the work processes needed in planning, implementing and assessing a project that capitalizes on ICT for rural communities.



Technology has become such an essential part of society today, with the latest advancements in idea and product development that continue to enable better efficiency. However, the convenience of technology has not reached out to everyone around the globe, as many rural communities are still placed at a disadvantage due to remote geographical locations and the lack of access to necessary infrastructure.

Bridging the digital divide has captured the attention of many researchers and technology providers alike, and there have been an increasing number of efforts to introduce ICT projects to numerous rural communities around the world, especially in the Asia Pacific region (UNESCO BANGKOK, 2005). However, working with rural communities entails more than just bringing in the technology and installing it in the village and expecting the community to agree, accept, adopt and adapt the innovation that comes with the technology introduction.

In the experience of SHARE, three main players make the technological innovation work in a community – the technology providers, the beneficiary community, and the research and development team who are identified from local universities. Each player has its own strengths that would enable the technology project to run. Synergy between the players is vital towards the success and sustainability of an ICT project. This can be achieved through effective communication, to ensure mutual understanding of the objectives and expected outcomes of the project. What is interesting to note is that even though close communication is a crucial part of running a project, this aspect is not always given top priority. On the outset, the three players seem to play separate roles and are responsible for their own individual outcomes. However, the three roles are highly dependent on one another throughout the various phases of an ICT project. For example, although the technology drivers are responsible for bringing in the technological solutions to the community, they need input from both the researchers and the community in order for the technology to be relevant to the needs of the beneficiary community. The researchers are needed to engage with the community to learn about what the communities want, and are able to support.

The information will determine how to best deploy these solutions to meet with their technological needs. The research teams are seen to take on a more central role in this process, as they will be the middle persons who will convey the thoughts of the communities to the technology providers, and vice versa.

Communities, on the other hand, are responsible for the articulation of necessary information to the other players in the project. The information will design the scope and nature of the ICT solution. Throughout the project, community representatives will also have to work closely with the project teams so that they will be able to take over the management of the project upon its completion.

On a more academic perspective, an approach to be considered as it can enable mutual beneficial relationships between project stakeholders is Participatory Action Ressearch (PAR). Through PAR, rural communities take on an active role in the research process, becoming co-researchers and contributors towards the development and sustainability of the project. Besides that, researchers and technology drivers have the opportunity to see how they can further improve their solutions and deployment methods for the community through PAR. PAR also allows for all those involved in the project to not only build a close working relationship with one another, but to also lead towards a long-term commitment of confidence and trust with each other. It is this type of relationship between all the stakeholders that forms the core of every ICT project for rural areas, and is something which must be addressed and taken into consideration from the get-go of every project.

DESCRIPTION OF CHAPTERS

This section presents a brief description of each chapter created for this handbook. The section serves to assist readers to plan for what they read, to enable a more efficient access to contents of interest to readers.

Chapter One (1) describes the project initiation phase, where a project leader has to make early decisions about the scope and breadth of the intended project with a rural community. The chapter includes considerations for conducting a needs analysis, a feasibility study, and use the information collated to make informed decisions.

Chapter Two (2) covers tasks related to Planning. It explores issues related to the particular needs of the target rural community as identified in the first phase of the project. During this stage, project initiators will be able to plan and decide on suitable solutions that can be applied in the project, especially in terms of functionality, usability, availability, efficiency and sustainability. In the development stage, project leaders formulate the project activities that will be implemented in the project.

Chapter Three (3) looks at the systems design of a project, as systems design is an integral component to consider when initiating a project as there are various different requirements that need to be complied with in order to ensure that the chosen solution is suitable to meet with the needs of the target community. This chapter examines various aspects of systems design that project managers have to consider when planning to roll out an ICT project for rural communities, such as the needs of the community, the solutions that can be applied, the appropriate technology to be deployed and sustainability.

Chapter Four (4) essentially guides the implementation phase. At this stage, the actual implementation of the project is carried out as planned out during the design and development phase of the project. The implementation phase of the project rollout is important as project initiators will have to look at issues pertaining to the budget and scheduling of the project, as well as project sustainability. The chapter also looks at the management and monitoring aspect of an ICT project and the role of a project manager to monitor and address emerging issues in a timely manner. The chapter also summarises key tasks that need to be created and undertaken, to ensure a smooth and efficient hand-over of the ICT project to the rural community. It is the final step to verify the work processes in all phases in the project, which is crucial in determining the life cycle of the project to continue after the project concludes.

Chapter Five (5) is the final chapter in the handbook, which illustrates emerging trends and concepts related to introducing ICT projects to rural communities. A conceptualization of the Pattaya Protocol is described, detailing the growth of ideas by SHARE partners in designing projects for communities in rural areas. The Pattaya Protocol is an approach to be considered to move forward in the quest to integrate technology solutions efficiently for communities in rural areas.

PROJECT INITIATION

Every project begins with a need. A need is identified when it affects human social, economic, psychological and health aspects of living. When a need forms, a solution, or a combination of solutions is needed. One strategy to design a solution fit for the need is to initiate a project that focuses on addressing the nature of the need.

To pursue any type of project with communities in rural areas, there is a need to be prepared about the opportunities and challenges to be addressed, specific to the community. A project requires a leader and a team whom will create, manage and monitor the project. Oftentimes it involves individuals with various types of skills, qualifications, experience, and world view. As a team, they need to work on a timeline and a budget agreed upon for the project. There are several key points when planning a project, which involves a specific rural community. The questions can be categorized into three aspects – justification, significance, and role of ICT in the project:

Justification

- **What was the criterion used to identify the community to work with, for an ICT-based project?**
- **What are the characteristics of the community?**
- **What terms/points of reference are used to define the community as "rural"?**

Significance

- **What are the strategies used to collect and verify information on needs for the project?**
- **How will the community members contribute to the identification of needs of their community?**
- **Could working with the community create problems with other indigenous peoples in the region?**

Role of ICT in the project

- **What does this project offer that is new in terms of ICT?**
- **How and to what extent is the identification of knowledge base/ talents/ sources of reference will be identified to be relevant to the needs of the rural community?**

Choosing the community to work with, for an ICT project, is important in every community-based project. However, it is evident that there are more aspects to be considered when working with a rural community, in comparison to communities living in urban settings. Each rural community is unique from one to the other, due to geographical, economical, educational attainment or cultural ranges. It is therefore essential to consider the context in which the ICT project is proposed for. Project leaders should consider these unique factors when planning to initiate a project in rural settings, as each project has its own impact and kinship to its target community. The specific needs of the community as well as the problems that they face must first be addressed before any solution can be proposed for installation.

Below are several points of consideration to narrow the choice for selection:

- **How do you justify having chosen Community A rather than Community B?**
- **Is ICT access and literacy an important criterion for selecting the community?**
- **Is ICT service or product an important must-have in the project, to elevate the current problem, demand or context of living in the selected community?**
- **Are there any previous record or experience within the community where ICT has been used community-wide to solve a problem they face? What was the rate of success, or failure, of the previous project(s)?**
- **What are the significant impacts notably observed through previous ICT projects?**

1.1. PROJECT ORGANIZATION

The first step to begin the project with the rural community is to prepare a proposal. If there is a funding agency available, Upon approval, a budget or further management commitment for the project may also be required before an individual is assigned to begin work and lead the project, and before the project is authorized to progress to Project Initiation.

In cases where the selected community has its own leadership management team, there is a need to prepare a set of project proposal for the community's management team, in order to obtain support and acquire agreement from the leaders of the community. Local leadership is essential in driving the success of the project, as it will lead to the sustainability of the project. Sustainability of ICT projects for rural communities will be further explored in the sixth chapter in this handbook.

1.2. CONDUCTING A NEEDS ANALYSIS

Before designing and developing, or making a decision about an ICT solution to a rural community, it is crucial to first identify the needs of this community. These needs involve the long-term goals towards better economy, human development and sustainability. Without identifying these needs, it would be very useless to start a project introducing ICT solutions to the community. The solution offered would be irrelevant to the community and the resources spent on the project would be a waste.

One of the most useful methods to find out the needs and characteristics of a community is through conducting a needs analysis survey.

WHAT IS NEEDS ANALYSIS?

Need Analysis is the process of identifying and evaluating needs in a community or other defined population of people. The identification of needs is a process of describing "problems" of a target population and possible solutions to these problems.

Need analysis focuses on the future, or what should be done, rather than on what was done as is the focus of most program evaluations. Some people use the related term "needs assessment".

Extracted from: https://extension.arizona.edu/evaluation/.../needs.pdf

In identifying the community needs, a project should begin by looking at the community characteristics, especially the outstanding ones. There are many aspects in the characterization of a community. Some of which are the demographics, geographical locations, economic situations, political landscape and interests, local culture and values, history, education access and priority, etc. For instance, if the selected community is located near a fresh-water lake and aquaculture and ecotourism are the most important sources of livelihood for the people there, then that would mean that it is a need of that community to achieve sustainable livelihood practices that would not cause massive damage to the environment and therefore, harm the aquaculture and ecotourism industries existing within the community.

To begin, these are some questions to lead toward establishing characteristics of the selected community:

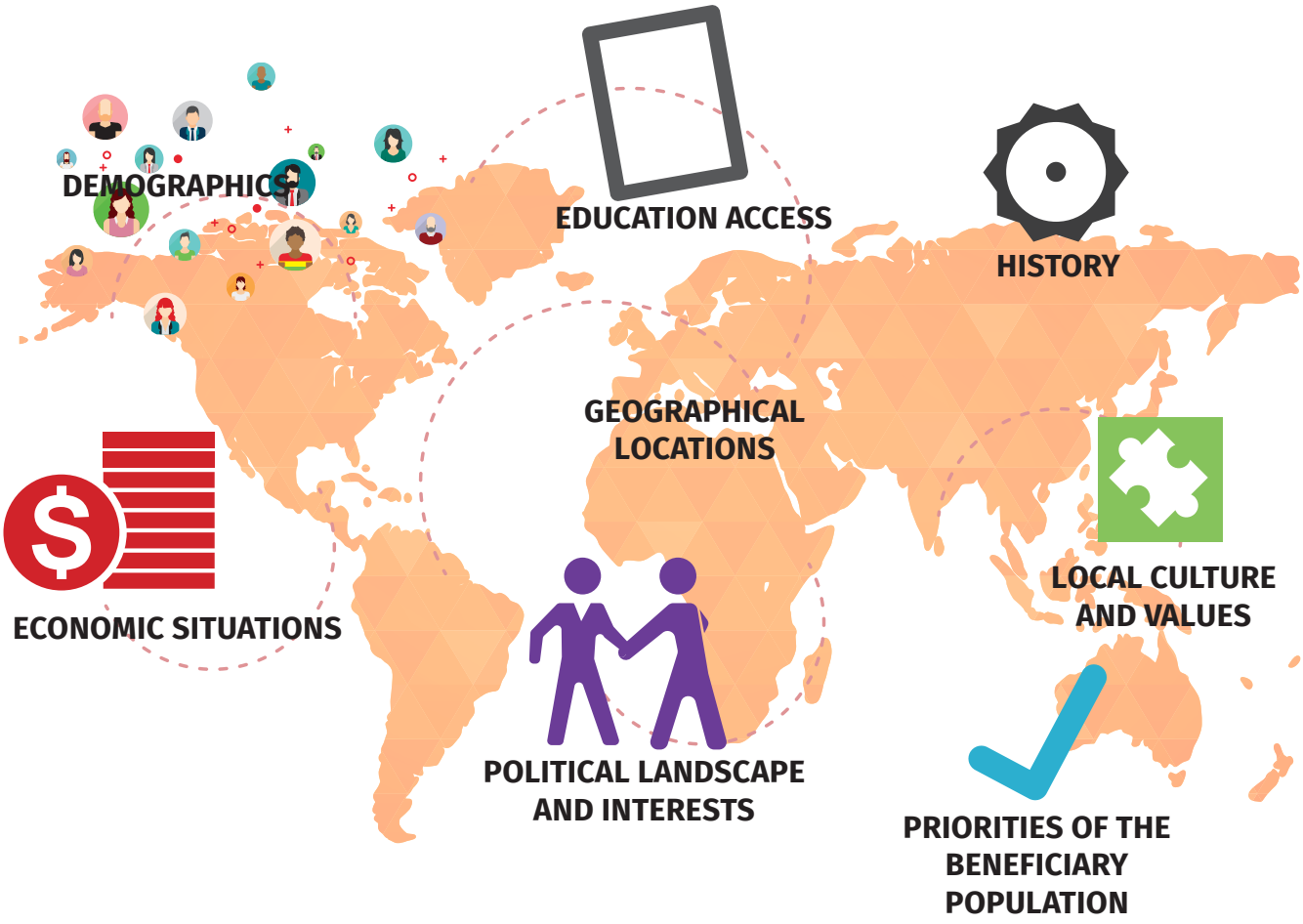


Figure 1 : Characteristics of a Rural Community

- **What are the needs of the community?**
  - Socio-economic
  - Cultural (arts or language)
  - Education
  - Health
  - Any other unique needs identified by the community

- **To what extent has any type of help or assistance been provided by other parties for the rural community? Is there any other assistance planned for the next few years, which may coincide with the proposed project?**

There are various strategies at the disposal of the people leading a community-based project when collecting and verifying these information. The choice of strategies to use very much depends on those responsible for creating the ICT project. Community members would have a lot of very useful information on their community and their contribution to the process of identification of the needs cannot be ignored. Information can be collected from them through interviews, self-report, community consultations, immersive inquiry, questionnaire surveys, artefacts etc. For example, in a case study project rolled out in Bario, Malaysia, community dialogues were held with key community leaders, to ensure that understanding and consent are sought from the very beginning of the proposal for the project. There were also instances where leaders changed positions, and a similar rhetoric had to be repeated to the new leadership line-up, but it was necessary to be done because community buy-in is essential to make sure the project runs as planned, and supported continuously by community members.

It is a good practice to have a set of criteria in identifying the community. The practice helps to justify in choosing a particular population over another. It is possible that working with one rural community may create or lead to problems with other rural communities, and/or other institutions, such as government agencies or stakeholders. It is wise to learn to be open about the local politics within the community, because not all communities function similarly to one another. Gender, religion, access to education, and significance to socio-economic activities are common elements seen in almost all case study projects conducted by authors of this handbook, in locations across Asia Pacific. Issues indigenous to the communities may either boost or hamper the progression of the project. Therefore, it is reasonable to engage with the community members, especially their leaders and stakeholders, to address potential issues that may affect the success of the proposed project.

1.3. FEASIBILITY STUDY

1.3.1. Project scope

Identifying what innovations to use in the ICT Project will determine the kinds of value that can be added to the infrastructure, skills, knowledge and economic activity of the community and its members will help project leaders decide whether the community will benefit fully from the solution to be introduced. There are different ways in identifying the knowledge base, talents and sources of reference for the project, depending on the conditions in the rural community. The project leaders may also encounter certain limitations in the identification process.

1.3.2. Deliverables

Project deliverables are an important indication of the completion of a project, as these deliverables will show the amount of work that has been conducted at the project site and justify the time and costs involved in the implementation of the project. Project deliverables are also closely related to the objectives of the project, as they show that the various objectives that the project sought to accomplish were achieved.

The number of deliverables varies according to project, as some projects may produce only one deliverable whereas others may have several deliverables to show for the work that has been carried out at the project site. Some of the deliverables that can be produced from an ICT project include:

- Telecentre
- ICT services (through use of applications customised through the project)
- Training modules
- Activity modules
- Intellectual property
- Standard Operating Procedure guides

Once a project is completed, all the deliverables of the project are handed over to the various stakeholders such as the community and project funders. It is advised that the budgetary management for the ICT solution is discussed throughout the project thoroughly, to ensure the community understands and is ready to accept the responsibility to maintain the solution provided through the project.

A final report usually accompanies the deliverables, indicating that the project team has completed what it has been contracted to produce. There should be an agreed timeline for the project teams to handover all the deliverables of a project to the stakeholders. The timeline should be discussed, agreed upon and displayed clearly at the initiation stage of the project. If there are changes to be made to the timeline, agreement has to be sought, to enable everyone involved to commit their deliverables in a timely manner. In an ideal situation, deliverables should be produced within 4-6 weeks upon completion of each phase of the project.

1.3.3. Duration

Scheduling is one of the most important aspects of a project, as all the stakeholders will have to know how long the expected duration of the project should be, from the initial start-up to its completion date. A project can be considered to have failed if it cannot be successfully completed in time.

Proper scheduling also allows for proper division of tasks among the team members, and will allow the project manager to duly inform each team member when their services will be needed during the project.

Project managers will have to consider several aspects when planning a schedule for the project, such as:

- The amount of time needed for the solution to be successfully implemented at the site
- The different phases of the project and what expertise will be needed during these individual phases

One useful tool that project managers can make use of to manage and monitor the schedule of the project is by using a Gantt chart. Gantt charts allow project managers to quickly view the overall progress of the project and take necessary action if there are any glitches to the project, ensuring that the project can be completed on time.

There are several things to consider when setting up a Gantt chart, namely:

- What are all the tasks involved in the project?
- Who are the people responsible for these tasks?
- What are the possible problems that may crop up throughout the duration of the project?

Through the setting up of the Gantt chart, project managers will also be able to ensure that all the tasks are distributed to the right people in the team, and that there is ample allocation of time and resources to handle any potential problems that may occur. Using a Gantt chart also allows project managers to view each task according to the levels of priority, and define the task sequence that must be completed in order to deliver the project on time

PROJECT DEVELOPMENT CHART

Phases	**Time in Months**																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Phase 1:Project Initiation																								
Planning of Project																								
Proposal Submission																								
Needs Analysis																								
Feasibillity Study																								
Phase 2: Design & Development																								
Design Project Plan																								
Develop Project Goals & Objectives																								
Design Management Plan																								
Development of Project Activities																								
Develop Project Team																								
Proposal of ICT Solutions																								
Phase 3: Implementation																								
Create a Project Plan																								
Project Execution																								
Phase 4: Monitoring and Controlling																								
Identifying Potential Issues																								
Corrective Action Plan to Control Execution of Project																								
Monitor Ongoing Project Activities Against Planning & Performance Indicators																								
Approval of Any Changes Implemented																								
Phase 5: Closing																								
Closing of Project																								
Handover to Community																								
Preparation of Final Report																								

1.3.4. Resources

Worldwide, many governments, international aid agencies and NGOs have increased efforts in generating rural development by introducing projects such as community-based telecentres in various locations. However, it has been noted that the success of these efforts is very much dependent on the communities involved, as their commitment and sense of ownership of the project can be seen to be the driving force of the sustainability of these projects.

The participation of the rural community in the project is definitely crucial to the success in the implementation of the ICT solution that they are to benefit from. Without their contribution, the ICT solution to be introduced to them will be at best, difficult to implement and at worst, useless. The community members are the primary sources of information for the project leaders in identifying their needs. The more involved the community members are, the better it would be for the project leaders to design the proposed ICT solution for the community. In essence, the solution is at a better standing to empower the community would inherit and own the solution upon the closure of the project.

There are many ways that the rural communities can participate significantly in the definition and design of the project. In identifying these ways, the project can be implemented in the way that can maximize the benefits for the proposed solution for the community. Their participation can also help them familiarize themselves with the ICT solution introduced through the project. They may have input on various concerns on the project and there are different methods of validating these. These inputs can be used to measure the success or failure of the project and it is the task of the project leaders to determine how to use these.

Members of the community may have skills and knowledge base that contribute to the project. By identifying these knowledge and skill sets, the project is able to harness the strengths of the rural community, possibly enabling the tasks to be accomplished ahead of schedule and lowering the costs of implementation, as well as empowering them. For example, in the case study project conducted in Bario, Malaysia, when rolling out a proposed E-Health solution for the community, the researchers were able to transfer the technology solution efficiently to the community members, because there were pensioners who lived in the community who have had experiences visiting doctors to check their blood sugar levels and BMI range. When they were introduced to the E-Health solution, they quickly learned to use the tools, and were able to conduct their own health checks with those living in the same longhouse. The learning curve was notably shorter for those who were used to undergo health checks at locations outside Bario.

Another aspect that is significant to the estimation process in planning for resources for the proposed ICT project is to identify the scope and quantity of socio-economic activities that have already existed in the rural community. It is ideal to address all possible socio-economic activities, and it is sensible to focus on those that would bring the most impact on the rural community. Therefore, there is a need for proper method in identifying these sectors. It is also important for the project leader to ask how the stakeholders are identified because they would be the ones directly interacting with the ICT solution introduced through the project.

1.3.5. **Costing**

Costing is an integral part of project planning as project managers will have to first determine the estimated cost of implementing the project before they can start looking for funding for the project. Accurate costing estimation will allow for better control over the budget of the project and will give investors an idea as to what to expect from their investment in the project.

Costing estimation will assist in:

- Weighing anticipated benefits against anticipated costs to see the value of implementing the project
- Determining how much funds need to be allocated to support each phase of the project
- Monitoring expenditures based on the estimation to ensure that there are sufficient funds to complete the project
- Estimating the cost of a project is not simple and straightforward, particularly when dealing with a context unfamiliar to the team proposing the ICT solution. There are various factors to consider, to define the reach of the proposed project, such as:
- What is the scope of the project?
- How long is the duration of the project?
- What are the risks that need to be taken into consideration in terms of budgeting?
- Is there any need for contingency plans? If yes, which phase of the project would be critical?
- What are the sources of funding for the project? What are the sources of funding after the project closes?

Developing a project budget is essential to develop a detailed project budget based on the estimated costing. Typically, a detailed budget includes a time-phased estimate of all resource costs for the project and may require revisions while the project is in progress. Some of the details that should be included into the project budget are:

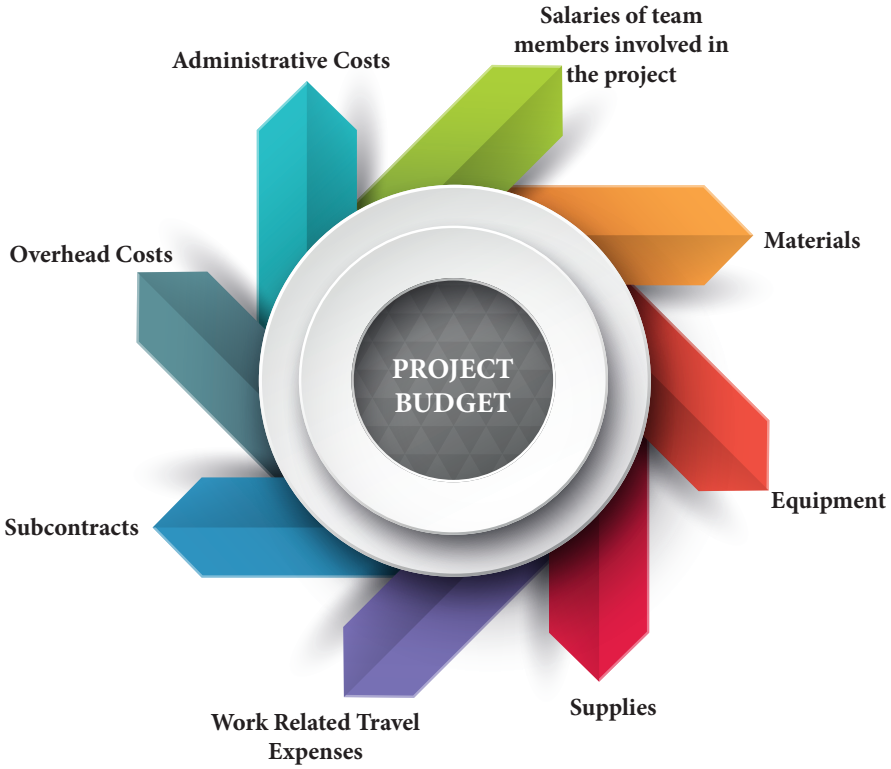


Figure 2 : Project Budget

Managing the project budget is extremely important. The budget determines how well each activity within the project would be carried out. Poor management of funds may also result in the delays, and even cancellations of activities, when executing the project. Any loss of quality of the deliverables and possibly conflicts between the different project team members would impede the success of the proposed ICT project.

CHECKLIST FOR CHAPTER 1

- [ ] **Has a proposal been submitted to funders? To community leaders?**
- [ ] **Has a rural community been identified? What are the bases for selection?**
- [ ] **Has there been a preliminary study conducted on the site of the proposed project?**
- [ ] **Will the potential project to create a product or develop an ICT product or service potentially elevate or solve an issue or problem faced by the rural community?**
- [ ] **Has the project leader identified the local leadership team in the rural community?**
- [ ] **Has there been any identification of a local champion among the local community?**
- [ ] **Does the design of the needs analysis questionnaire reflect the objectives of the project?**
- [ ] **Has the scope of the project been outlined?**
- [ ] **Have the deliverables for the project been identified?**
- [ ] **Has the duration of the project been determined?**
- [ ] **Are the resources and requirements needed for the project identified?**
- [ ] **Has the estimation for investment been conducted?**

PROJECT PLANNING

In planning an ICT project for rural communities, tasks and activities are to be identified and described in alignment with the local context and needs articulated by the community members. Engagement and participation with the community are critical to ensure the project plan is understood and agreed upon by every person and team involved in the entire duration of the project.

Specific to projects in rural areas, the level and access of education also play a crucial role in determining the success of a project. The readiness of the community, in terms of comprehending and committing to the project, determine the rate of achievement of the project. Access to basic facilities, such as water, electricity and transport, also defines the inclination and acceptance level of the community toward technology.

2.1. CONSTRUCTING A PROJECT PLAN

2.1.1. Project Goals and Objectives

Goals are drivers in a project. They are statements of intentions, and they guide the shaping of a project. In writing goals and objectives for an ICT project for rural communities, the intentions to create, construct, introduce or produce an ICT solution for a need that is distinctive to the local people.

Formulating a goal depends on deliverables defined for the timeframe of a project. The deliverables are bound to the funding and human resource available for the project. In projects involving communities living in rural areas, there are probabilities that factors that are not identified or apparent at the first instance of the planning phase may emerge and affect the planning of the proposed project. Examples include damages after a natural disaster on location that may impede accessibility to travel to the rural area.

Solutions are also usually designed to address the identified need. In identifying the need for the community, it is useful to recognize first the preliminary context of the need.

The writing of the project scope statement would include the project charter, the various stakeholders of the project, the problem statement, goals and objectives of the project, project requirements, deliverables, milestones, constraints, possible risks and the cost estimates of the project. The project scope helps in outlining the depth and breadth of the project, to ensure all parties are aware of the scale and expectations for the project.

2.1.2. Project Phases

Using the scope statement of the project, the next step is to look into the design of the project management plan. The main outline of the project is spell out the phases in the project. The outline includes:

- Scope management
- Schedule management
- Financial management

The project management plan should provide leaders with an idea of the rollout of the entire project as well as allow them to look at the various phases of the project according to the stages of implementation. This will also allow project leaders to identify any problems or setbacks that could occur at any stage and ease the counter-measure actions that they can take to overcome the issues at hand. With a thorough project plan, project leaders will be able to guide the execution of the project and exercise project control, document the process, facilitate communication among the various stakeholders as well as monitor the progress of the project.

2.1.2.1. Scope

Whenever a project is being planned, it is important to base the project on the determined goals and objectives of the project as this will set the scope and overall direction of the project. This is essential to ensure that there are sufficient resources to support the completion of the project and the delivery of all the deliverables. When dealing with projects with communities in rural areas, the scope has to be clearly described, to ensure that the project does not intrude boundaries that are off-limits for the project. For example, if a telecentre is planned to be built as part of the milestone for the project, the telecentre should be constructed at an area agreed collectively by the community. It should not be constructed to be advantageous to only one group within the community, or at a location sacred to the community for cultural or religious purposes. Some of the criteria that can be used to determine the scope of the proposed project are allocated budget, available human resource on site and in the project team, available materials for use in the project, and the entire duration of project allowed for the funding approved for the project.

2.1.2.2. Schedule

The project schedule is fundamental in marking the timeline for a project. All projects follow an achievable timeline to avoid unnecessary delays during the rollout of the project. All project activities are defined during the planning stage of the project are duly met according to the schedule.

Planning the schedule of a project is more than just selecting dates to match specific activities. Project leaders should consider factors that could affect their planned schedule. Examples include the possibility of natural disasters on location and lack of local leadership support to initiate tasks on site. The worst case scenario for any project schedule is a delay or a complete strike-off of a project activity, due to an unexpected occurrence during the implementation stage. It is good practice to think about all possible situations which could happen during the course of a project, and to make extra considerations to cushion the impact, should there be any hindrance to the project activities once they take off.

In working with communities in rural locations, it is also good practice to find out the seasons that are important to the local people. For instance, during dry seasons, when local farmers are busy harvesting their crops, the local community may not be able to spare time and effort on the proposed project because they would have to focus on working in the fields or plantations. During festivities, the local community would tend to concentrate on the celebrations, and it would be challenging to obtain participation during such periods. Considerations should be made when planning for the project schedule to include time-sensitive events or activities that are respected by the local people.

2.1.2.3. Financial Management

Sufficient funding is critical to ensure the project sails through to its completion. Project leaders have to consider factors that affect the project in terms of costing, and to ensure that there are contingency allocations in the budget to address possible situations that may arise. For example, logistics can be a very challenging aspect when implementing projects in rural locations. Project leaders need to take into consideration the various methods of transporting materials or infrastructure into the location, as there could be delays due to weather conditions or sudden unavailability of transportation caused by natural phenomena or shortage of resources. Apart from that, project leaders also need to consider any additional cost that could arise from transferring project materials using other modes of transportation or even labor related costs due to the delays in the schedule.

Using the estimated budget as a guideline, project leaders can develop a more detailed project budget when the project commences. Some of the key points to determine when detailing the project budget are:

- Who controls the budget? Is it by a person, a role, or a committee appointed for the project?
- Who provides the source of funding? Is there any restriction on the procurement processes?
- Are there any requirements by project funders that will affect the decisions related to purchasing and payments?
- Is there any conflict of interest between the source of funding and the benefactor rural community?

There are several local and international sources of project funding that can be obtained by project leaders such as from the government, industry players, NGOs, NPOs as well as from universities. Projects that are of public interest such as issues in agriculture, aquaculture, environment, health and education would increase the likelihood of obtaining funding, as the findings of these studies will contribute greatly to the body of knowledge with regards to these problems. An example of such a problem that would garner interest worldwide would be peat forest fires and the emission of CO2 that contributes to the global warming phenomenon. In one of the case study projects implemented in Palangkaraya, Central Kalimantan, Indonesia, the project was constructed on the absence of strategies to detect fires at Palangkaraya peatland forests, which essentially hinders local communities to manage their firefighting efforts on the ground. The project opened an opportunity for international dialogues, because the peat fires are of an international concern to people in Asia Pacific region.

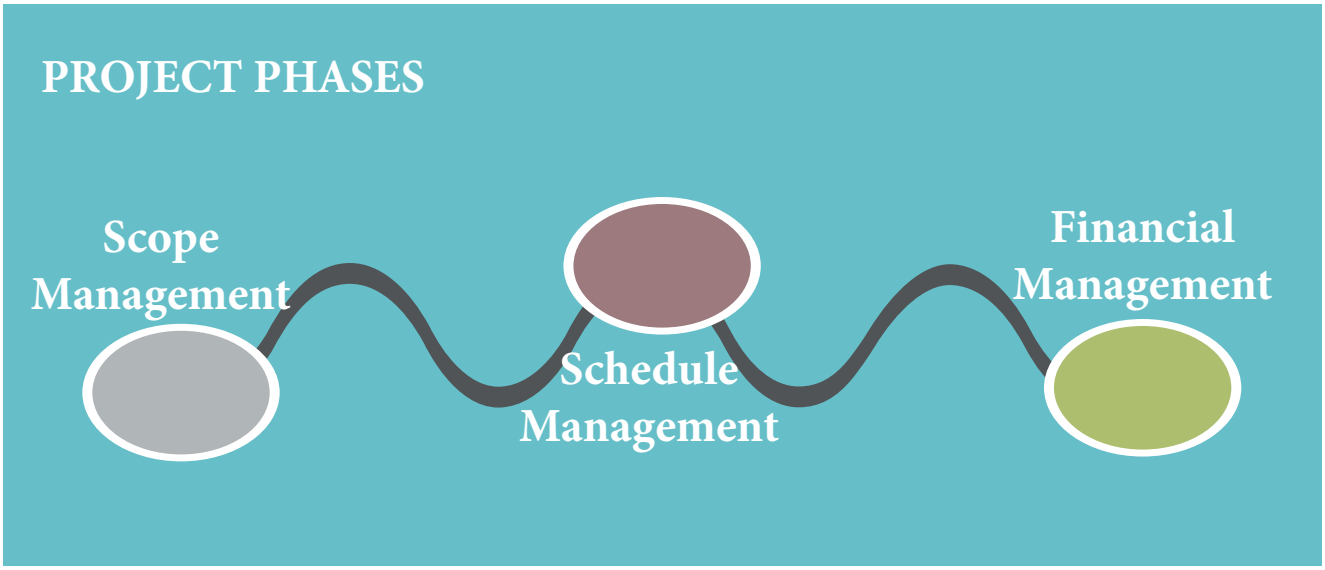


Figure 3 : Project Phases

2.1.2.4. Sustainability

One of the biggest concerns when initiating an ICT project is the sustainability of the project after it has been formally handed over to the community. Sustainability of a project here means that the objectives and desired outcomes of the project are continuously carried out by the community in order to ensure that the life of the project does not extinguish even after the project team has pulled out from the site. Sustainability can be achieved through:

- Organising activities that are consistent with the goals and objectives of the project
- Identifying activities which are available to all, or focused on one or more focused groups
- Ensuring that the activities can meet the needs of the community as identified through the initial needs analysis of the community
- Identifying champions of the community to ensure that services and activities operate as effectively as possible for the rural community

The project team will need to think about sustainability of the project even before the project comes to a close, as there could be instances whereby the community will not be able to successfully sustain the project. The project team needs to:

- Identify short-term and long-term sustainability strategies that will work for the community (based on needs analysis and observation data collected throughout the project)
- Conduct an assessment of the current project to gauge the extent of sustainability which can be carried out by the community based on the data that has been collected
- Determine the activities that should be continued and the desired scale of activities that the community can sustain
- Start a planning process for sustainability
- Identify the different resources needed to sustain the project

There are also several strategies that can be applied by the project team in order to achieve sustainability, which include:

- Having discussions with the community on how to best move forward with the project
- Considering any changes that should be made to the project, taking into account the preferences, needs and desired outcomes
- Planning for possible future funding of the project

It is important to obtain the buy-in among the community members as without commitment from the community, it could be difficult to achieve continued sustainability of the project.

Project teams will need to first develop a sustainability plan, looking at how to systematically undertake the appropriate steps needed to sustain the project. Some of the steps include:

- Assessing the current performance of the project
- Identifying activities that are relevant to the community
- Deciding on what activities need to be changed or added and what should be maintained in order to achieve the desired outcomes
- Choosing suitable sustainability strategies and methods
- Developing action plans for sustainability
- Establishing an operations management plan with the community
- Identifying any potential current funders who may be interested in continuing support for the project
- Building collaborative ties between the community and other stakeholders or parties interested in the project
- Identifying the local champions to push the project forward
- Documenting and communicating the sustainability success

2.2. CREATING A PROJECT PLAN

To efficiently implement and monitor progress of all activities, a Project plan should be created, and all these items shall be included. Below is a list of project tasks to be considered in a project plan:

- Percentage of Completion – list of percentage for each task completed and underway
- Task Status – list of status for each project task (for example: on schedule, behind schedule, cancelled, or postponed)
- Day Started – data about the dates (and time, if it is relevant) to indicate how and when each project activity begun
- Day to be Completed – data on estimated dates for task completion
- Actual Completion Date – the definite date when each task is completed (with verification, if necessary)
- Task Assignment – Name of task owner
- Priority – the listing of rank between each project activity (for example: High, Medium and Low)
- Milestones – An indication of achievement made by the project team, based on the list of project tasks
- Notes/Project Logbook – miscellaneous comments and feedback

In the project plan for projects using ICT, it is essential to consider additional tasks and time that may not be factored in early in the project plan. It is common for ICT-based solutions to require additional attention paid on hardware and software integration. The integration work has also need to be in tandem with the training of human resource. The local community members should be included in the training programme to ensure they will have sufficient knowledge and skills to run the project once the project has been signed off.

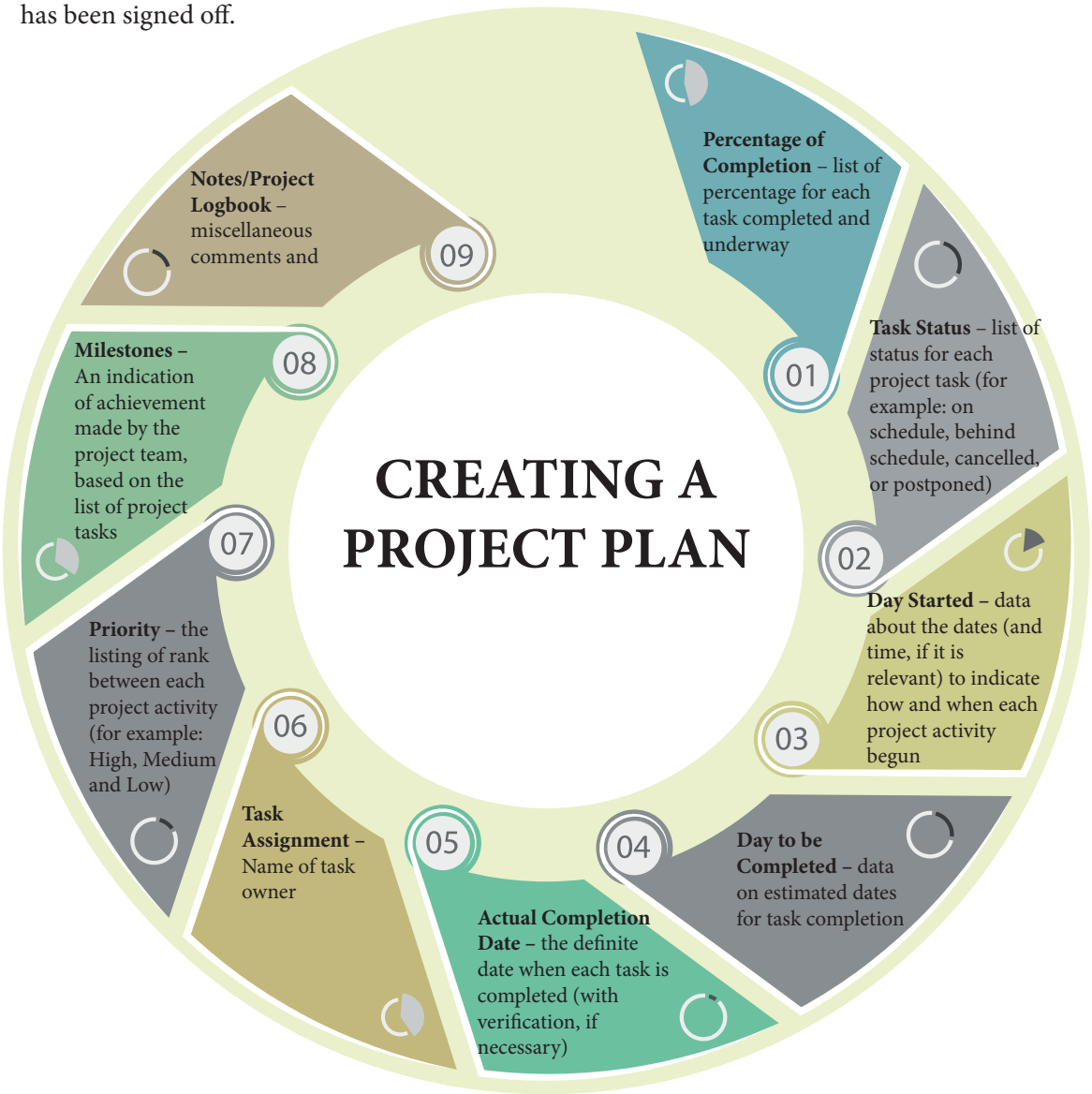


Figure 4 : Creating A Project Plan

2.3. DEVELOPMENT OF PROJECT ACTIVITIES

The second phase of the planning stage is the development of project activities. The phase includes activities related to, but not confined to:

- Quality management
- Resource management
- Stakeholder management
- Communications management
- Project change management
- Risk management
- Procurement management

2.3.1. Quality Management

Quality management is significant because it is through this process that the expected levels of excellence for each deliverable are spelled out. Project managers have to look at various methods of creating and implementing quality planning, quality assurance and quality control throughout the duration of the project. The audit process is necessary to ensure resources are in good order.

2.3.1.1. Quality Planning

Quality planning allows project managers set the quality targets that have to be achieved to ensure that the deliverables are produced according to schedule. Some of the quality targets that project managers can work towards are:

- Listing out project deliverables
- Setting quality criteria of the deliverables
- Defining the quality standards of the deliverables
- Listing quality assurance activities
- Developing a quality assurance plan
- Planning a schedule of tasks to ensure that the deliverables are produced according to the set timeframe

2.3.1.2. Quality Assurance

To ensure that there are minimal problems when delivering solutions to the project sites is through performance of quality assurance. By performing this step, project managers can ensure that the proposed solutions are both "fit for purpose" (that the solutions serve their intended purposes) and "right first time" (that there are no mistakes made). Quality assurance includes the management of:

- Quality of raw materials
- Products and components
- Production and inspection processes

Quality assurance also allows project managers to quickly address any problem so that the risks can be minimised and the solutions could be further improved.

2.3.1.3. Quality Control

Project managers, together with the project team, have to work closely ensure that the deliverables produced from the project are in line with the project scope. It is done through proper inspection of the proposed solutions, and timely reporting of any problems that could arise to the project team so that these issues can be immediately resolved. Quality control in an ICT project primarily looks at the hardware and software provisions; in a rural setting, these resources may be placed in locations in which the optimal environment is difficult to achieve. An example scenario is the location of a server in a room without air-conditioning, because electricity is scarce and expensive. Altitude, humidity and general hygiene can also affect the quality of project resources.

2.3.2. Human Resource Management

Human resource management is about managing people. Project managers need to pay close attention to the individuals chosen to make the project team. The capability and competency of the team will determine the success and failure of the project. Without a proper organisational structure, the team will not work in synchrony. The structure comprises of a team of project members who will be placed in key positions in every phase of the project, and will be responsible towards ensuring that the project runs smoothly and the deliverables are produced in a timely manner.

2.3.2.1. Human Resource Planning

One important aspect to consider when developing a project is human resource planning, as it is crucial to have a reliable team with the desirable skills, reasonable experiences and competencies to contribute towards the success of the project. Through human resource planning, the project manager will be able to manage both the manpower and resources needed to run the project as well as provide the project with the necessary structure needed in terms of responsibility and accountability.

Once the overall project team structure has been established, the project manager will then need to look at individuals or teams with the best fit to work with the requirements of the project. Some of the criteria that project managers can use to narrow down the selection process of team members are:

- Availability
- Ability/Talent
- Experience
- Interests
- Skills

The project manager will also have to look at the respective roles and responsibilities of each team member, and provide the team with a list of tasks that will be expected of them during the project. This will be beneficial during the rollout of the project so that each team member has a clear understanding of their scope of duties and responsibilities.

2.3.3. Communications Management

There are several aspects that need to be considered when planning the communications component of the project, such as the stakeholders to whom the project managers will be mainly communicating with, how the information will be distributed and the targeted audience, who will receive performance reports as well as what are the contents of communication which will be exchanged.

2.3.3.1. Information Distribution

One of the goals of most evaluations is to provide useful feedback to a variety of audiences, including beneficiaries/users, stakeholders, community members, funding agencies, staff, developers, and other relevant constituencies. Even though the results of the assessments should be given to all partners involving in the project, only relevant assessment results should be presented to each partners. The characteristics of the target audience are important. The report of the assessment results should contain only necessary information for each group to which the report will be presented.

Assessment results are to be reviewed and reflected upon. Findings and analyses should be discussed in a forum with community leaders, and if there are any significant changes or effects to the project, information is to be disseminated through the official forums within the community.

2.3.3.2. Communications Management Procedures

Communication among team members is extremely crucial to ensure that the project runs smoothly, and project managers will need to ensure that there is a communications system in place for the team members and various stakeholders. Some of the communications management procedures may include:

- Using email to share project information
- Formal documentation of information
- Using social networking as a platform for discussions
- Setting up regularly scheduled reports and meetings to review progress

2.3.4. Managing Stakeholders

There are many different stakeholders to a project, such as the beneficiary community, funders, researchers, government agencies, NGOs, NPOs, industry players and members of the academia. Therefore, it is important that project managers take the following steps when managing stakeholders:

- Identify, recognise and acknowledge stakeholder
- Determine their influence and interest
- Establish a communication management plan
- Influence and engage stakeholder

It is important that project managers establish a close communicative relationship with all the stakeholders as the various stakeholders are all important contributors to the success of the project. Project managers will also have to come up with a system to engage each stakeholder with various phases of the project, or according to the level of interest, or how involved they are with the project.

2.3.5. Risk Management

It is important to remember that at various stages of the project rollout, there is always a possibility of emerging situations which could delay or adversely impact the project may arise. One of the ways to overcome this possibility is through project risk management and the formulation of a risk management plan to address these potential issues.

2.3.5.1. Risk Management Planning

Risk management planning allows project managers to devise a guideline that will look at the various risks in the project and come up with counterplans to address the possible scenarios that could happen. Through risk management planning, project managers and the project team can:

- Assess the possible scenarios that could happen
- Make necessary adjustments to the project management plan
- Identify who should be responsible for handling the potential risks
- Decide on the frequency of conducting risk planning
- Look at the potential impact to the project that could be brought about by the risk

It is important to get feedback from the entire team with regards to risk management as the various people responsible for the different phases of the project would be the ones to assess what could or could not happen during the rollout project. Another important point to remember is that the team should constantly communicate with one another throughout the project on potential risks, as issues could arise at any stage of the project.

2.3.5.2. Risk Identification

The first step in preparing the project and the project team for efficient risk management is risk identification. The project team, together with the various stakeholders, should come up with a checklist of potential risks that could happen as well as evaluate the likelihood of the risk actually happening during the rollout of the project. Past experiences with similar projects could be helpful in identifying the different potential risks and ways to overcome these risks. Some of the categories for potential risks include:

- Technical
- Budget
- Schedule
- Environment
- Political
- Social
- Technological
- Resources

The next step to take is to perform a risk assessment of all the identified potential risks, and categorise these risks according to the different levels of severity. The action will assist in planning appropriate and timely responses that can be taken to address identified potential risks.


2.3.5.3. Risk Response Planning

Some of the options that project managers can consider in order to overcome a potential risk are:

- Risk avoidance
- Risk minimisation
- Risk acceptance

When a potential risk has been identified and been deemed to bring about a significant impact to the project, the project team could look at reorganising the project so that the potential risk can be completely eradicated from the start. It could potentially require the project team to change the proposed solutions which are to be applied at the project site or look at using different materials when applying the solution.

Risk minimisation looks at ways of trying to prevent the risk from happening by influencing the causes or reducing the negative effects that could result from the risk. The project team could also look at accepting the risk at hand, especially if the risk is considered to be not too detrimental to the project or the chances of the risk happening is very small.

2.3.5.4. Risk Monitoring and Control

Once the potential risks have been identified, the next step is to categorise the potential risks in a chart and systematically list out possible impacts and consequences that could affect the project. In this step, the evaluation of the risks will determine the scope and type of risks. It will also allow project managers to keep track and monitor the risks that have been identified, which will in turn work towards ensuring that there are actions that can be taken to overcome all potential risks.

2.3.6. Procurement Management

The procurement of assets and materials are essential when rolling out a project, especially if there is no infrastructure available at the proposed project site. Project managers will often be faced with the question of what to purchase and where should they make the acquisitions from. Procurement management allows for a systematic approach to be put in place to ensure that the service or product best serves the purpose of the project.

There are several steps involved in the procurement process namely planning the purchase, selecting vendors and managing the ordering with the selected vendors.

2.3.6.1. Planing for Purchase and Acquisitions

After discussions with the project team, community and stakeholders, project managers will then have to assemble a list of products as required by the project before they can proceed with planning the purchase and acquisitions of these items.

Some of the items that may need to be purchased to start an ICT project in rural communities include:

- ICT tools
- Software
- Construction materials

2.3.6.2. Selecting Vendors

Once the items that need to be purchased have been identified, project managers will then need to compile a list of potential vendors that can supply the goods needed for the project. The next step will be to ask for quotations, proposals or information from the respective vendors so that the project managers will be able to source out the best prices and packages for the items required.

Once the vendors have been selected, project managers will begin communication with the selected vendors on the details of the contract. Some of the details that should be ironed out by the project managers with the vendors include:

- Vendor's compliance with contract provisions
- Ensuring that the services are performed according to the quality, quantity, objectives, timeframes and manner specified in the contract
- Work schedule and date of completion by vendor
- Delivery of items by vendor
- Provision for any changes that may need to be made
- Amendment of contract
- Monitoring of expenditures
- Payment for goods and services
- Verifying that all requirements of the contact are fulfilled before the submission of the final invoice

2.3.6.3. Contract Administration

Once the contract has been awarded to the respective vendors, project managers will have to begin the contract administration of the procurement process. During this stage, project managers will be able to keep track of the procurement process, ensuring that everything goes according to plan. Any problems that may arise are also detectable at this stage, making it easier for project managers to address any issues before it is too late.

Project managers should also maintain a file with all the documents pertaining to the procurement process for reporting and auditing purposes.

2.3.6.4. Contract Closure

Contract closure is the step that ties up all the loose ends of the procurement management phase. During this stage, project managers will be involved in the product verification and administrative closure. Project managers will also have to show that all the products have been delivered and all services have been performed before they can close the contract with the respective vendors. All documentation that has been compiled throughout the procurement process must also be in place for auditing purposes. Once all the processes have been verified by the project team and stakeholders, the contracts for all procurements can be formally closed.

CHAPTER 2 CHECKLIST

- [ ] Have the suitable ICT solutions been proposed?
- [ ] What are the criteria for choosing the ICT solutions?
- [ ] Have the project goals and objectives been developed?
- [ ] Has the outline for the project management plan been spelled out?
- [ ] Have the project leaders decided on how the project will be monitored?
- [ ] Are there action plans in place to control the project?
- [ ] Has the scope of the project been determined?
- [ ] Is there a project schedule in place?
- [ ] Has the financial management aspect of the project been considered?
- [ ] How will the continued sustainability of the project be achieved?
- [ ] Has a list of project tasks been created?
- [ ] Does the list of tasks include additional tasks that were not factored in the initial project design?
- [ ] Is there a timeline for the activities that will be conducted for the project?
- [ ] What are the measures that will be taken to ensure that the project will go according to schedule?
- [ ] Is there a contingency plan which allows for any unexpected changes or delay in the planned schedule?
- [ ] Has the budget for the project been formulated?
- [ ] Has an implementation project plan been created?
- [ ] Is there a set of standards to measure the quality management of the project?
- [ ] Is there a plan in place for human resource management?
- [ ] Has a project team been recruited?
- [ ] Is there a plan for communications management?
- [ ] Have the stakeholders been identified?
- [ ] Who will receive the results of the feedback?
- [ ] How will the information be distributed?
- [ ] Have the potential risks been identified?
- [ ] Is there a plan formulated to overcome any potential setbacks that could occur during the rollout of the project?
- [ ] Is there a plan in place for the procurement of items?

CHECKLIST WHEN PLANNING A SCHEDULE

- [ ] **What are the deciding factors for the schedule?**
- [ ] **Urgency of the need**
- [ ] **A set time frame or conditions by the funders**
- [ ] **Weather/ climate**
- [ ] **Permits and licenses from government agencies**
- [ ] **Cooperation from the community**
- [ ] **Readiness of the community**
- [ ] **Procurement of equipment**
- [ ] **How are the milestones and timeline determined?**
- [ ] **Is every work item clearly explained and aligned to the goal of the project?**
- [ ] **Are your team members all able to commit to the planned schedule?**
- [ ] **What are the provisions made for project coordination?**
- [ ] **Will all resources be made available throughout the duration of the project?**
- [ ] **Who will monitor the project schedule?**
    - [ ] **Project leader**
    - [ ] **Persons in charge of specific stages of the project**
- [ ] **What are the communication channels that will be used by all members in the project?**
- [ ] **What measures will be taken to ensure that the project runs according to schedule?**
- [ ] **Will there be any provisions in the schedule for unexpected or uncontrollable delays?**
- [ ] **Health issues of team members**
- [ ] **Equipment delay**
- [ ] **Environmental issues**
- [ ] **Natural disasters**
- [ ] **Rejection of licenses or permits**
- [ ] **Change of politicians**
- [ ] **What happens when the funding is used up unexpectedly?**
- [ ] **What provisions are made to buffer the impact on the project implementation?**
- [ ] **What are the steps to take in the event that the project is ahead of schedule, and there is an unexpected surplus of funds and resources?**

SYSTEMS DESIGN

Systems design is an integral component to consider when initiating a project as there are various different requirements that need to be complied to ensure that the chosen solution suitably meets the needs of the target community. Systems design consists of the architecture, parts, interfaces, modules and data for a system that is constructed to meet the requirements of a target group of users. It is an application of the systems theory, in that it breaks down the process of constructing a system from fundamental philosophy to final product or outcome.

Every project is unique in terms of the ICT solutions chosen and applied. Each tool utilized for a project relies on the scope of project and available expertise in the project team. In the SHARE experience, each project in each country has needed a unique mix of technology solutions, driven by the needs examined in each project location. Systems design is sought to answer the needs of the people in the most efficient way. One of the key features of systems design is the level of impact that it can have on the sustainability of a project, as it has been observed that while there are many projects that set out to use ICT to support rural communities and co-operatives, very few are making an impact desired, because of their limited scale and lack of sustainable business models. Sustainability has been a long-standing issue in ICT for development projects (World Bank, 2002), and the development of sustainable business models has increasingly come under spotlight (Rout, 2002; Kumar, 2004; Singh, 2003; John, 2004, in Dearden, Fu, Matthews, Gupta, & Wills).

Some of the aspects that project managers have to look at include:

- Overview of the solution
- Analysis of the situation and status
- Target data, collection and analysis
- Appropriate technology
- Human resource

The following section highlights the aspects of systems design which were taken into account before each SHARE project was implemented in the various project areas in Southeast Asia.

3.1. OVERVIEW OF THE SOLUTIONS

Projects managers shall first conduct a study on the actual needs for each demographic areas involved. From initial findings collated, it was discovered that, for each project area, different challenges contribute to multiple design factors and the challenges shaped the way the systems design was articulated in each project, and in the case of SHARE, five systems designs were constructed.

The initial needs analysis would consequently inform project owners the viability of the project, and scope of project development would be determined at this point to enable planning and valuations done. Once these are confirmed and budgeted, the design and development phases begin. In the case of SHARE projects, these phases are undertaken by researchers of local universities. The content knowledge that would be packaged with the technology solution is sequentially organised, to enable the learning process to happen almost immediately after the technology hardware is installed. Knowledge transfer is embedded through the use of manuals, digital materials, on-site training, and online tutorials.

Each project enables the project manager to have full control of data dissemination from any location without physically being there on-site. To allow the project manager to do so, the two locations are connected through a network – in this case, the public network to the Local Hosting Server / Controller with Main Site (External Location).

In terms of data transmission to 3rd-party devices owned by the user, a Wi-Fi / Mobile Signal / Internet-ready devices shall be ready. However, it is dependent on the geographical design of the area, which in turn will determine what type of devices are suitable to use for local information dissemination. Other than that, connection shall also be established through LAN/WAN Network.

Users would also need to be able to provide input or feedback to the Local Host Server / Controller at the project site. This is to ensure that the 2-way data link from the user to the Main Site (External Location) could still be established and monitored.

When the technology solution starts its implementation at the community site, the community members are brought into the project site to begin individual and group experience to learn the ways of the solution.

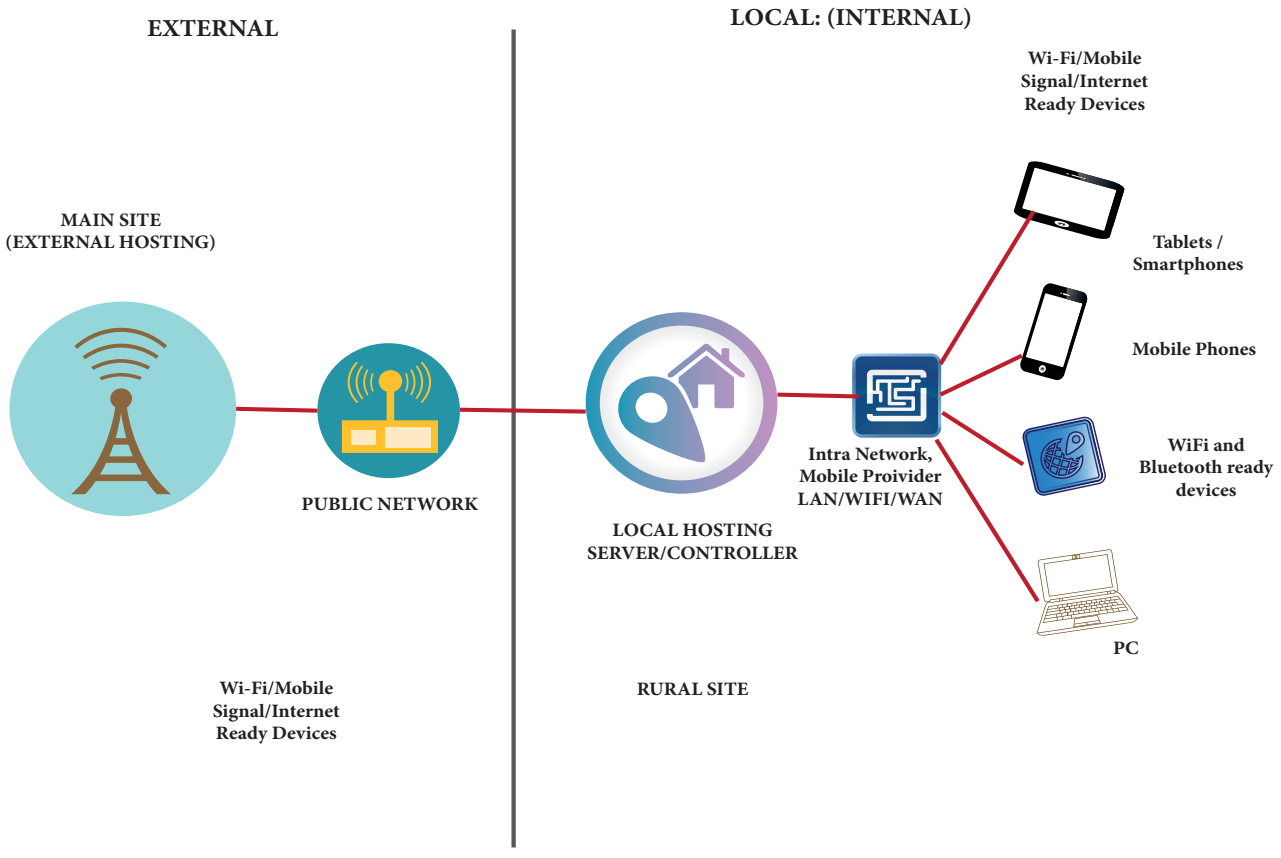


Figure 5 : System Design used for SHARE Projects across Southeast Asia

Data is crucial in the implementation phase of such projects. Connections to data server play a significant part in ensuring decisions are made on a timely and efficient manner. In the design of the technological solution for rural communities, the type, size and classification of data have to be clearly expounded through materials, interactions and training initiatives provided in the installation phase of the solution.

The data server is heart of the technology solution; as it collects data from the project resources, it progressively assists community members to be able to decide and take action on situations happening within their site.

3.2 ANALYSIS OF THE SITUATION AND STATUS

Analysis of the contextual conditions is done based on the surveys conducted before the project implementation. This step is instrumental in deciding the requirements for all five systems.
The set of technical requirements for every project differs, because each set of requirements caters for unique needs and demands of each community. The sections below discuss how each project's system design was tailored to assess actual conditions and constraints.

3.2.1. e-Aquaculture

3.2.1.1. Purpose and implementation of an Environment-oriented Survey

- To find out the main reasons behind fish kill in the area
- To determine which kind of sensor is needed (water temperature, pH, DO and so forth)
- To determine the location of monitoring
- To determine availability of existing ICT system such as communication networks and PC equipment available in the area

3.2.1.2. Measures and effect

- Based on the above survey, decide what kind of sensor system is suitable and necessary.
- Numbers of fish kill using the system
- Improvements to the income of fish folk

3.2.1.3. Business Model

Generating a business model is necessary to ensure the longetivity and sustainability of the ICT project. By surveying relevant conditions, including the following items in the list below, it is useful to generate and assess a business model for e-Aquaculture services.
Factors to consider include:

- Purpose of deployment, necessary system and benefits to be expected should be clarified.
- How much fish harvest was improved using the system and solution.
- Reduction of manpower costs by saving the time in measuring environmental data
- Benefits to enhance technical skills of local young ICT engineers and to provide e-Education service to the local residents
- Costs of system deployment, operation, and maintenance
- Financial support: who will operate and maintain the system.

3.2.1.4. Cost Estimation

For e-Aquaculture system, the basic cost surveys covers:

- Survey of electricity in the environment (existence or possibility of a power supply, quality of electricity)
- Survey of existing communication network environment (existence and reliability of wired or wireless broadband access)
- Survey and compare the damage of fish kill and the investment for system implementation, operation, and maintenance.

3.2.2 e-Education

3.2.2.1. Purpose and Implementation of an Environment-oriented Survey

- To evaluate the existence of Internet environment or ICT penetration level in the target area
- To analyze the rate of child labor
- To collect data related to the school attendance rate (necessary to determine readiness for self-study, and the current rate of truancy due to child day- time labor or local economic situation, etc.)
- To analyze the number of teachers per capita (necessary to determine readiness for self-study, from the perspective of teachers)
- To determine the scope of geographical area where one school should cover (necessary to determine readiness for remote/distance learning)
- To gather the number of children or students in the area (necessary to determine communication environment among children across a distance)
- To record social surroundings like existence of zoological or botanical gardens (providing alternate education materials for children without such study environments)

3.2.2.2. Measures and Effect

Based on the acquired baseline data, decisions are made to determine the type of e-Education solution which best fit the contextual needs and challenges identified.

Relevant reference indices are determined to indicate the quantitative effect or impact of the project goal.

3.2.2.3. Business Model

To generate a business model for the E-Education services, it is crucial to survey relevant conditions including the following items to generate and assess a business model for e-Education services. Considerations include:

- To determine the economic situation of local government or schools, i.e. whether they are able to keep up with the cost of system introduction and run it as local government or school services sustainably.
- If it is determined that difficulty is predicted in sustaining and managing the project, it is necessary to identify potential financial support from the central government, grants, or other potential grants from countries.

3.2.2.4. Cost Estimation

For e-Education system, the basic cost surveys shall cover:

- Survey of electricity in the environment (existence or possibility of a power supply, quality of electricity)
- Survey of existing communication network environment (existence and reliability of wired or wireless broadband access)
- Survey conditions and estimate the cost of introduction, operation, and maintenance of e-Education systems.
- Required type of systems and services to be introduced, and necessary facilities such as servers and buildings for them; communication network equipment, terminal devices, education materials, and so on.
- Coverage of area size, population density and distribution
- Readiness of available teachers or education expert resources in the target area
- Challenges to establish maintenance system for ICT and e-Education systems

3.2.3. e-Environment

3.2.3.1. Purpose and Implementation of an Environment-oriented Survey

- To identify construction area
- To determine the water level in the canal / peatland
- To gather CO_2 / methane concentration data
- To collect Rainfall data

- To collect temperature and humidity data
- To collect wind speed data
- To find out any local environment setup
- To survey existing ICT system such as communication networks and PC equipment

3.2.3.2. Measures and Effect

Based on the above survey, decide what kind of systems is suitable and necessary. In case of its application to the peatland, is it:

- Effective for prediction of fire and its protection
- Useful for the canal dam design to recover water supply

Some reference indexes should also be set-up and considered to determine the quantitative effect.

3.2.3.3. Business Model

The E-Environment system directly impacts communities. It is imperative to survey and construct a sustainable business model to finance e-Environment services. Considerations include:

- Reduction of manpower cost by saving time in measuring environmental data
- Benefits of getting useful data on a timely basis (ex. the data for dam design, fire prediction, and rapid fire-fighting for environment conservation).
- Benefits of enhancing the technical skills of local young ICT engineers and to provide e-Education service to the local residents
- Costs of system deployment, operation, and maintenance
- Economic strength of local governments in the region
- Financial support of the central government or other countries

3.2.3.4. Cost Estimation

For e-Environment system, the basic cost surveys shall covers:

- Survey of electricity in the environment (existence or possibility of a power supply, quality of electricity)
- Survey of existing communication network environment (existence and reliability of wired or wireless broadband access)
- Survey conditions and estimate the cost of introduction, operation, and maintenance of e-Environment system.- Presence (or supply potential) of the power supply and power quality
- Necessary ICT system (center building, communication equipment / terminal equipment)
- Coverage area and construction difficulty of ICT equipment maintenance system

3.2.4. e-Healthcare

3.2.4.1. Purpose and Implementation of an Environment-oriented Survey

- To determine the presence of local Internet access services, and Internet penetration rate
- To collect data related to demographic composition by age, literacy rate etc.
- To gather data related to the ratio of medical institutions (hospitals and clinics) per household and area coverage per medical institution (hospitals and clinics) (to determine the need for remote healthcare services)
- To identify availability of regular health checkup services and checkup consultation rates
- To identify the availability of any health insurance schemes
- To check if there any availability of medical office automation
- To identify most common diseases, and records on presence of endemic diseases in the area

3.2.4.2. Measures and Effect

Based on baseline environmental survey, decisions are made to determine the type of e-Healthcare systems or services needed. In addition, selection of specific targets to perform a quantitative review of the results of the implementation.

3.2.4.3. Business Model

E-Healthcare services involve personal patient data, and all services have to be handled with care and integrity. The following factors are considered when constructing a viable business model for e-Healthcare services:

- Economic readiness of the local residents (whether service fees could be collected from local residents will be sufficient to cover costs for system implementation, operation, and maintenance, etc. As such, it is to be determined if private commercial businesses ran by medical institutions are feasible operators to sustain the e-Healthcare services in the future).
- Economic readiness of local municipalities and medical institutions (whether the system deployment, operation, and maintenance costs can be covered by municipalities if fees collected from the local residents are insufficient; whether municipalities are capable of the continuous management of the system).
- Availability of central government or foreign financial aids (whether financial support could be obtained from the central government or other governments if both service fees and municipalities cannot cover the costs).

3.2.4.4. Cost Estimation

For e-Healthcare system, the basic cost surveys shall cover:

- Survey of electricity in the environment (existence or possibility of a power supply, quality of electricity)
- Survey of existing communication network environment (existence and reliability of wired or wireless broadband access)
- Survey relevant conditions including the following items to estimate costs associated with e- Healthcare system implementation, operation, and maintenance.
- General description of required system (service details), facilities (center building, telecom facilities, terminal equipment, instruction materials, etc.)
- Coverage of area size, population density and distribution
- Readiness of local community members to sustain the e-Healthcare system after deployment
- Challenges to establish maintenance system for ICT and e-Healthcare systems

3.2.5 e-Disaster Risk Management

3.2.5.1. Purpose and Implementation of an Environment-oriented Survey

- To check the existence of broadband access for IPTV services
- To collect data on the existence of digital broadcasting for wireless services
- To analyze the frequency of natural disaster in the target area (country)
- To collect data for the availability of mobile terminal devices such as smart phone receiving ISDB-T.
- To collect data for the availability of IPTV terminal devices such as STB and TV with IPTV functions

3.2.5.2. Measures and Effect

Based on baseline environmental survey, decisions are made to determine the type of e-Disaster Risk Management system or services needed.

In addition, selection of specific targets to perform a quantitative review of the results of the implementation.

3.2.5.3. Business Model

E-Disaster Risk Management services are complex and unique to the contexts in which they are utilized. To generate a viable business model for its services, it is crucial to consider:

- Availability of ISDB-T including head-end system and terminals to deliver emergency information when disasters happens
- Availability of IPTV services (broadband, head-end and terminals) to deliver emergency information when disasters happens

3.2.5.4. Cost Estimation

For e-Disaster Risk Management system, the basic cost surveys shall covers:

- Survey of electricity in the environment (existence or possibility of a power supply, quality of electricity)
- Survey of existing communication network environment (existence and reliability of wired or wireless broadband access)
- Survey relevant conditions including the following items to estimate costs associated with e-Disaster Risk Management system implementation, operation, and maintenance
- War room specification that delivers the emergency information and also collects the personal and disaster area information.
- Coverage of area size, population density and distribution.
- Readiness to regulate a small broadcasting system to broadcast disaster information to specific areas.

3.3. TARGET DATA, COLLECTION AND ANALYSIS

In systems design, the project teams should always consider the types of data needed and to be collected, to determine the basic needs that fits the systems. The table below illustrates what was established in the SHARE projects conducted across Southeast Asia:

e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
Water temperature.	Academic performance of students in local schools.	Climatic conditions, carbon dioxide / methane (CH4) concentration.	Height.	Disaster area (potentially dangerous area).
pH.	Rate of basic literacy and arithmetic knowledge.	Rainfall, temperature, humidity and wind speed.	Weight.	Disaster type.
Dissolved oxygen (DO).	Knowledge about local culture.	Local environment appearance (in case of the application to peatland).	Body fat percentage.	Disaster date, time.
Turbidity and conductivity around the lakeshore.	Ability in creative thinking skills.	Canal construction area.	Temperature.	Route to Evacuation.
Water circulation.	General student satisfaction rate about learning within the target context.	Water level in the canal and peatland. Fire generation and frequency.	Blood pressure.	Number of dead people, their names and other personal information.
Ecology of fish and water pollution.		Storage technology for the above data and appropriate analysis skills.	Pulse rate, and so forth.	

Table 1: Data types collected for five systems developed for SHARE projects

3.4. APPROPRIATE TECHNOLOGY

In determining the best-fit solutions, the data gathered from the process explained in sub-section 3.2 Analysis of Situation and Status above, is used to choose the appropriate technology for each project area. The determining factors involve; **Communication Technologies, Sensor Network Technologies, Center Facility and Terminal Devices**. Table 3.4 shows the summarized technology needed for all four categories mentioned above.

	e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
Communication Technologies	Between fisherman household (Telecenter) and fishing community center or university (knowledge center). Needed broadband capacity	Select the communication technologies by considering the cost of introduction and usage of each technologies, taking into account the environmental conditions, existing facilities, and possibility of shared usage with other appropriate services, etc. At this juncture, relevant system s are decided to meet the required performance in a cost-sensitive way, not necessarily with regard to leading edge technology. **1. Area and long distance** • Optical fiber and PON*1 system, metal, microwave and WiFi *1 PON: Passive Optical Network • Satellite communication • Mobile phone data communication service **2. School connection requirements** • Wired LAN or WiFi • Cable system for broadcast	Communication tool (Wi-Fi and millimeter wave technology)	**1. Regional/ wider geographic area** • Optical fiber/ metal cable/ microwave + wireless LAN • Satellite communication • Mobile phone (data communication) services **2. Situational customer-based premise** • Wired/wireless LAN • Broadcasting system	ISDB-T, WiFi and IPTV
Sensor Network Technologies	1. Sensor and measuring equipment (Dissolve oxygen, air & water temperature, pH, humidity, and imagery, etc.) 2. Radio wave (such as WiFi) technology 3. Power equipment (solar panel and battery)	(Normally not applicable)	1. Sensors and measuring equipment (Water level, CO_2 / methane concentration, rainfall, temperature, humidity, wind speed, etc.) 2. Radio wave (such as WiFi) technology 3. Power equipment (solar panel and battery)	1. Measuring equipment to provide health checkup service (height scale/ weight and body fat scale/ thermometer/ blood-pressure gauge/ pulse counter) 2. Short range wireless communication technology (Bluetooth) for the data collection of health checkup service.	N/A

	e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
Center Facility	1. Server technology for storage of collected data 2. Internet server's capability to respond to remote area	1. Data server and storage machines 2. Broadcast server or head-end 3. e-Learning systems (application systems and contents) 4. Relevant multimedia educational materials including pictures, video, sounds, text, and so forth, interactive tools, using the digital playground space created.	1. Server technology for storage of collected data 2. Internet server's capability to respond to remote area	1. Data server and storage machine 2. Multimedia electric learning materials database 3. e-Learning systems (application systems and contents)	1. Data survey and storage machine 2. ISDB-T and IPTV head-end system to deliver information
Terminal Devices	Personal computers and smart device including GPS functions	1. Personal or shared computers (desktop, laptop or tablets, smart phones, etc.) 2. School devices (displays, sound systems, electronic whiteboards, etc.)	Personal computers (desk top type)	1. Personal or shared computers (desktop, laptop or tablet, smart phones, etc.) 2. Facilities of medical institutes and administrative institutes (visual displays, audio equipment)	ISDB-T terminal WiFi terminal IPTV terminal

Table 2: Summary of Technology Needs for Available Systems

3.5. HUMAN RESOURCE

From the SHARE experience, these e-based systems needed at least one ICT personnel to operate and maintain the systems, in order to provide support in case of system failure. The personnel is also tasked to conduct training for users, should there be any emerging need from the stakeholders of the project.

Every personnel required for the SHARE projects that have been implemented has his own ICT qualifications and experience. Their ICT knowledge differ, as the requirements from each project are unique to the design of each project. The following lists describe contributing human resource needs for each system, which played a significant role in the success of each project:

3.5.1. e-Aquaculture

- Experts for design and construction of M2M monitoring system
- Maintenance personnel of e-Aquaculture system; experts for data analysis
- Teachers or education experts for ICT training and environment education of local ICT engineers and residents

3.5.2. e-Education

- Teachers or education expert resources
- Maintenance personnel for e-Education systems

3.5.3. e-Environment

- Experts for design and construction of M2M monitoring system
- Maintenance personnel of e-Environment system; experts for data analysis
- Teachers or education experts for ICT training and environment education of local ICT engineers and residents

3.5.4. e-Healthcare

- Medical doctor or professional health services resources
- Maintenance personnel for managing medical facility and services (remote medical checkup services)

3.5.5. e-Disaster Risk Management

- Maintenance personnel for IPTV and ISDB-T equipment to deliver disaster information
- Maintenance personnel for creating effective disaster information to government and persons in disaster areas

CONCLUSION

In sum, the chapter presents strategies to consider when constructing the systems design for ICT projects meant for rural communities. The unique value in the system design for such communities lies in the approach, in that the technology solution is packaged with relevant content knowledge that complement the ways of the communities. Indigenous knowledge is not ignored; it is integrated with new knowledge, to assist community members to accept and embrace the learning without much resistance. The system design is also constructed through informed decisions, as preliminary research and community engagement have been carried out.

CHAPTER 3 CHECKLIST

- ☐ Have the surveys provided adequate information for system design?
- ☐ Has the purpose of the system that meets the need of local folks determined?
- ☐ Have the target data collection and analysis been done?
- ☐ Is there any previous research which looked at similar issues as the ones identified in the target community?
- ☐ Has the system technological needs been determined?
- ☐ Are there any local policies or beliefs that need to be addressed by Project Manager?
- ☐ Has the local community leader being approached and involved in setting up the ICT facilities?
- ☐ Have the ICT personnel to operate and maintain the system been appointed?
- ☐ Is there a plan to train the community to continue the project upon handover of the project?
- ☐ Is there any digital or online materials available for the community after the project ends?

PROJECT IMPLEMENTATION

The project officially kick-starts at the implementation stage, and involves the coordination of tasks, people and resources. This phase focuses on implementing all defined project activities, ensuring that all project items are implemented or addressed according to the agreed project plan. The team works within the scope of the defined project, making sure challenges, threats that appear in, or are caused by, the project implementation is minimized or reduced as efficiently as possible. Considering that deliverables defined at an earlier stage of planning for the project may not be achieved when glitches emerge within the implementation phase of the project, several parameters to activate relevant and timely response should be put in place.

4.1. PROJECT EXECUTION

During the project execution phase, project managers will be able to see the actual implementation of their project; therefore it is important that the plans formulated to manage and monitor the project are laid out as thoroughly as possible. Project managers should look at how each phase of the project is implemented to have a greater understanding of what to expect during the rollout.

4.1.1. Coordination of Tasks

Coordination of the tasks should be conducted according to the set schedule of the project. During this stage of the implementation phase, project teams will be able to assess the situations of the project as it progresses, as there are times when the planned tasks require additional information or support for the task to be effectively implemented.

An example of a project execution can be seen in past case study projects involving agriculture and aquaculture communities in Indonesia and The Philippines, as the project implementers needed timely and relevant information that can aid the farmers in the conduct of their daily farming activities. For instance, the fisher folks in the Lake Palakpakin project needed the water quality measurements (amount of dissolved oxygen in the water, pH level and water temperature, and so forth) to monitor the state of the lake and avoid fish kills. Sensors were designed to monitor these parameters and report the results to farmers. Through experience, the project found that a similar system could be developed for a shrimp farm for the early detection of shrimp pathogens.

The e-Environment project in Palangkaraya, Indonesia, saw how local communities would benefit from the immediate identification of the location of forest fires.

The E-Education case study project in Bario, Malaysia, focused on the issue of access to education. At the remote rural location, Bario's children had limited access to education, even though the community has long realised the imperative need to educate their young. The remoteness of their location made it challenging to connect to the rest of the world, thus widening the digital gap between them in Bario and the other children across the globe.

The e-Health solution that was introduced as a case study project in Tanah Datar, West Sumatra, Indonesia, looked at building a database of information for better health services of the community. The community was recording an increase of community members suffering from hypertension and diabetes. The deteriorating quality of diet alarms the community, and they required a quick solution to enable them to monitor their blood sugar levels without visiting the local clinics.

Based on these case study experiences, there are also measures that must be taken to ensure that the project execution is properly conducted and managed. When directing the execution of a project, project managers will have to take into account the deliverables of the project, log of change requests, log of work performance, project management plan updates and project document updates. Any project work that is closely monitored and carefully managed will incur minimal changes or deviations from the initial plan.

In the event that there is a problem or issue arising during the implementation of the project, project team members would have to collect and analyse all available information and resources related to the issue. The project leader would then bring the issue to discussion, and bring together team members who would be able to assist in resolving the issue. In the experience of authors of this handbook, the relationship formed between the project leader and the most prominent

member in the community (usually the community leader, or second in command) plays the most significant role in resolving issues or conflicts that occur within the duration of the project.

4.1.2. Coordination of People

Teamwork among all the project team members is crucial during the implementation phase, as everyone has the responsibility to work towards achieving the goals and objectives of the project as a collective team. Project managers will need to ensure that teamwork and motivation among the team members are high and that any conflict that arise would be handled in a constructive manner so that team spirits are maintained at all times. The project manager will also have to ensure that all communication between the team members is cohesive and efficient so that decisions can be made at the right time and in a respectable manner.

Close communication between the team also allows project managers will also be able to monitor the progress of the project, address any arising issues or changes that need to be made to the project as well as provide timely feedback wherever needed. This can be done through:

- Provision of performance reports
- Observation of all communication and conversations
- Conflict management
- Issue logs
- Provision of feedback by the appropriate team members
- Project management plan updates

Performance reporting should be done in a form that is precise, straight to the point, and easy to understand. Apart from the results, the information that should also be presented in the report includes:- list of conclusions (state whether the system meets its objectives); recommendations (addressing the need to continue and/or modify the system, lessons learned during the project development/deployment, reflections of what could be done or alternative plans and so forth); supplements (e.g. manuals).

Project managers should also observe all the communication and conversations between the project team in order to keep track of the progress of the project. Monitoring these conversations will also allow the project managers to identify any source of conflict and act towards resolving any problems which may arise within the group. Any issues pertaining to the project should also be recorded and logged for monitoring purposes so that immediate action can be taken accordingly.

Strategies to monitor progress should be shared among team members, to ensure all communications about opportunities or interventions that will impact the deliverables are openly accessible at all times. The project leader/manager is responsible to ensure the reporting of achievements and delays is updated regularly.

Where possible, there should always be provisions for feedback for the assessment results. The feedback is important to improve the project; it could be used for fine-tuning, especially for the systems installed in the field/real environment, there could be unplanned or unpredicted circumstances. However, the feedback provision process itself may need an allocation of budget. Should the feedback causes any change or revision of the proposed ICT solution, the variation will affect the remaining funds. To avoid costing issues, the plan for feedback provisions could be considered from the beginning, to be included as a part in the project plan. All project development partners should agree on how and how long for feedback gathering, settling on the budget for feedback provision. The funding could be reserved for possible system tuning or revising, if deemed necessary.

4.1.3. Coordination of Resources

The management of ICT solutions introduced through the project should be scheduled to align with the expectations of the rural community. If the anticipation for the solution to work is immediate, effort should be put in to ensure the deadline for tasks are efficiently planned. To begin, these are a few issues to think and reflect to assist in the management and monitoring aspects of the project implementation:

- How easy are the equipment used, and are they available all the time?
- How can we ensure/guarantee the availability of the equipment, hardware, power sources?
- How easily available is the software?
- What is the support given/ available?
- Does the design of the equipment consider ease of use for the intended target users?
- Does the design of the equipment consider potential external environmental and contextual factors which may affect the availability and security of the hardware?
- What is the extent of the use of the solution until there is a need to upgrade or change the hardware?
- How do you ensure the compatibility of the solution with other hardware/ software available?
- In the design of the solution, is there any consideration for hardware changes/ upgrades which will impact the performance of the solution? If yes, how do you minimise the impact?

In the case study project in the Philippines, when rolling out the Lake Management System, the rural community, through a community leader, was very hands-on in the implementation of the ICT solutions. Since the lake was located approximately three hours away from the location of the project team, the community leader was able to directly contact the team through SMS messages or mobile calls in case of any questions or problems in the system. Because of the close-knit connection within the community, feedback was communicated easily and immediately to the project team, enabling space and time for extended improvements.

All project leaders should be aware that although some ICT solutions appear theoretically sound, the solutions may not translate as successfully on the ground. Therefore, to ensure efficient implementation, constant monitoring of the project is very crucial.

One of the biggest challenges faced during the implementation stage is communication with the communities. Communication with the community members is imperative to ensure the sustainability of the project as well as to guarantee that there is value added to the project, especially from the perspective of the communities. For many rural communities, it is important that researchers first gain their trust and confidence that the project is beneficial to them, rather than something that the researchers feel that the community should benefit from. However, it has been observed that close communication with the community often stops after the needs analysis phase, as the implementers of the project look towards successfully rolling out the planned project, and not ensuring that the end result of the project fits in with what the communities had in mind. Lack of communication from both parties will inevitably result in the project ending when the project team hands over the project back to the community, as there is no motivation or seen benefit for the community to bring the project forward.

4.2. COMMUNICATION WITH THE COMMUNITY

When dealing with an emerging issue, it is best to address the issue from all possible perspectives. Some of the effects from the raised issue may not be obvious or clarified succinctly at the first instance. Project team members have to initiate interactions that will reveal the "whole story"; for example, it may be difficult to introduce ICT solutions to communities where traditional methods are still strongly used and perceived to the "right way" of conducting the task. The project team has to find a suitable approach to introduce the technology, without confusing or encroaching on the community's values and beliefs.

To avoid or minimize opposition from the community, it is very important that the community accepts and understands the project. Communication with the community is a vital step that must be taken in order to overcome any possible opposition from them. One way of initiating communication with the community is through the organization of several community meetings throughout the development process to explain the objectives of the project and the assessment process to explain the possible effects from the process. It is also important to train local community members on how to use the system which will be put in place at the site.

Approval from the community leaders is crucial, as they are viewed to be the most important members of the community. As community leaders, they are in the position to talk to the members of the community in a way which would allow them to see and understand that the project would benefit the community, and not as a project which could threaten their livelihoods through the introduction of a method or system foreign to them. It is also through this shared understanding between the project team and the community that the initiation and execution of the project can move forward smoothly.

In the event that the locality for the project is affected by political, social or economic pressures, it is advised that the project team acquires assistance from an external evaluator, who is objective and stands on neutral ground.

4.3. COOPERATION FROM THE COMMUNITY

The buy-in from the community determines the overall success and sustenance of the proposed project. Support and patronage from the local community is critical in ensuring the sustainability of the project, after the project has been handed over to the local community for good. To measure level of cooperation, dialogues should be kept open and frequent, and all feedback and reflections should be written and logged, to ensure a record is kept for analysis purpose.

Language plays a significant position in making sure dialogues are open and frequent. The nuances within a language which is used for the communication between project team members and the community should be observed closely, because they indicate the level of engagement built between persons and teams through the process of the project. Confusions and disagreements often emerge when there is a misunderstanding about contentions and values. It is also observed in experiences conducting case studies across Asia Pacific that sharing a similar language does not readily mean that similar messages are sent and received by either party.

When the support from the community is detected to have slowed down, or dwindled over time, steps must be taken by team members to gain renewed or new support, or reaffirm and reclaim previous support. Continuous engagement with leaders in the community should be part of the implementation plan, to ensure sustained interest in the project.

In the case study project for the Lake Management System, it was fortunate that a steady communication is already set up between the community and the project team, partly because the community is already a partner in several other projects, and not just in the ICT project. The project team has also developed a less formal relationship with the community wherein direct communication is encouraged in case any feedback or problem comes up. The rural community, through a community leader, was very hands-on in the implementation of the ICT solutions. Since the lake was located approximately three hours away from the location of the project team, the community leader was able to directly contact the team through SMS messages or mobile calls in case of any questions or problems in the system. Because of the close-knit connection within the community, feedback was communicated easily and immediately to the project team, enabling space and time for extended improvements.

All project leaders should be aware that although some ICT solutions appear theoretically sound, the solutions may not translate as successfully on the ground. Constant monitoring and follow-up should also continue after the implementation phase, and even after the project turnover, if possible. To help in the project implementation phase, it might be beneficial that the identified community be sustained in other aspects as well, and not limited to ICT only, so that the community would get a holistic assistance, and would be more ready to familiarize themselves with the proposed ICT solution.

4.4. COMMUNITY PROTOCOL

Introducing ICT solutions to the community is a risky task. The benefits are obvious to team members, but they may not be as clear to community members. The buy-in relies on the level of understanding and exposure to the ideas initiated to the project. Until the understanding is shared and reciprocated, there is an immense possibility that the ICT solution would not be accepted and adapted by the community. Community protocol is a concept which is viewed as an accepted approach that will help project implementers to effectively engage with the community. When approaching a community and trying to initiate a discussion with them, the project team must first understand the cultural and hierarchical under-linings of the community. There may be certain steps that must be taken before the researchers can talk to the community, such as first talking to the community leaders to seek permission to talk to the community. Certain communities may also require that the researchers make several visits to the community grounds as a means of familiarising the community to the outsiders before initial discussions can be initiated.

In a study conducted by Zaman et.al., it was noted that cultural protocols emphasise on "free, prior and informed engagement process, development of understanding and respect for customary laws, values and decision-making process" and the "failure to respect these cultural norms, whether intentional or not, can lead to conflict, deterioration of otherwise constructive relations, and negative impacts on relationships".

Communities in rural areas have expressed their concerns on allowing outsiders to enter their localities with the promise of introducing technology for the betterment of their livelihoods. These apprehensions were caused mainly because the communities were unable to see the so-called benefits to their lives, and viewed these projects as being mainly to serve the needs of the researchers themselves. It was observed in the same study by Zaman et.al., that projects should deliver all promised outcomes according to the agreed schedule and should benefit both the communities and the researchers equally. Should there be any cause for delays during the roll-out of the project, these delays should be communicated to the communities immediately, and a close communicative relationship between the project team and the community members should be maintained at all times to sustain the trust levels and to achieve an agreeable solution in order to complete the project.

Below are examples of how previous case studies which introduced new technologies to rural communities across Asia Pacific were presented:

- E-Health solution – West Sumatra, Indonesia: Patient information, collected through the use of a simple health check system, is computerised to a central database at local clinics, to enable a more efficient management of healthcare for local doctors and healthcare providers.
- E-Environment – Kalimantan, Indonesia: Pictures of current forest conditions are captured and sent to a central server for early detection of forest fires. The solution enables preliminary assessment of forest fires, and assists in putting out necessary alerts to local communities. Gas omitted from the fires are acquired to enable researchers understand the impact of forest fires on the health and safety of local communities.
- E-Aquaculture – the Philippines: Water quality sensors are installed on lakes to better manage fishing operations. It is a solution to enable fisherfolk at Lake Palakpaksin to manage their catch, and to minimise fishkill.
- E-Education – Bario, Malaysia: The remoteness of the schools in Bario made it challenging for its children to learn and collaborate using technology with other children around the world. Access to learning materials are limited to what was available in schools; with the E-Education solution, children were able to connect, collaborate and learn with other children from different locations outside Bario, and Malaysia. Children were also able to capture and curate local content, and share it with other children, to enable rich documentations of their local language and culture be presented to people outside Bario.

Sources of conflict that could expound during the execution of a project include conflicts between project team and individual or groups within the community, or between institutions that are stakeholders of the project, and between the proponents of the ICT solution and the local government. Below are some examples of conflicts:

Example 1
In the Palangkaraya e-Environment project, some of the problems encountered by the proponents include inconsistencies between agencies that they had to deal with to be able to implement the project. Since the project site is under the jurisdiction of three different local governments, securing permits became a problem. Some inefficiencies in government processes also caused delays in the implementation.

Example 2
During an aerial imaging mission for the Seven Lakes case study project, a concerned parent from the school where the team is deployed complained to the school administration. Despite having permission from the principal to deploy there, the team was asked by the school to submit a written documentation from the LGU justifying the operations of the project. It was also reported that the local city office also issued a memo regarding the use of UAV for the project. The local government units and city office were visited by the project team, to mitigate the emerging concern from the local community. Assistance and support was acquired from the head of a non-government organization Friends of Seven Lakes, and a request letter was signed as proof of the project coordination.

In the event that conflicts do arise, it is important that the project team works towards an amicable resolution of the conflicts as soon as possible. All communication between team members, local agencies and the community must be transparent and straight to the point in order to ensure that all the parties have a clear understanding on the project.

The project team should also observe the existence of solutions from other stakeholders, which may have already been installed at similar locations assigned in the project. Community problems usually need multidisciplinary solutions, wherein introducing the ICT component is just one part. For example, the Lake Management System started as a collaboration between the lake community and the biologists and environmental scientists who were interested in conducting natural science experiments in the lake. From these interactions, the scientists were able to identify problems or systems whose executions may be optimized by ICT solutions, opening the lake community to engineers and innovators who could implement these solutions. This made the Lake Management System a multidisciplinary project that primarily involved inputs from the beneficiaries and ICT solutions that are endorsed by other experts in the field. The acceptance of the solutions by the community was also easier since they are already familiar with the implementing institution. If the proposed solution is building on top of existing systems in the community, then it should be able to offer improvements. Some examples include the efficiency of equipment, a better way to manage, store and publish the data, or by automating the system.

4.5 COMPLETION OF PROJECT

Closing a project is equally as important as beginning one. It is at this phase that the project managers formally completes all activities of a project or a project phase and reports the overall level of success of the project to the funders and other stakeholders of the project. The project closing report also verifies that the defined processes are completed in all phases to close the project as appropriate, and formally establishes that the project is finished. In the SHARE case study projects, this phase is formally known as the "handover".

It is also during this phase that project responsibility is delegated to the community, as the project team hands over the project and activities to the identified community leaders to continue moving forward. During the formal handover of the project to the community leaders, the project manager obtains a formal sign-off from the community leader(s) in order to formalize the closing of the project.

Project leaders will also have to look at creating a project completion report. The report details all the activities that have been carried out throughout the entire duration of the project. This report should also include all the project plans, final accounting of the project budget, data collection results, and information regarding the handover of the project must be stated in the report. Plans for sustainability of the project as well as the leaders of the community who are responsible to move the project forward should also be recorded in the completion report. Contents of the completion report include:

- An objective evaluation of the project – did the project achieve all set out goals and objectives?
- An outline of the accomplishments of the project
- Project data (based on milestones)
- Significant changes observed after the implementation of the project
- Future directions of the project
- Final project accounting
- Recommendations for future projects (lessons learned)

It is recommended that project managers conduct a post implementation review within three to six months after the project has been closed. This review will allow the project team to monitor both the levels of success of the project and the sustainability of the project after it has been handed down to the community. This will provide the project team to review the project and observe any lessons learnt from this project experience for future projects.

One method of obtaining data for this is through feedback questionnaires. Project managers will have to distribute the questionnaires to the community leaders, community members and stakeholders, and if necessary, supplement the questionnaires with interviews. Data from the personal interviews would provide a vivid picture of the impact of the project on the community.

Apart from that, project managers must also ensure that all project documents and deliverables are collected and stored on the project server or network drive. This will ensure that there is a record that is available for review by any of the stakeholders should the need arise.

It is also important that all the stakeholders are formally informed of the closing of the project. Project managers will have to choose a medium of forwarding the completion report to all the stakeholders involved in the project, which could be through the delivery of the actual report or through a presentation of the project during a closing meeting with all the stakeholders.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CHECKLIST FOR CHAPTER 4

- [ ] Have the implementation activities been defined?
- [ ] Have the list of tasks been coordinated with the project schedule?
- [ ] Have the plans formulated to direct and manage the project been thoroughly laid out?
- [ ] Is there a communication plan set up by the project team, to enable communication channels to be active throughout the project?
- [ ] Are there communication strategies in place to resolve any conflicts that may arise during the project?
- [ ] Do the communication plans include the community?
- [ ] How will their feedback be used to enhance the project further?
- [ ] Does the proposed solution meet with the expectations of the community?
- [ ] Has the project team looked at how the proposed ICT solutions may be improved to suit the needs of the community?
- [ ] Has the project team scheduled any meeting with the community and community leaders to discuss issues that affect the implementation of the project?
- [ ] What strategies are in place to ensure cooperation from the community is alive and active throughout the project?
- [ ] Have the project members been informed of the community protocol at the project site?
- [ ] Has the plan to introduce the project team members to the community been discussed with the community leaders?
- [ ] Are there strategies in place to strengthen communications between the project team members and the community?

- ☐ **Has the project been formally handed over to the community?**
- ☐ **Was the sign-off from the community formalized? Is there any outstanding issue that has to be dealt with by the community, after the sign-off?**
- ☐ **Have community leaders who will take over the project been identified? Have the stakeholders been informed of the closing of the project?**
- ☐ **Is there a project sustainability plan in place? Has this plan been discussed with the community leaders?**
- ☐ **Are there any plan to conduct a post implementation review? Has the person in charge of designing the questionnaire or interview been identified?**
- ☐ **Is there a project server or network drive available for the storage of project documents and deliverables?**
- ☐ **Has the completion report been forwarded to all the stakeholders?**

STEPS FORWARD

Community development is one of the main reasons why it is necessary to propose the usage of ICT in rural areas. The key beneficiaries of such projects involve communities that need solutions to a problem or an issue that can be addressed through the use of relevant technology and support. Once a problem has been identified and investigated by the project team, suitable ICT solutions that can alleviate the issue can be determined and proposed by the project team. In perspective, these solutions would then serve to elevate and enrich the quality of lives of the communities involved.

The SHARE experiences acquired through case study projects across Southeast Asia illustrate the win-win situation for both the project teams and the communities of rural areas selected for the projects. In all projects, the project teams were able to learn and apply knowledge, skills and expertise through the planning and implementation of the projects. The opportunity to conduct such projects also allowed for unique opportunities to collaborate with experts from various fields of studies. The combination of ideas and experiences enabled project teams to continuously challenge the approach and methodology in introducing ICT for the rural communities. The SHARE partnership between the different countries – Malaysia, Indonesia, the Philippines, Thailand, Vietnam and Japan – was a strong incentive for the project teams to drive projects towards a greater agenda, which was to capitalize on ICT for the betterment of lives through positive collaborations.

For the communities, being involved in these projects made it possible to unlock new ways of thinking and learning. The communities are afforded the exposure to view their own practices and levels of knowledge, and they would be able to negotiate their perceptions and beliefs to understand how the proposed ICT solutions would thrive in their conditions of living. In various instances, the ICT projects also enabled community members to question the viability of the proposed solutions, especially if they were uncertain about what benefits the solutions would bring about when implemented in their contexts.

In conducting ICT projects for rural areas, the interactions and relationships formed through project activities are fundamental in driving the projects as a whole. Sustainability of a project, particularly when it involves communities from rural areas, is a complex and complicated aspect in any project. A strong positive relationship with the community essentially would allow for sustainability factors to be put in place from the beginning stage of the project. According to UNESCAP's report on ICT Brief on ICT Applications in the Knowledge Economy (2007), there are three perspectives in Sustainability that have to be addressed and resolved: **financial sustainability, human resource sustainability and social sustainability.** When these categories of sustainability are sufficiently focused on from the beginning of the project, the chances for the community to benefit from the technology solution would be greater.

5.1. SCALABILITY

Scalability is a concern when investing in any project. Scalability denotes the potential for a project to grow, to expand and to extend beyond what it was originally designed for. Scalability for ICT projects in rural areas would open ways for the projects to spread to other areas, or to a bigger scope with greater impact. For example, in the case study at Lake Palakpasin in the Philippines, in which the monitoring of fishkill was done through use of unmanned aerial vehicles (UAV), the same tool was later improved to cover a larger size of land, to provide an impactful analysis at a regular basis for the fisher folks in Philippines. The tool was also extended to enable another project team to learn about effects of natural disasters, for instance typhoons and hurricanes which often hit the Philippines. The methodology to scan, collate and analyse aerial view data continues to be developed, to suit the needs of communities, and to provide timely data for decision-making.

However it is also observed that not all ICT projects are scalable. ICT technologies that are selected for projects may not lend themselves naturally in one setting to another, because the needs for them are dependent on the local expectations and initiatives to use the technologies. For example, in Bario, Malaysia, where a telecentre was built as an ICT solution for the community to connect with the rest of the world, its sustainability was acquired when the community members began to build their own small businesses using the Internet access provided at the telecentre. In contrary, the SHARE project that intended to introduce previous case studies solutions completed in Malaysia and Philippines, to another location in West Sumatra, did not accomplish what the integration of ICT tools were meant for. Instead, the ICT solutions could not be implemented successfully because of resistance from the local community. In such cases, the scalability goal was challenged, although the proof-of-concept was already made at a different location, prior to the implementation of the project in West Sumatra, Indonesia.

5.2. COMMERCIALIZATION

Commercialization is a definitive goal, because it explores strategies to ensure the life of an ICT solution to be prolonged and extended after the project is handed over to the community. In instances when the ICT solution does not lend itself naturally for commercialization, initiatives may have to explore strategies to match and combine relevant services, existing or new, that could be built with the aid of the ICT solution proposed.

Based on the SHARE experience, not all projects with rural communities are commercially viable. As such, provisions need to be created with relevant stakeholders, within the community, or external to the community, to enable initiatives to develop to create opportunities for commercialization. The commercial value may be explored through the by-products created through use of the ICT solutions. Identifying possible by-products has to be identified and commitment from local agencies is one of many possible strategies to ensure the community's interests are sustained through a positive and beneficial collaboration. The potential for such collaboration with local agencies could be initiated and developed from the start of the project. The direct involvement would build trust and sense of ownership, and over time, agencies would be able to decide and determine the plan of actions to extend the scope and impact of the project at a new scale. In the case of the case study project at Lake Palakpaksin in the Philippines, it illustrates a successful transfer of their project to commercialization. The project team was also able to further extend the ICT solution by establishing a commercial arm that invests on providing services to local government agencies in the Philippines, capitalizing on the capabilities of Unmanned Aerial Vehicles (UAVs).

5.3. CONTINUED SUSTAINABILITY

In order to make the community self-reliant in a sustainable way, it is important not only to reduce the digital divide, but also to have a knowledge transfer model that could help them learn how to improve themselves and learn how to effectively use IT.

In the past, the transferring knowledge or training process was done in a face-to-face manner. The expert team would go to the field to teach people in the community, and after the training phase, the experts would occasionally visit the community to follow-up. The method proved to be quite difficult to succeed because, without continuous supervision, the community members tended to return to their previous practices. In order to integrate their habits or lifestyles to include changes needed when utilising the technology solutions, researchers not only need to put in continuous effort, but also need to make the community feel that they have ownership of the project, and to realize the benefits of modify their usual practices.

With the usage of ICT, it becomes possible for rural communities to become connected with various information and technology, something which would have been difficult to achieve in the past. In rural communities, farmers are realizing the true complexity of sustaining efficient, productive and profitable agriculture. In advanced countries farmers are embracing advanced technologies like aerial imaging, satellite imagery, GPS, and big data analytics. This move, tentatively labeled as Ag 3.0, centres on every farm operation being monitored and tracked, from soil biochemistry, ground moisture, seeds planted, insect infestation and disease watch. In Aquaculture, decision support systems are becoming crucial for fisherfolks to monitor their yield, time of their harvest, and strategies to avoid massive fishkill.

The main question at hand now is the most suitable strategy, or strategies, to transform a community that was part of the digital-divide towards becoming an ICT-enabled community.

5.4. IMPACT ON POLICY

Challenges in implementing ICT for rural areas are unique, complex and have much to be explored and understood. All involved parties need to discuss as many perspectives about such projects, as the participation and collaboration between government agencies, researchers, industry players, and the community are imperative to compose policies that would benefit the community as a whole. Policies are drivers for continued initiatives to be designed and implemented, with considerations for appropriate grants. Private-public partnerships are also a strategy to enable continuation and expansion of projects with rural communities. However, such partnerships should be guided with relevant policies that would not impede or jeopardize the rights, safety and well-being of communities in rural areas.

In the experience of SHARE, solutions that were experimented in the various locations were able to accumulate stories and experiences that informed decision-making. For instance, in Malaysia, when telecentres were built to introduce ICT to communities in rural locations, the idea was adopted by the Malaysian government to initiate a country-wide roll-out of telecentres for identified rural locations across the country. The implementation of the telecentres was assigned to a governmental agency that regulates multimedia development and monitoring in the country, such as the Multimedia Corporation (MMC) in Malaysia. Training was provided for local communities to empower its members to develop personal and group skills in capitalizing on technology for the betterment of its socio-economic activities.

Another example of a case study project undertaken by SHARE members is the Cyberbrain Project, which was an idea developed by partners at Kasetsart University, Thailand. The Thailand government capitalised on the idea developed by the university researchers to improve the community-based cooperatives across the country that are instrumental in their rice and agriculture industry. The following section describes the idea developed by SHARE Thai partners based on projects implemented with rural communities in the country.

5.5. KNOWLEDGE SYSTEMS – CYBERBRAIN PROJECT

The CyberBrain project was initiated by UKNOW Center, at the Department of Computer Engineering, Kasetsart University. The goal of CyberBrain is to develop IT solutions, combining IT infrastructure, services, and knowledge management, to improve the quality of lives of rice farmers. The assumption of the CyberBrain project is that if the rice farmers have access to the right agricultural information and knowledge, the cultivation process will become more effective, resulting in the improvement of productivity and product quality, consequently, increasing their income. With this assumption, this project focused on developing an IT-enabling knowledge service that will deliver such agricultural knowledge to the rice farmers. Examples quoted in this section refer directly to the ideas and experiences in Thailand specifically in designing and implementing Cyberbrain.

In the case of CyberBrain, the objective is to develop a knowledge bank and service that could be used to help the cultivation practices of rice farmers become more effective, which will consequently help them increase their income and improve their life quality. Four main aspects were chosen as the focus when selecting the knowledge content to achieve these objectives, which are:

- Knowledge to help reduce cost
- Knowledge to help reduce risk
- Knowledge to help increase cultivation and product quality
- Knowledge to help increase productivity

The knowledge content should cover the entire life-cycle of cultivation processes, from the farm to the market; including information on what needs to be done before planting, during planting, after harvesting, and market information.

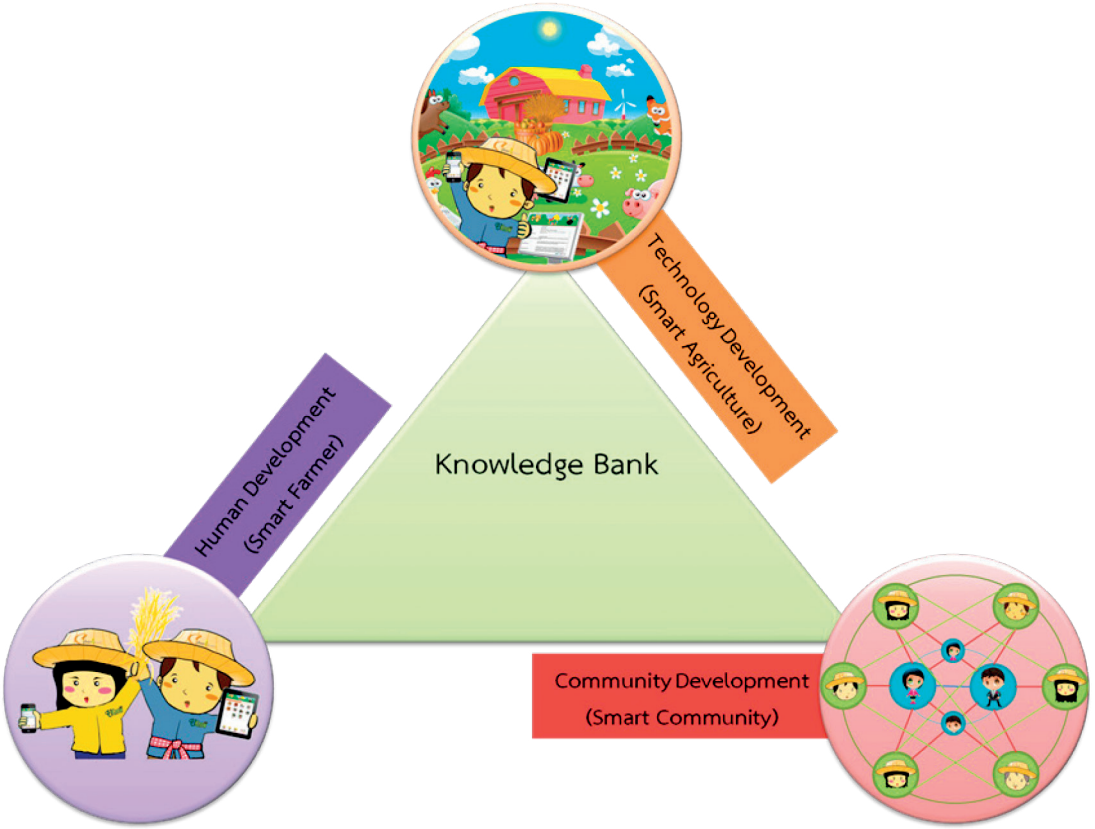


Figure 6 : CyberBrain model: Keen and Green Innovative Farmers with Digital Economy and Life Long Learning capabilities

In the knowledge service platform design, there are two main aspects that must be considered, namely **content knowledge** and **service**.

5.5.1. Content Knowledge

In designing and selecting content, it is necessary to keep in mind that the content must be relevant and can contribute towards the successful accomplishment of the goals of the project. The content should also be able to support the processes or practices that could positively impact the communit

5.5.2. Service

What the CyberBrain developers have learned from past experiences is that rural communities have difficulties in using technology. Digital divide occurs not only because of the lack of IT infrastructure, but also the lack of IT knowledge. Although a lot of agricultural knowledge has been made available on many websites, from both public and private organizations, the usefulness of this to the rice farmers is very limited. A vast majority of rice farmers in rural areas are not capable of identifying the relevant information, searching the internet, reading, analyzing or synthesizing such information to solve their problems.

Based on the observation, it is obvious that a passive-style service does not suit with this scenario. In order to design knowledge services, it is important that the services, as well as the knowledge delivered by the services, must be both ready-to-use and easy-to-use. The services must work in a proactive manner in the form of personalized, delivery services.

In personalized service, the information and knowledge are tailored to suit the user's profile. In CyberBrain, there are two key points that are emphasized:

- Time-based service: Focusing on temporal aspects, for example the timeliness of the service, if the knowledge delivered is suitable with the growing period and season.
- Context-aware service: Focusing on contextual aspects of the user. The knowledge and information delivered must be relevant to the situation, environment, and context of the users.

In making content knowledge to be ready-to-use, the selection of content is imperative to ensure that it matches with user needs and context. It was observed that in many cases, there was a need to integrate various knowledge in order to create a one-stop-service. For example, in the rice disease diagnosis application developed for farmers in Thailand, knowing just the cause of a symptom was not sufficient to solve the problem. Besides possessing the necessary content knowledge for disease diagnosis, the application needed to be able to suggest how to prevent and eradicate the disease, where to buy the chemical treatment, how to apply the chemicals, and other supporting information and actions that could be considered by the farmers.

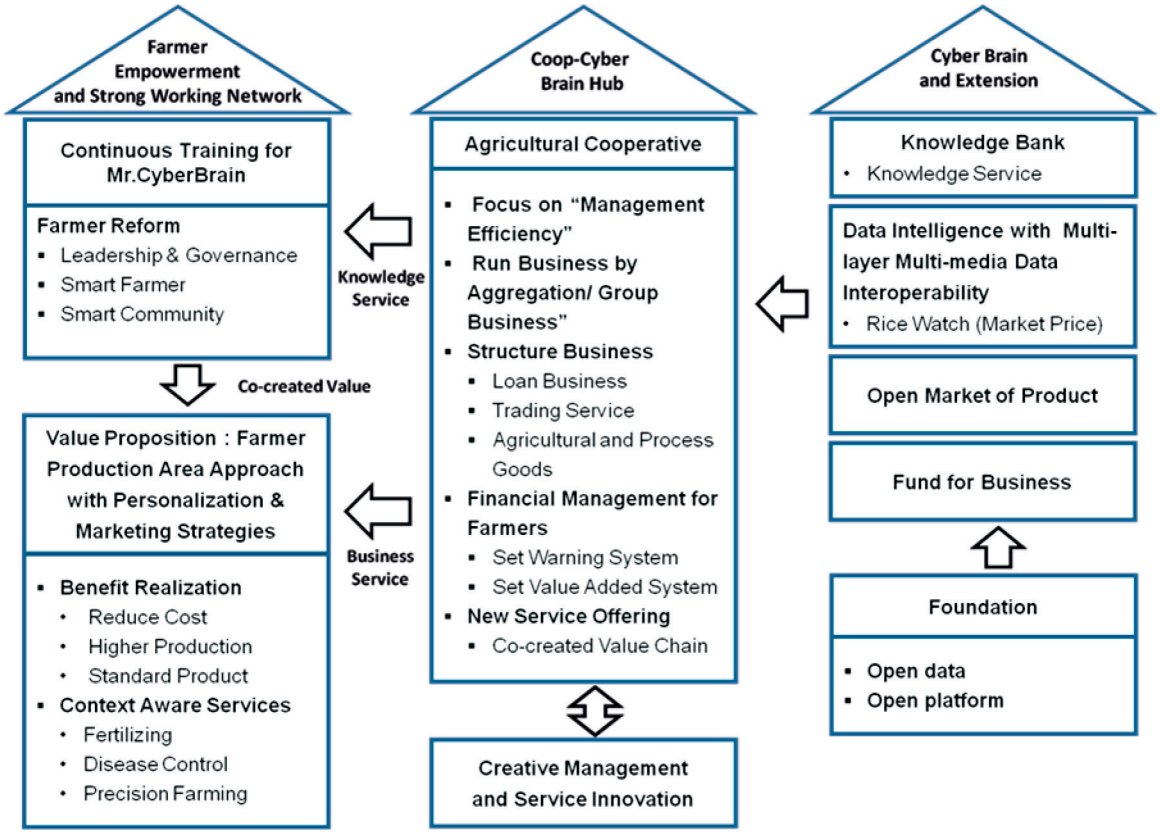


Figure 7: CyberBrain :- Hub for Knowledge Management and Sharing

5.5.3. Collective Intelligence

CyberBrain is designed based on a conceptual framework that stems from the importance of knowledge sharing. Apart from focusing on technical design and development, it is important to emphasize on how to make the system sustainable. For developing a knowledge service system, to facilitate sustainability, it is necessary to keep the knowledge or information current and responsive. Knowledge and information that are out-dated may affect decision making, resulting in failure of project implementation, and decrease in group morale. Cooperation between all stakeholders within a knowledge service system possibly would lead to the concept of collective intelligence where computers and groups of people could collaborate in bringing together and sharing knowledge.

Oftentimes implementations of IT systems quote their most frequent fault on focusing attention on developing a good IT infrastructure. Minimal attention focused on the aspect of information and knowledge management. While it is relatively simple to assume that the information or knowledge content was already available, the assumption may not be correct for all accounts. Advancements in ICT have already provided emerging IT devices and computer software that are designed with the capabilities of automatically collecting and analyzing data, or even developing a prediction model based on the collected data. However, there are some issues that cannot be done by computers alone, for example:

- Large amounts of agricultural knowledge is tacit knowledge and has never been digitized
- Digitized agricultural knowledge is usually in an unstructured format, which is difficult to be used by computers
- Lack of reliable data and knowledge verification methods

It is believed that through collective intelligence involving the work of both computers and humans, these issues can be avoided or minimized.

Aside from building ICT platforms for knowledge collection and sharing, another key criterion in creating collective intelligence is to ensure that a collaborative community of interest is built. This community needs to work closely with one another to share knowledge, verify and enrich existing knowledge as well as warn and report situations. The community of interest should not only consist of target users, but should also involve all the different sectors such as government sectors, private sectors, experts and individuals, in order to ensure that that the knowledge in the system is complete and alive. As people in rural areas usually face difficulties in both accessing and using the IT devices and applications, it is therefore imperative to have partners that will act as the middle-man for knowledge services, i.e. "Knowledge Broker". The role of the knowledge broker is to support communities with using these technologies to solve their problems.

5.5.4. Transfer Model and Collective Intelligence

In finding a way to make the system sustainable even after the funding period, CyberBrain has initiated collaborations with multiple partners.

In order to continually promote system usage by the rice farmers, it is believed that it would be effective to collaborate with partners who have direct contact with them. Amongst various institutions, Agriculture Co-operative is seen to be one of the best candidates. The roles of the agriculture cooperatives are to support the farmers in procuring supply for production, the marketing of farm products, or even financial support. As a partner to CyberBrain project, a new role of the co-operative is to act as a knowledge broker for their member farmers, supporting the rice farmers who do not have IT devices or face difficulties in accessing the CyberBrain systems.

Although the cooperative officers are good knowledge brokers, one problem was identified – the officers lacked sufficient agricultural knowledge to maintain content knowledge in the system. To initiate a community of interest that is capable of verifying and sharing the knowledge, cooperation from academics and experts in agricultural domains who are ideally perfect stakeholders for this role was received. However, the solution to the problem was not as ideal as initially imagined, as these experts had too many other obligations which affected the commitment of their role in CyberBrain.

During the CyberBrain experience, there was a plea for attention from an association of farmers in Thailand to be a part of the community of interest. Through this group, the farmers moved from being only knowledge consumers, to becoming people who were also able to share their knowledge and experiences with the group. The collective intelligence platform would become a means for farmers to exchange knowledge and support one another, consequently strengthening the farmer community in Thailand. Successful farmers could become living examples for other farmers and allow them to realize the importance of using knowledge systems in cultivation practices. With the direct participation in maintaining the system from the target users, it was hoped that a sense of ownership would be created, which is an important factor for system sustainability.

It has been noted that in developing personalized services such as the one provided for the association of Thai farmers, it is not necessary for it to be just for individual usage. In many cases, IT services are needed to improve management in the community level, for example, a body of individuals that has a certain inter-relationship, such as group of farmers in the same area. One example of such a service is for resource scheduling and resource management that was personalized at the community-level. Effective resource scheduling within a group of individuals could directly contribute to a greater cost reduction and indirectly create a bond that could help strengthen the community.

5.6. FUTURE DIRECTIONS OF BIG DATA - PATTAYA PROTOCOL

SHARE is essentially built on the collaboration of ideas and expertise from various disciplines, with a focus to enable better living quality for people from marginalized locations, through applications of technology. Case study projects coordinated by SHARE members to date have enabled dialogues about future ideas for the meaningful integration of technology.

Expanding on the CyberBrain framework, the Pattaya Protocol is an example of collective knowledge that capitalises on the visualization of knowledge and experiences to consolidate justifications for the need for Good Data in ICT solutions. In a world which is currently trying to identify and justify the uses of Big Data, the Pattaya Protocol is a conceptual framework drawn up by SHARE partners, to assimilate ideas and experiences from past case study projects with current needs for technology projects in rural areas. The Pattaya Protocol believes that Good Data, when mined efficiently, will enable development of technology-based projects that are more impactful for communities in need. For example, to drive Good Data for the development of Agriculture and Aquaculture, it was observed in the Philippines and Thailand projects that dealt with farmers and fisherfolks, where the original thrusts in aquaculture to prevent fishkills has spawned the development of floating field servers that provide real time monitoring of the water quality around fish ponds, aerator systems that can be controlled to mitigate the loss of oxygen, and information systems that monitor the farmers yield and feed costs. A powerful addition to these capabilities has been the demonstration of aerial imaging for lakes and for agriculture in general. In Thailand information system link farmers' cooperatives with distant markets, new farming techniques flow from experimental farms to new areas for planting, helpful suggestions are personalized for individual farmers that formulate fertilizers, classify pests, and quality control feedback. At the time of writing, the SHARE partners have begun to apply the potential of aerial imaging technology throughout the region, by replicating the success in the Philippines. These efforts focus on the need for big data monitoring with aerial imaging, combined with actual ground truth data that will address strategic directions.

5.7. SUMMARY

When looking at improving the quality of lives of people in rural areas, it is necessary to have a knowledge transfer model, together with ICT infrastructure and services, to assist them in creating a self-reliant community. The design and selection of knowledge content is very important when developing a knowledge service platform, and such knowledge and information should be able to help solve the problems or difficulties faced by the community. The content in the knowledge service platform should also be of high-quality, high-coverage, complete and up-to-date.

One major problem in developing IT systems for rural communities is the digital divide. Project failure often occurs after the funding period due to communities' resistance to technology or inability to use the IT system without supervision. In transferring the system to the community and promoting the continuity usage, it is important to develop a sense of ownership within local people by letting them participate in the development process. It is also necessary to have a network of partners or stakeholders working in collaboration to support users, maintain the systems, as well as share and enrich knowledge.

SHARE is now well positioned to leverage its projects into early commercialization of "good data" companies throughout ASEAN. Our new companies will be technology platforms that aggregate, analyze, and present farmers and fisherfolk critical actionable data in a simple and clear way. These new information systems leverage local wisdom from farmers/fisherfolk and new insights into weather, yield prediction models, market forces, climate change and disaster science. Hence the SHARE programs already form a basis for early commercialization efforts. Several new capabilities like smart V-Hub technology, mobile cloud information systems, aerial imaging and real time multi-platform data gathering position SHARE for early entry into big data applications. Materials which describe the use of aerial imaging for Agriculture and Aquaculture are included in the Appendix for further reading.

In conclusion, SHARE will continue to develop regional use cases for these emerging information technology platforms that address the crucial issues of food security, food safety, farm to market logistics, and decision making.

BIBLIOGRAPHY

C. A. F. Ezequiel et al., "UAV aerial imaging applications for post-disaster assessment, environmental management and infrastructure development," Unmanned Aircraft Systems (ICUAS), 2014 International Conference on, Orlando, FL, 2014, pp. 274-283.

C. A. F. Ezequiel et al., "Aerial Imaging Consortium: Augmenting Ground Observation With UAS Remote Sensing for Environmental Resource Management," Journal of the Philippine Geosciences and Remote Sensing Society, vol. 1, pp. 12-20, Sept. 2015.

D. B. Solpico et al., "Towards a web-based decision system for Philippine lakes with UAV imaging, water quality wireless network sensing and stakeholder participation," Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 2015 IEEE Tenth International Conference on, Singapore, 2015, pp. 1-6.

J2-J3-TMP. (2016, July 27). Retrieved July 27, 2016, from Asia- Pacific Telecommunity : http://www.aptsec.org/J2-J3-TMP

ICTs Go Rural. (n.d.). Retrieved from International Telecommunication Union : http://www.itu.int/osg/spuold/wsis-themes/ict_stories/themes/e-rural.html

Trochim, W. M. (2006, October 20). The Planning- Evaluation Cycle. Retrieved March 2016, from Research Methods Knowledge Base : http://www.socialresearchmethods.net/kb/pecycle.php

FY 2002 GPRA Performance Plan. (2001, April 19). Retrieved March 2016, from National Science Foundation : http://www.nsf.gov/pubs/2002/nsf02057/nsf02057_2.pdf

Trochim, W. M. (2006, October 20). Introduction to Evaluation. Retrieved March 2016, from Research Methods Knowledge Base: http://www.socialresearchmethods.net/kb/intreval.php

Klaucke, D. N., Buehler, J. W., Thacker, S. B., Parrish, R. G., Trowbridge, F. L., & Berkelman, R. L. (1988, May 6). Guidelines for Evaluating Surveillance Systems. Retrieved March 2016, from Centers for Disease Control and Prevention: http://www.cdc.gov/mmwr/preview/mmwrhtml/00001769.htm

Management, C. f., Environment, B. o., Sciences, D. o., & Council, N. R. (2001). Progress in Improving Project Management at the Department of Energy. National Academies Press .

ICTs Go Rural. (2006, November 27). Retrieved March 24, 2016, from International Telecommunication Union : http://www.itu.int/osg/spuold/wsis-themes/ict_stories/themes/e-rural.html

Institute, P. M. (2013). A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Fifth Edition. Pennsylvania : Project Management Institute, Inc.

Titcomb, A. L. (2000). Need Analysis. Retrieved March 2016, from ICYF Evaluation Concept Sheet: https://extension.arizona.edu/evaluation/sites/extension.arizona.edu.evaluation/files/docs/needs.pdf

Hosman, L., & Fife, E. (2008). Improving the prospects for sustainable ICT projects in the developing world. International Journal of Media and Cultural Politics , 51-69.

Miscione, G. (2007, June). TELEMEDICINE IN THE UPPER AMAZON: INTERPLAY WITH LOCAL HEALTH CARE PRACTICES. MIS Quarterly , pp. 403-425.

Dearden, A., Fu, X., Matthews, P., Gupta, S., & Wills, S. Rural e-services: Participatory co-design of Sustainable Software and Business Systems in Rural Co-operatives.

Zaman, T., Yeo, A. W., & Winschiers-Theophilus, H. (2015). Reducing “white elephant” ICT4D projects: A Community Researcher Engagement . Seventh International Conference on Communities and Technologies (C&T 2015). Ireland : University of Limerick .

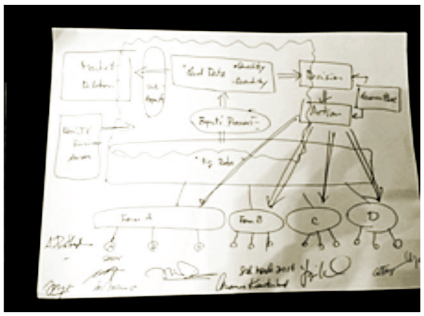
UNESCO. (2005). Information and communication technologies (ITCs) for community empowerment through non-formal education: Experiences in Lao PDR, Sri Lanka, Thailand and Uzbekistan. Bangkok: UNESCO Asia and Pacific Regional Bureau for Education .

APPENDICES AND ANNEXES

Next Steps: From CyberBrain to Cyber Life for Better CARE with SHARE PATTAYA Protocol on SHARE extension

The PATTAYA Protocol on SHARE extensions is an international agreement, developed at Pattaya on 8th March 2016, which aims at sharing the thirteen years of experiences and lessons learned arising from the strong network of SHARE members, i.e., Japan, Indonesia, Philippines, Malaysia, Vietnam and Thailand.

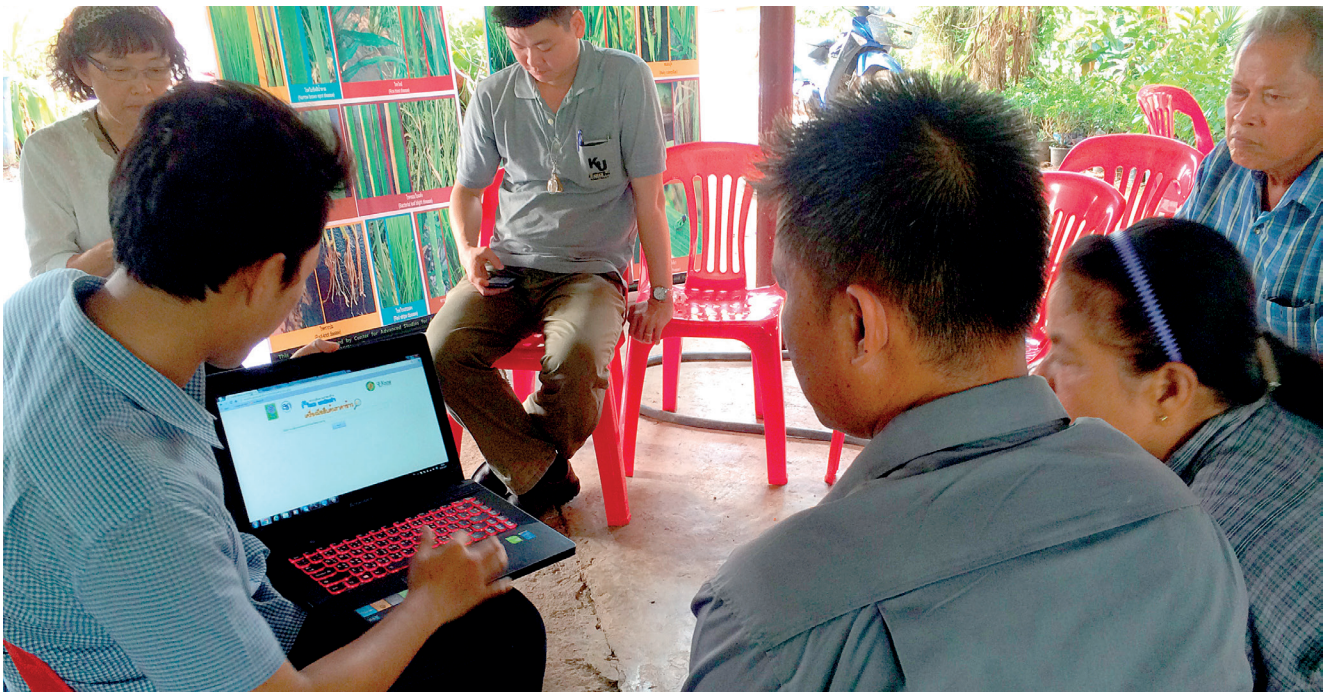




The agreement is to start the implementation of the SHARE strong network in practical project which will bring the utilization of collaborative research resources in a fair and equitable way.

"SMART Community for Better Life" Initiative in Thailand

To comply with the twenty-years National Strategy 2017-2036, Towards Thailand 4.0, and with three-years Digital Government Action Plan 2016-2018, The "Smart Community for Better Life" Project is initiated by UKNOW center, Kasetsart University and will be implemented with the stakeholders, at Ubon-rajchatani Province in the North-East of Thailand, supported by Electronic Government Agency, Ministry of Information and Communication Technology; National Institute for Emergency Medicine, Ministry of Public Health; National Science and Technology Development Agency, Ministry of Science and Technology; Ministry of Interior and Ministry of Social Development and Human Security Thailand including TOT Public Company Limited. Figure 2 shows the concepts behind of developing smart community. Based on Information and Communication Technology enabling connected government development, innovation in services to the community for wealthy, healthy and sustainability will be delivered in greater efficacy, enhanced transparency with reducing transaction cost and avoidance of duplication. The e-services will be delivered through government and public sector to citizens, business and other parts of government in the area of emergency healthcare during disaster, knowledge service for the farmers, one-stop service for social welfare integrated, and Cyber Market for agricultural products and so on.



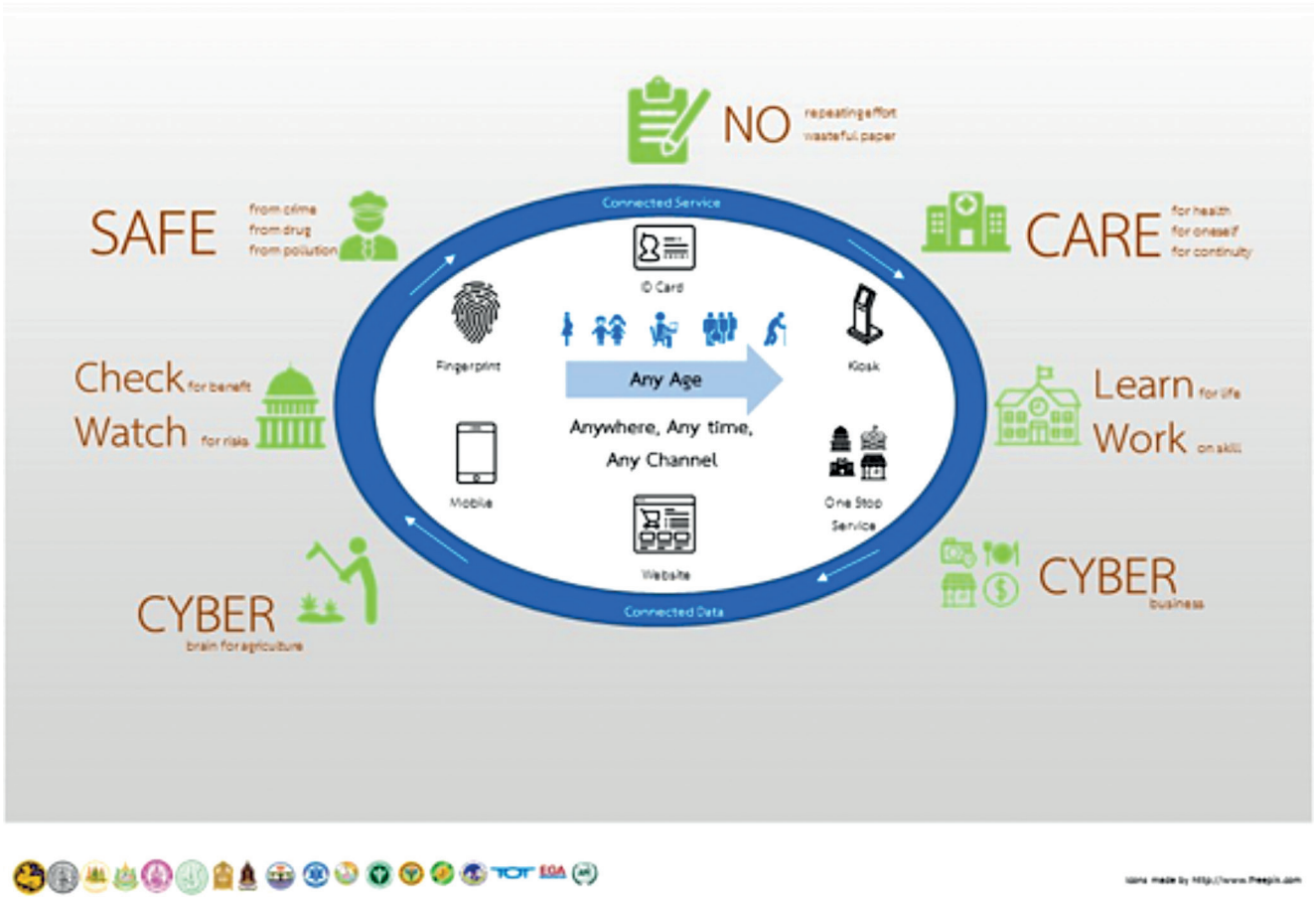
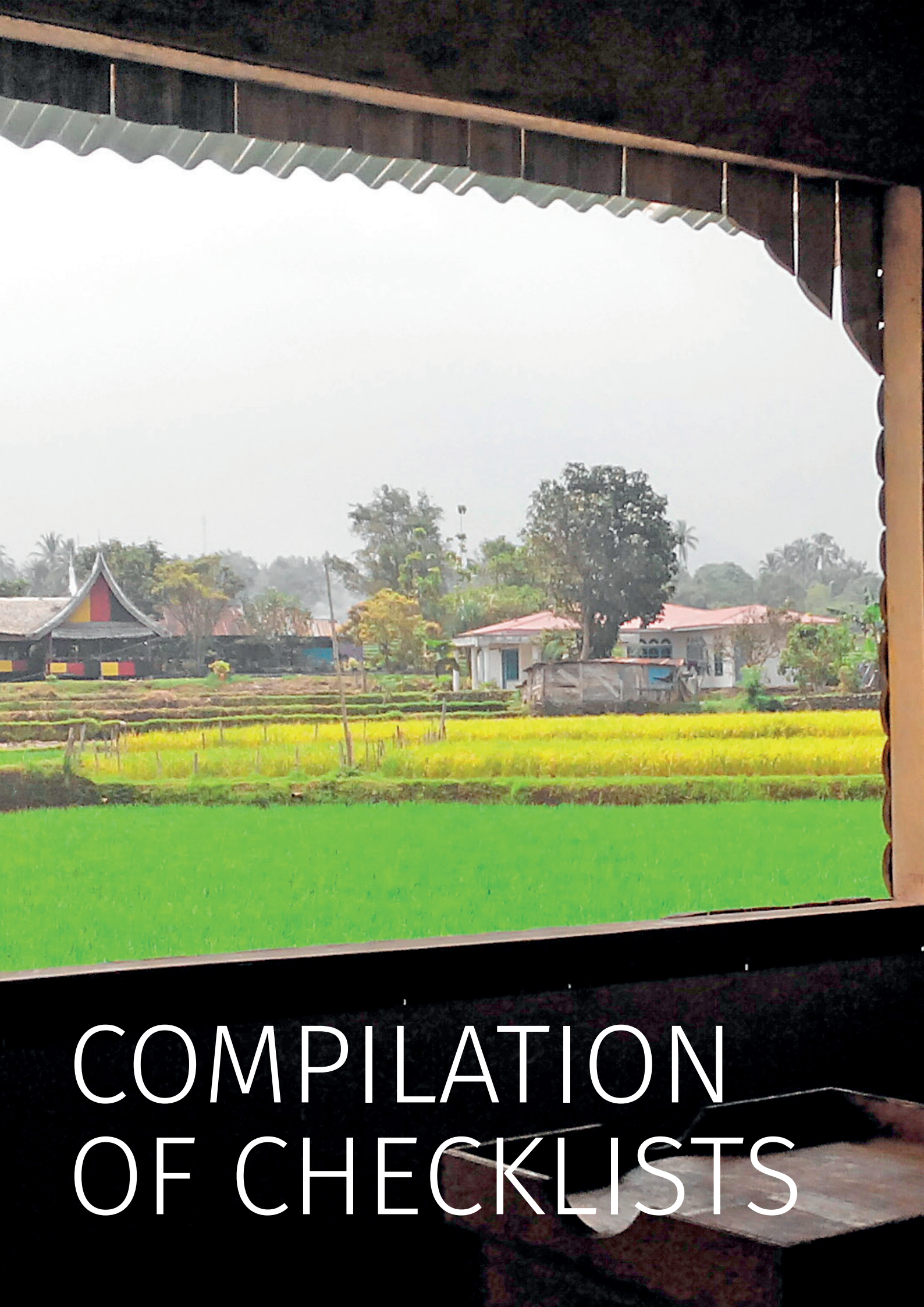


Figure 4: The framework of citizen and business centric services under Connected Government Platform

Accelerating SMART Community Project with SHARE extension

To accelerate the Smart Community project, it is important to have strong networking both from national level and international level, especially the collaborative expertise and practices from each country of SHARE members. This Project at Ubon-rajchatani Province will be a Pilot project for harvesting thirteen-years SHARE activities and looking forwards to the success of implementation of the Pattaya Protocol for knowledge-sharing and benefit-sharing in the future.



COMPILATION OF CHECKLISTS

CHAPTER 1 CHECKLIST

- [ ] **Has a proposal been submitted to funders? To community leaders?**
- [ ] **Has a rural community been identified? What are the bases for selection?**
- [ ] **Has there been a preliminary study conducted on the site of the proposed project?**
- [ ] **Will the potential project to create a product or develop an ICT product or service potentially elevate or solve an issue or problem faced by the rural community?**
- [ ] **Has the project leader identified the local leadership team in the rural community?**
- [ ] **Has there been any identification of a local champion among the local community?**
- [ ] **Does the design of the needs analysis questionnaire reflect the objectives of the project?**
- [ ] **Has the scope of the project been outlined?**
- [ ] **Have the deliverables for the project been identified?**
- [ ] **Has the duration of the project been determined?**
- [ ] **Are the resources and requirements needed for the project identified?**
- [ ] **Has the estimation for investment been conducted?**

CHAPTER 2 CHECKLIST

- ☐ **Have the suitable ICT solutions been proposed?**
- ☐ **What are the criteria for choosing the ICT solutions?**
- ☐ **Have the project goals and objectives been developed?**
- ☐ **Has the outline for the project management plan been spelled out?**
- ☐ **Have the project leaders decided on how the project will be monitored?**
- ☐ **Are there action plans in place to control the project?**
- ☐ **Has the scope of the project been determined?**
- ☐ **Is there a project schedule in place?**
- ☐ **Has the financial management aspect of the project been considered?**
- ☐ **How will the continued sustainability of the project be achieved?**
- ☐ **Has a list of project tasks been created?**
- ☐ **Does the list of tasks include additional tasks that were not factored in the initial project design?**
- ☐ **Is there a timeline for the activities that will be conducted for the project?**
- ☐ **What are the measures that will be taken to ensure that the project will go according to schedule?**
- ☐ **Is there a contingency plan which allows for any unexpected changes or delay in the planned schedule?**
- ☐ **Has the budget for the project been formulated?**
- ☐ **Has an implementation project plan been created?**
- ☐ **Is there a set of standards to measure the quality management of the project?**
- ☐ **Is there a plan in place for human resource management?**
- ☐ **Has a project team been recruited?**
- ☐ **Is there a plan for communications management?**
- ☐ **Have the stakeholders been identified?**
- ☐ **Who will receive the results of the feedback?**
- ☐ **How will the information be distributed?**
- ☐ **Have the potential risks been identified?**
- ☐ **Is there a plan formulated to overcome any potential setbacks that could occur during the rollout of the project?**
- ☐ **Is there a plan in place for the procurement of items?**

WHEN PLANNING A SCHEDULE

- [ ] What are the deciding factors for the schedule?
- [ ] Urgency of the need
- [ ] A set time frame or conditions by the funders
- [ ] Weather/ climate
- [ ] Permits and licenses from government agencies
- [ ] Cooperation from the community
- [ ] Readiness of the community
- [ ] Procurement of equipment
- [ ] How are the milestones and timeline determined?
- [ ] Is every work item clearly explained and aligned to the goal of the project?
- [ ] Are your team members all able to commit to the planned schedule?
- [ ] What are the provisions made for project coordination?
- [ ] Will all resources be made available throughout the duration of the project?
- [ ] Who will monitor the project schedule?
    - [ ] Project leader
    - [ ] Persons in charge of specific stages of the project
- [ ] What are the communication channels that will be used by all members in the project?
- [ ] What measures will be taken to ensure that the project runs according to schedule?
- [ ] Will there be any provisions in the schedule for unexpected or uncontrollable delays?
- [ ] Health issues of team members
- [ ] Equipment delay
- [ ] Environmental issues
- [ ] Natural disasters
- [ ] Rejection of licenses or permits
- [ ] Change of politicians
- [ ] What happens when the funding is used up unexpectedly?
- [ ] What provisions are made to buffer the impact on the project implementation?
- [ ] What are the steps to take in the event that the project is ahead of schedule, and there is an unexpected surplus of funds and resources?

CHAPTER 3 CHECKLIST

- [ ] **Have the surveys provided adequate information for system design?**
- [ ] **Has the purpose of the system that meets the need of local folks determined?**
- [ ] **Have the target data collection and analysis been done?**
- [ ] **Is there any previous research which looked at similar issues as the ones identified in the target community?**
- [ ] **Has the system technological needs been determined?**
- [ ] **Are there any local policies or beliefs that need to be addressed by Project Manager?**
- [ ] **Has the local community leader being approached and involved in setting up the ICT facilities?**
- [ ] **Have the ICT personnel to operate and maintain the system been appointed?**
- [ ] **Is there a plan to train the community to continue the project upon handover of the project?**
- [ ] **Is there any digital or online materials available for the community after the project ends?**

CHAPTER 4 CHECKLIST

- [ ] **Have the implementation activities been defined?**
- [ ] **Have the list of tasks been coordinated with the project schedule?**
- [ ] **Have the plans formulated to direct and manage the project been thoroughly laid out?**
- [ ] **Is there a communication plan set up by the project team, to enable communication channels to be active throughout the project?**
- [ ] **Are there communication strategies in place to resolve any conflicts that may arise during the project?**
- [ ] **Do the communication plans include the community?**
- [ ] **How will their feedback be used to enhance the project further?**
- [ ] **Does the proposed solution meet with the expectations of the community?**
- [ ] **Has the project team looked at how the proposed ICT solutions may be improved to suit the needs of the community?**
- [ ] **Has the project team scheduled any meeting with the community and community leaders to discuss issues that affect the implementation of the project?**
- [ ] **What strategies are in place to ensure cooperation from the community is alive and active throughout the project?**
- [ ] **Have the project members been informed of the community protocol at the project site?**
- [ ] **Has the plan to introduce the project team members to the community been discussed with the community leaders?**
- [ ] **Are there strategies in place to strengthen communications between the project team members and the community?**
- [ ] **Has the project been formally handed over to the community?**
- [ ] **Was the sign-off from the community formalized? Is there any outstanding issue that has to be dealt with by the community, after the sign-off?**
- [ ] **Have community leaders who will take over the project been identified? Have the stakeholders been informed of the closing of the project?**
- [ ] **Is there a project sustainability plan in place? Has this plan been discussed with the community leaders?**
- [ ] **Are there any plan to conduct a post implementation review? Has the person in charge of designing the questionnaire or interview been identified?**
- [ ] **Is there a project server or network drive available for the storage of project documents and deliverables?**
- [ ] **Has the completion report been forwarded to all the stakeholders?**

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ANNEX 1

APT REPORT ON HANDBOOK TO INTRODUCE ICT SOLUTIONS FOR THE COMMUNITY IN RURAL AREAS

APT REPORT

On

HANDBOOK TO INTRODUCE ICT SOLUTIONS FOR THE COMMUNITY IN RURAL AREAS

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Adopted by

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1st Revision
The 26th APT Standardization Program Forum (ASTAP-26)
9 – 12 September 2015, Bangkok, Thailand

CONTENTS

1. Overview of the Handbook

This handbook summarises a selected list of projects which were conducted through the provisions of APT J2 and J3 programmes. The APT J2 programme is titled "HRD Programme for Exchange of ICT Researchers/Engineers through Collaborative Research" and APT J3 programme is titled "ICT Development Programme for Supporting ICT Pilot Projects in Rural Areas".

The goal of these projects is focused on strategies to demonstrate how rural needs can be addressed by deploying state-of-the-art ICT solutions. The proponents from every country proposed to address specific areas in their country for rural deployment. In these projects e-Aquaculture, e-Education, e-Environment and e-Healthcare were proposed in the Philippines, Malaysia, Indonesia; with support and assistance from local project leaders, and through regular consultations and collaborative meetings, the other team members and Japanese collaborators shared in the development and deployment of each project work. There has been instances in which innovations in one country flowed quickly to another team in another country. An important feature of these SHARE projects has been the development of a strong local build to the programmes. To meet the goal, it necessitated careful site selection for each project to ensure long term reliability and local co-ownership of the projects. To achieve the collaborative goal within a short period designated for each project, every team leader thrived on already existing relationships with local governments or relevant organizations. In this way the local people became co-innovators in the SHARE project.

Each project was carried out in one country; however every solution and constructed network system is applicable and useful to other member countries as well. The sharing of inforamtion about experiences with local communities in each country is invaluable; it has helped shape the strategies to engage and to deploy solutions that aligned with the SHARE goals. In the handbook four projects are presented as case studies of solutions. Each project begins with an introduction to the local sites, analysis of problems, decision processes for the design of solutions, system configurations and a conclusive description about the outcome of each project.

1.1 Introduction

The Telecommunication Technology Committee (TTC) Promotion Committee began its activities in April 2007. Its philosophy was based on the slogan "Let's SHARE -**Success & Happiness by Activating Regional Economy-** together." Through cooperation among five countries in Asia (Indonesia, Malaysia, Philippines, Thailand and Vietnam), and with the support of the Asia-Pacific Telecommunity (APT), TTC has been conducting ICT pilot projects in rural areas, with solutions for social issues in Agriculture, Aquaculture, Environment, Health, Education and constructing Telecommunications infrastructure.

In the 14th meeting in June 2008, a Case Study Team (CST) was established in 2008, under the standardization gap, from the point of how to use the latest ICT for improving people's lives and bringing more happiness in developing countries and how to implement latest technologies, systems and services at affordable cost toward that goal. These goals were realized through the development of various case studies enabled by APT funding, which were implemented in each country. The solutions created and deployed were extended to neighboring Asia countries upon completion.

In sum, SHARE members and CST were able to apply latest standardized technologies and systems to various applications and services through the collaborative experience in designing and developing innovative solution-based projects supported by APT's J2 and J3 programmes.

SHARE members have selected the following five applications over ICT to be developed as the solutions for social issues in rural areas.

- e-Agriculture and Aquaculture
- e-Education
- e-Environment
- e-Healthcare
- e-Disaster Risk Management

Details about each solution are presented in the following sections.

1.2 Generic Model of SHARE Pilot Projects

Figure 1-1. shows the generic model for pilot projects demonstrated in rural areas of South-East Asia. The model centres on the building of sensor networks, to gather data which are measured by various sensors on a file server, and the processed data are sent to specialists in urban areas through the network. Specialists would then be able to analyse the data, and provide prompt feedback through the network, to enable efficient resolutions to issues faced on location.

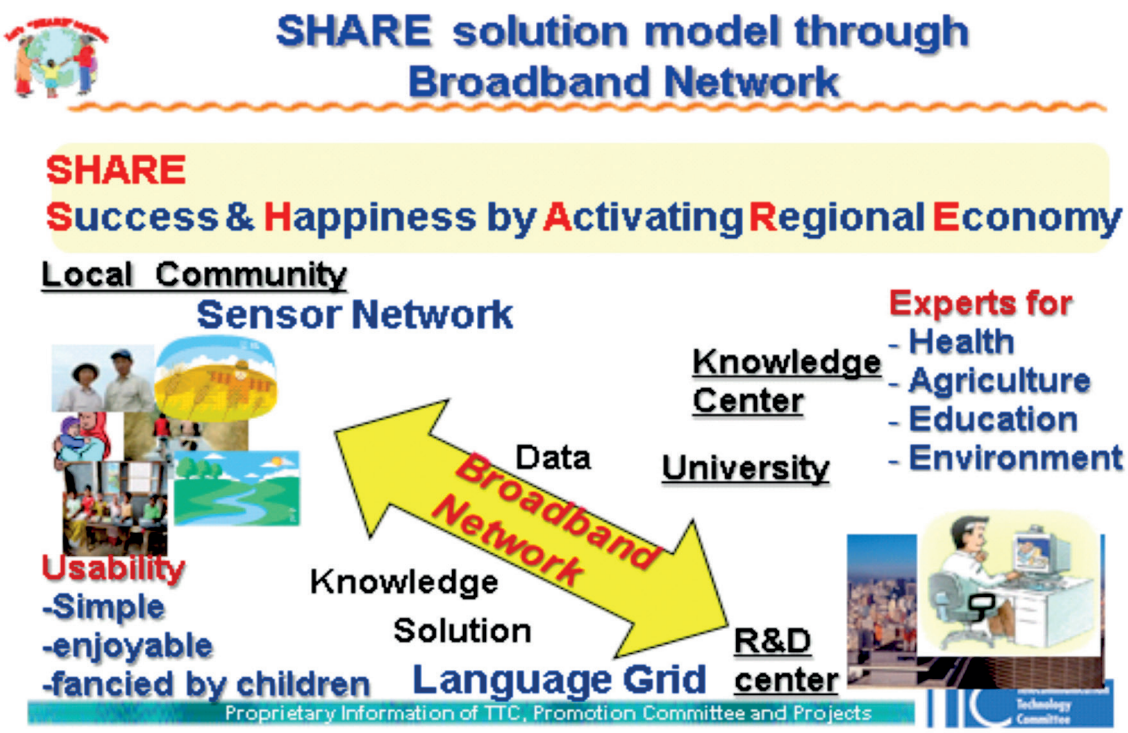


Figure1-1: SHARE solution model through Broadband Network

2. Case Study of Solutions

2.1 Aquaculture Solution in the Philippines

-APT J2 in the Philippines: **"A Broadband Farm to Market Ecosystem for Fisher folk Communities"**

-APT J3 in the Philippines: **"Broadband Farm to Market Ecosystem for Fisher folk Communities"**

The APT J3 project in the Philippines is the continuation of a previous study funded under the APT J2 Programme, which was conducted in CY 2009 to explore the technologies and protocol as needed with a view to designing the implementation (on a pilot scale) of an open access broadband farm to market ecosystem. The Project "A Broadband Farm to Market Ecosystem for Fisher folk Communities" cover activities leading to the pilot deployment and development of a network of sensors, field servers, ICT telecenters and knowledge management systems aimed at enabling a fully functioning research, social, economic and education ecosystem centered around the tilapia raising industry of a well-organized community of fisher folks in the Seven Lakes of San Pablo City, Laguna, Philippines.

2.1.1 Background of the Project

Aquaculture production in the Philippines rapidly grew in the last fifty years (Figure 2-1-1). It is important to note that Aquaculture production has increased twice of marine production (Fig. 2-1-2) and consequently requires strong support to expand further. At the project site, the seven lakes of San Pablo City Laguna, Philippines, has been diagnosed to have a lack of oxygen supply, leading to sudden killing of many fish. The project aims to reduce fish kill thathas been caused by oxygen deficiency in the lake since 2010, by monitoring water quality. The solution was to monitor the dissolved oxygen, conductivity, turbidity, and temperature of the water.

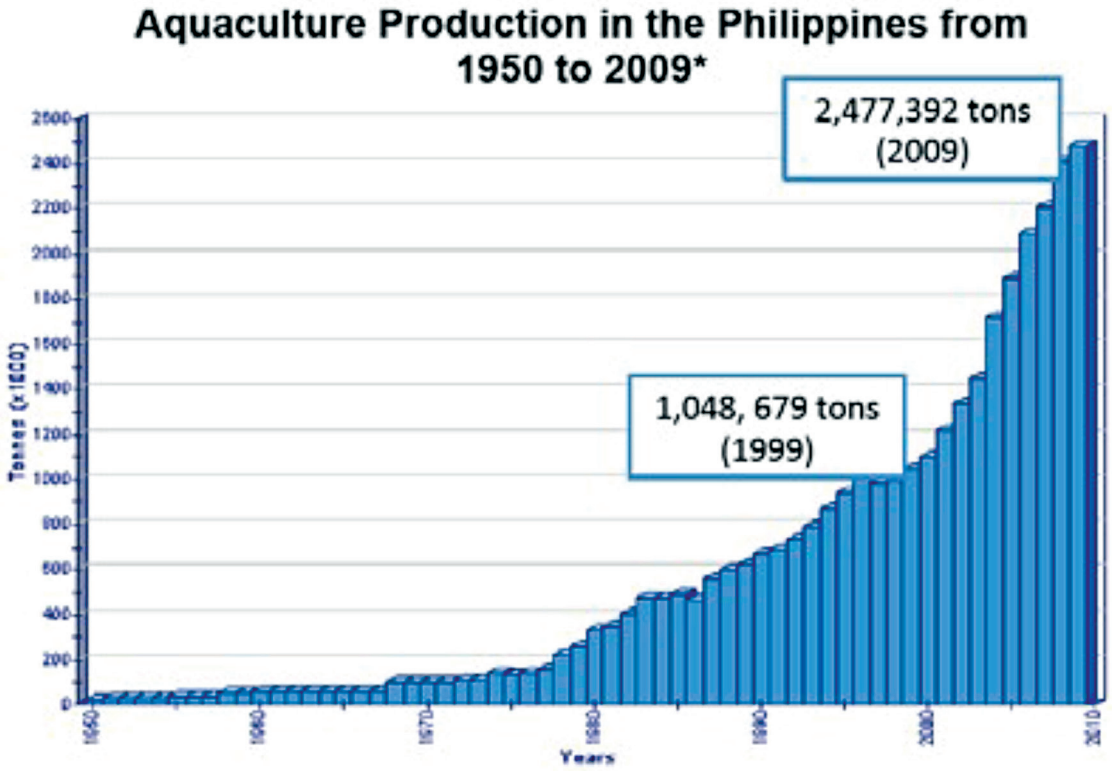


Figure 2-1-1: Aquaculture Production in the Philippine from 1950 to 2009

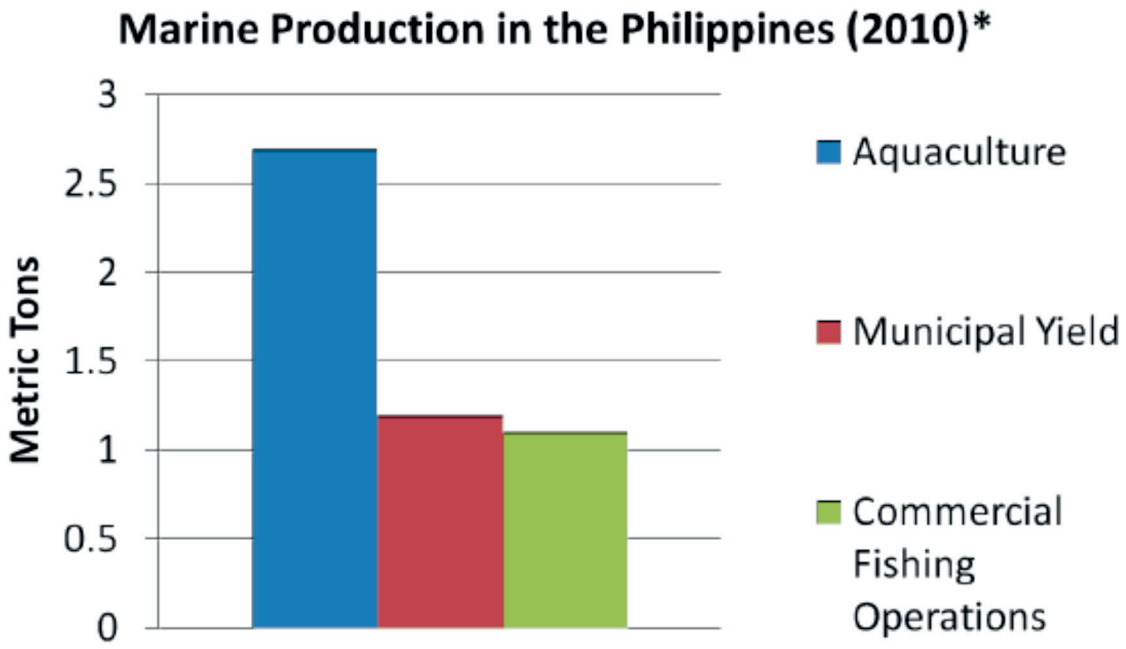


Figure 2-1-2: Marine Production in the Philippine 2010

2.1.2 Objectives

The fish kill problem is one of the biggest problems for fishing communities in the Philippines. Fish kills often happen when there is insufficient dissolved oxygen. Fully polluted water decreases gas absorption in water. Another cause for fish kill is over-feeding, which leads to increased biological demand for oxygen. At the project location, there also exists an issue about the multiple management of the lake resources, which caused misalignment in strategies to upkeep the fishing industry efficiently. The main aim of the project is to reduce fish kill that is caused by oxygen deficiency in the lake. The project constructed a sensor network that measured and monitored the dissolved oxygen level, temperature and transparency of the water. Furthermore it also builds a knowledge database that contributes to market growth and training the young fisher folks. In sum, the data can be viewed on a website in almost real time, enabling lake management best practice.

2.1.3 Project Site

Lake Palacpakin, located 14°06’771’’N and 121° 20’194’E in the city of San Pablo, Laguna is the second largest lake among the Seven Crater Lakes. It has a total surface area of 43 hectares and a maximum depth of 7.5 meters (MSC Technologies Inc., 1998b). It is bordered by the three barangays of San Buenaventura, San Lorenzo and Dolores. The inlet of the lake brings water in from Lake Calibato through the Prinsa River (Figure 2-1-3). Aside from rainfall, this river system is the only source of water for the lake. Water from the lake goes out into a connecting river, and eventually drains into the Laguna Lake.

Figure 2-1-3: Map of seven lakes area

Four sites were sampled, specifically;

Site 1 is at the inlet where water comes into the Palacpaquen from Lake Calibato;
Site 2 is at the pool beside the inlet, where there is relatively calm water;
Site 3 is on the periphery of the lake in between the inlet and outlet, and
Site 4 is at the lake outlet under the bridge.

2.1.4 Partner Organization

・Ateneo De Manila University, Philippines

・Department of Transportation And Communication, Philippines

・Congressional Committee On Science Technology And Education (COMSTE), Philippines

・The Telecommunications Technology Committee (TTC), Japan

・NTT-West, Japan

・Kasetsaart University & NECTEC, Thailand

・Tokyo University, Japan

・National Agricultural Research Office (NARO), Japan

・Agriculture Land Reform Office (ALRO), Thailand

2.1.5 System Configuration

This project designed, built and constructed a sensor network that measured and monitored the dissolved oxygen level, temperature and transparency of the water. Eventually, once internet connection is established in the deployment site, the floating field server would be stationed anywhere in the lake to monitor the different lake parameters. Figure 2-1-4 illustrates the network diagram of the field servers at Palakpakin Lake as the pilot deployment site. As part of the lake monitoring, an unmanned aerial vehicle equipped with camera were also deployed for map stitching and surveying to make sure that the carrying capacity of the lake was maintained.

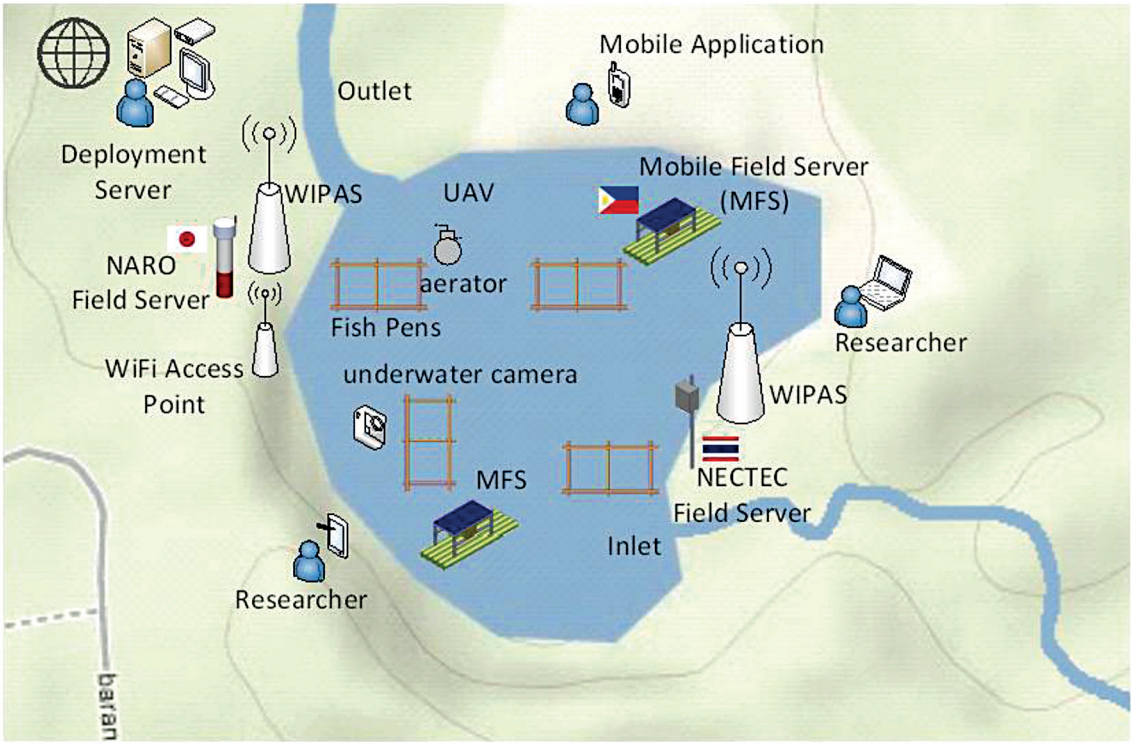


Figure 2-1-4: System configuration in Palapakin lake

The research team used each country's field server, specifically from Thailand and Japan. The Philippine's mobile floating field server was able to capture data about Dissolved Oxygen, conductivity, water temperature under 0.5 and 2.5 m and using GPS location. The Japanese Field Server was able to measure Dissolved Oxygen, pH, air temperature, humidity,-Built in IP camera. The Thai's Field Server-Measures was able to measure Dissolved Oxygen, pH, and humidity (Figure 2-1-5).

Figure 2-1-5: Field Server each country

Furthermore it also builds on a knowledge database that contributes to market growth and training the young fisher fork. In the information system the field server data are all displayed and often data (like pictures taken from the lake) can be added. Through the approach, the research team is able to demonstrate a lake management system.

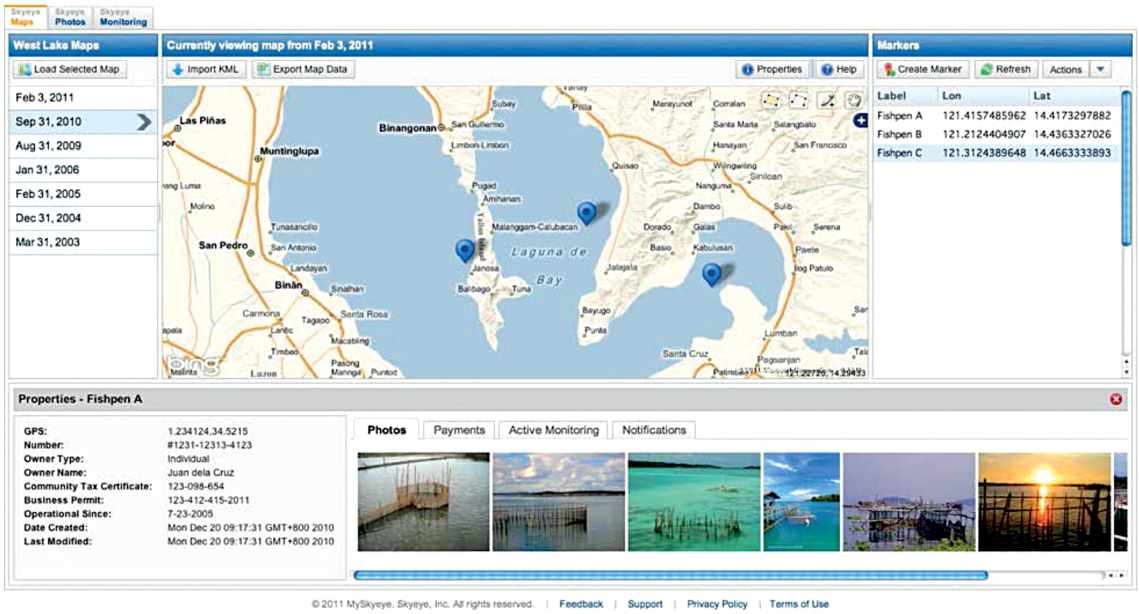


Figure 2-1-6: An information and knowledge base was developed from field servers data

2.1.6 Benefits of Introduction

Figure 2-1-7 shows a fishpond worker removing dead milkfish locally known as Bangus after thousands of them were found floating on Taal Lake in Batangas province, south of Manila, Philippines, recorded onSunday May 29th,2011. Losses from fishkill in northern Philippines are tremendous. Over 800 tonnes of fish die, and these losses from fish kill are estimated to be valued at P150 million. Our project is expected to help to stabilise aquaculture production and income for fisher folk through the Philippines, once standardized sensor systems are developed with full telemetry web information.

Figure 2-1-7: 800ton fish die in Taal Lake

2.1.7 Conclusion (Future Prospects)

A first cut network design has been completed. The sensor suite should include data on dissolved oxygen, conductivity, turbidity and temperature. First cut sub-system prototypes, the purpose of which would be to clarify design and implementation issues needed to be successfully deployed in such a system for the J3 Project Phase. After the project, AIC (Ateneo Innovation Center) continued the development of a newly developed system which has expanded the sensor system to include an aerator that pumps oxygen into the fish ponds, when they see the oxygen levels being really low, turn on aerator system by simply texting the field server. All data appears on a website updated every 30 minutes.

2.2 e-Education Solution in Malaysia

-APT J2 in Malaysia: "Bridging the digital divide in Remote rural areas: a universal Playground for children"

-APT J3 in Malaysia： "Technology enhanced solutions for Remote rural communities in Malaysia to facilitate Development of Learning and Preservation of local knowledge and create health awareness and practice for healthy living"

2.2.1 Background of the Project

Bario is a remote rural location on the island of Borneo, close to the Malaysia-Indonesia border between Sarawak, Malaysia and Kalimantan, Indonesia. There are twelve longhouses in Bario which are homes to about 1,000 people. While there are many locations in Sarawak that can be categorized as remote rural, Bario was selected because of its isolated geographical location.

Before the Universiti Malaysia Sarawak's project commenced in 1999, Bario did not have 24-hour electricity supply and water was available only through gravity-fed systems. There was also no sophisticated telecommunication service available, and communication was largely conducted using radio calls, as well as by passing messages to departing passengers、and getting messages from passengers arriving at the local airport.

In April 1999, UNIMAS started the e-Bario project with the general aim of bridging the digital divide between urban and rural communities. In order to achieve this, baseline data describing the technological needs and readiness of the Bario's community was obtained, and this was soon followed by the introduction of ICT to the community. The technologies deployed were VSAT (telecommunication system) which allowed the Internet connectivity to the Bario telecenter. Power is supplied by photo-voltaics (solar system) with computers there. Facilitated by UNIMAS e-Bario researchers, the people of Bario began connecting with the rest of the world using ICT, and this marked the first phase of the project implementation.

2.2.2 Objectives

This project proposed to implement a multifaceted approach to provide efficient technology-enhanced solutions for remote rural communities in Sarawak, Malaysia. Specifically, the objectives of the project are to establish a optical LAN infrastructure for two schools and a health clinic in Bario; to develop e-Education solution which serves as digital learning repository to complement formal teaching and learning experiences of the school community in Bario, Ba'kelalan, Long Lamai and Larapan Island; and to propose a sustainable health check system for use by community members in these identified remote rural communities in Sabah and Sarawak.

The optical LAN infrastructure is an important linkage that will enable the other two solutions (i.e. e-Education and e-Health) to be developed in these remote rural areas. The e-Education solution aims to design and develop a digital learning repository in five areas of interest: health sciences, ICT, communication, living skills, and indigenous knowledge and culture. The e-Health check system is to be introduced to children and young adults in the community, to raise awareness about regular health checks which need to be performed periodically to detect and monitor common illnesses.

Overall, the objectives of the project state that:

- Implement a multifaceted approach to provide efficient technology-enhanced solutions for remote rural communities in Sarawak, Malaysia
- Establish optical LAN infrastructure for schools and health clinic in Bario to enable

Develop an e-Education solution which serves as digital learning repository to complement formal teaching and learning experiences of the school community in Bario, Ba'kelalan, and Long Lamai in Sarawak and Larapan Island, Sabah

Develop an e-Health solution to provide a sustainable health check system for use by community members in these identified remote rural communities in Sarawak and Sabah.

Document the impact of e-Education and e-Health solutions on educational experiences and health awareness of the community members in these remote rural locations

2.2.3 Project Site

The project is mainly conducted at Universiti Malaysia Sarawak (UNIMAS) campus in Kota Samarahan, and Bario, the Kelabit Highlands. Figure 2-2-1 is a map of Sarawak indicating the locations of both venues

Figure 2-2-1: Location of Bario and Kuching on the Borneo map

Bario is a remote rural location on the island of Borneo, close to the Malaysia-Indonesia border between Sarawak, Malaysia and Kalimantan, Indonesia. The only practical way to get to Bario is a one-hour flight on a 19-seater Twin Otter airplane from Miri, Sarawak. At present, there are no gravel roads leading into Bario, and a land journey requires a river journey and a 14-day-long trek across forested mountains.

The majority of the people in Bario are Kelabits, one of the smallest ethnic groups in Sarawak. They are generally farmers, growing the famous organic, fragrant Bario rice, and the sweet highland pineapples. While there are many locations in Sarawak that can be categorised as remote rural, Bario was selected because of its isolated geographical location.

The Bario children go to the Bario Primary School which provides education from Primary 1 to Primary 6 or age 7-12. Bario Secondary School provides education from Form 1 to Form 3 (ages 13-15) only. When students finish school in Bario, they have a choice to either go to two nearby towns, Miri or Marudi, to continue their studies. Most students attending the primary and secondary schools in Bario stay at the school dormitories because their own homes are miles

away from the location of the schools. Today, the schools have received a growing number of Penan (who practice nomadic values and way of living) and Sabans (who migrated from another remote rural area for socio-economic needs), and both of these ethnic groups are of minority ethnic in Sarawak, living within close proximity to the Bario Highlands.

2.2.4 Partner Organization

- Universiti Malaysia Sarawak (UNIMAS), Malaysia
- The Telecommunication Technology Committee (TTC), Japan
- NPO Pangaea, Japan
- Japan Advanced Institute of Science Technology (JAIST), Japan
- Nippon Telegraph And Telephone Corporation (NTT), Japan
- Mitsubishi Electric Corporation, Japan

2.2.5 System Configuration

2.2.5.1 Fibre Optic Network

Figure 2-2-2 shows the schematic view of optical fiber network in Bario. We installed optical fiber from telecenter (eBario) to primary and secondary school and from telecenter to New hospital and current clinic.

One fiber count optical drop cable was used for aerial and one fiber count indoor optical fiber cable with SC connector was used for indoor. The existing poles once built for an abandoned hydropower supply plan were utilized to lay on optical fibers, Optical splitter is located at the pole between primary and secondary school and the pole between new hospital and current clinic, respectively. Total fiber length is about 2.5 km from eBario to secondary school, about 2.3 km from eBario to primary school, about 500m from eBario to a new community clinic, and about 200m eBario to the existing clinic, respectively.

Bario Optical Fiber Network Configuration

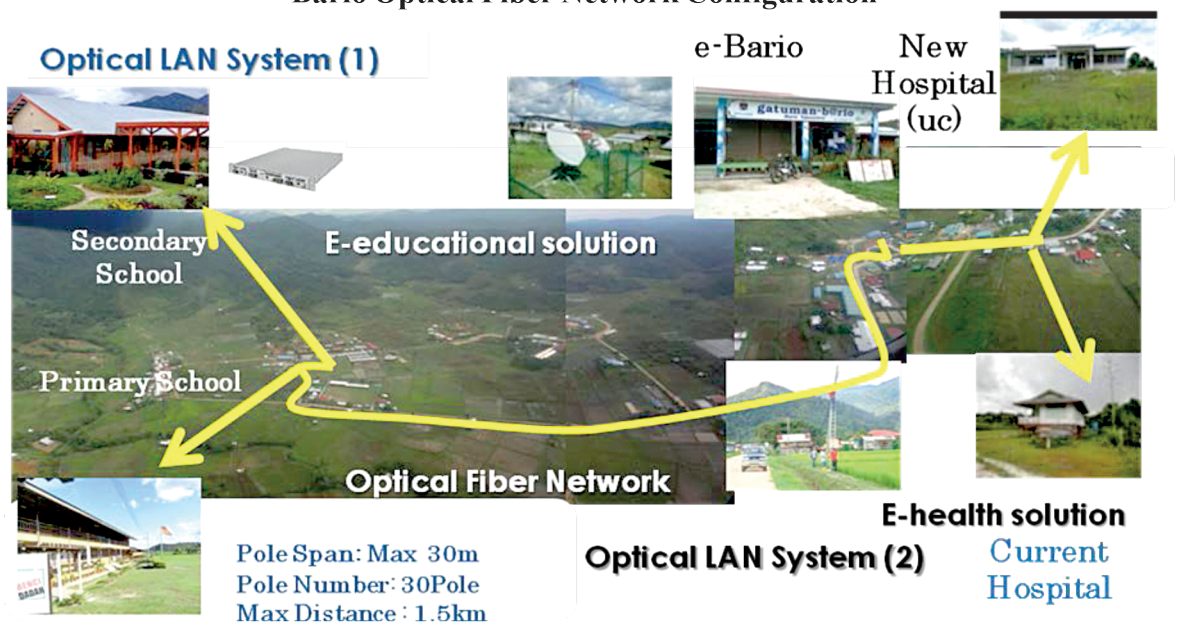


Figure 2-2-2: Optical LAN System

2.2.5.2 Optical Network System

Figure 2-2-3 shows the GE-PON network for APT J3 Malaysia Project at Bario. The GE-PON network is constructed over the optical fibers laid by Commuture in October, 2011. As shown in the figure, the GE-PON network consists of the following two PON lines:

Line A from TeleCenter to the Primary School and the Secondary School, and Line B from TeleCenter to the Current Clinic and the New Hospital.

Both Line A and Line B are terminated at the local telecenter by the OLT (Optical Line Terminal). The OLT relays packets over Line A or Line B to a server or a router via a L2 switch. The other ends of Line A and Line B are terminated by ONUs. An ONU has a LAN port to accommodate a PC, an L2 switch, or a WiFi BTS.

Bario Network System Configuration

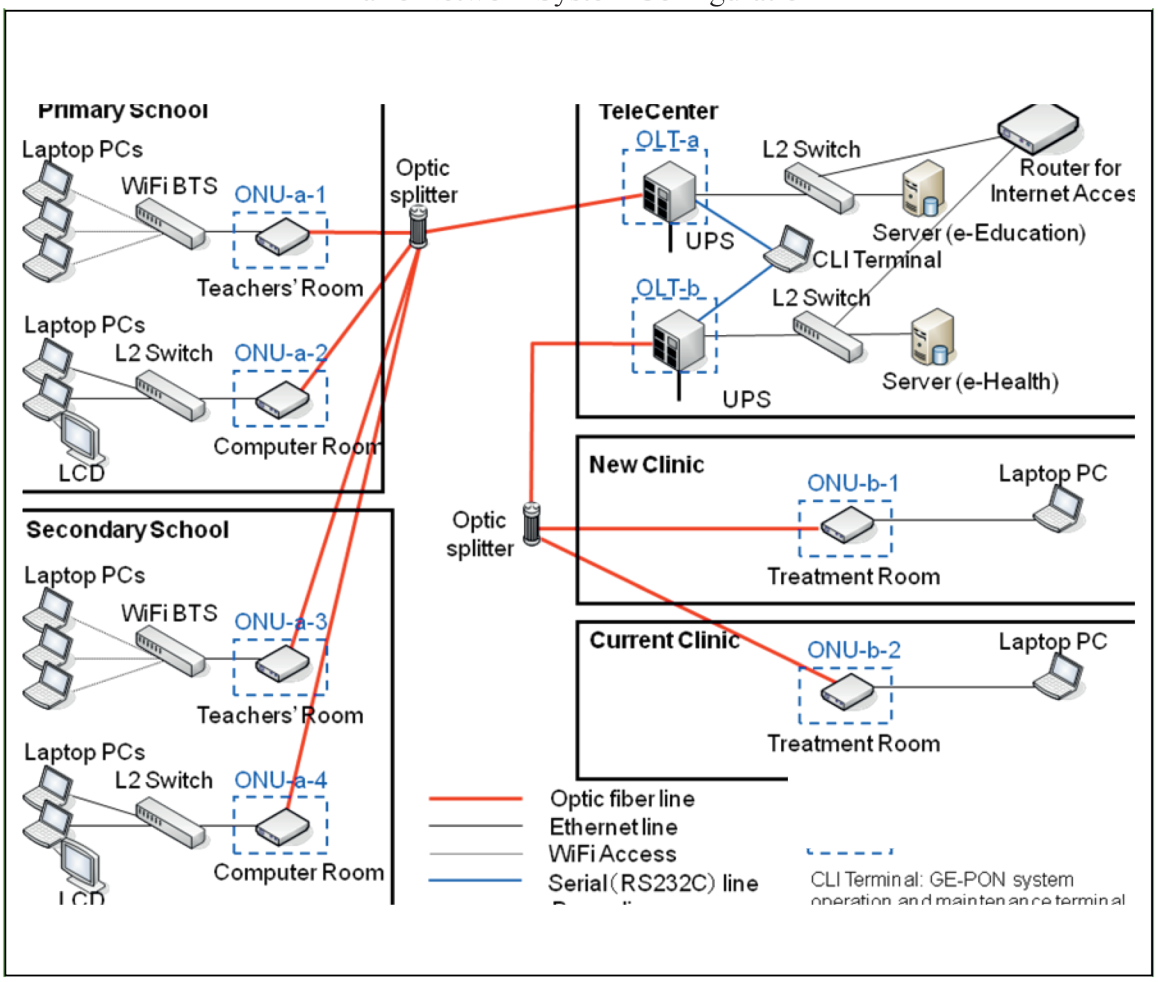


Figure 2-2-3: Bario Network System Configuration

2.2.5.3 WiFi Implementation

At the ONU termination in the two schools, the network connection was further extended to the common student activity areas via WiFi access point. The tablets required WiFi connection to the network as that is the only means to connect. WiFi access point allowed multiple tablets to connect to the GE-PON network concurrently. The WiFi access points deployedwere compliant to the IEEE802.11n standard for supporting maximum data rate to take advantage of the higher performance GE-PON system installed. The WiFi coverage was within 50 meters from the WiFi access point.

2.2.5.4 Server Implementation

There was a total of four servers being deployed in the e-Bario telecentre for various applications provision over the GE-PON network. The application servers are as follow.

a) e-Health Database Server

b) Viscuit Application server

c) Education Moodle Server

d) Backup Server for e-Health Database

Among the deployed servers, the e-Health Database server is a standard desktop computer comes complete with a monitor display, keyboard and mouse. The server is running on Ubuntu platform.

The Viscuit Application server is a notebook computer that hosts all the proprietary Viscuit application services. Viscuit enables users who is not familiar with computers to create graphical animation by utilizing drawing tools. The advantage of using Viscuit is to teach users the fundamental concepts of basic programming.

The E-Education server runs on a Windows platform. The server hardware utilizes the green computing concept or known as green server in that it is able to utilize energy, either from the telecentre, or from its own dedicated solar panel and battery system. The green server is a highly power optimized computer system built from Intel Atom processors and other power optimized system components such as solid state drive etc. Its power supply system is designed for native solar power input to take advantage of minimizing the power conversion loss throughout. The power of Green Computing System is supplied through a customized portable solar charging system with battery that can be installed almost instantly anywhere due to is small in size (battery and controller box dimension is around 10" x 12" x 7" and solar panel size is around 4' x 2.5').

The backup server for e-Health solution is a replica of the e-Health database server where its hardware is similar to that used by the E-Education server, which adopts the Green Computing System.

2.2.5.5 Solar Power Implementation

A separate solar power system was designed and deployed as additional electrical power input for the e-Bario telecentre. Figure 2-2-4 shows the solar panel, which is installed on the telecentre's rooftop. The size of this solar power system is 1.3kW. The main purpose of the system is to provide power specifically for the network equipment such as the GE-PON, switches, routers and servers deployed for the project. This solar power system is separated from the main telecentre solar power system in order to prevent single point power outage in the telecentre that maycause power blackouts to the critical network equipment. Hence, connectivity reliability can be further improved.

Figure 2-2-4: Solar panel installation on bario telecentre's rooftop

2.2.6 Outline of the Solution

2.2.6.1 e-Education system

There are several outputs identified for this aspect of the Digital Learning Repository (DLR). These are the features available on the E-Education system:

a) Creating an Android application which will be the primary input tool for the children to capture data and content

b) Creating a customized access and interface to an open source Learning Management system, which will be used to assemble and further develop the data and content captured by the children

c) Creating a user-friendly localized version of Viscuit, an open source application for children which teaches them to learn about basic computer programming using drawing tools

To best understand the process of data collection and processing between users and stakeholders in the project, an illustration of the scope of work for this project is presented in Figure 2-2-5.

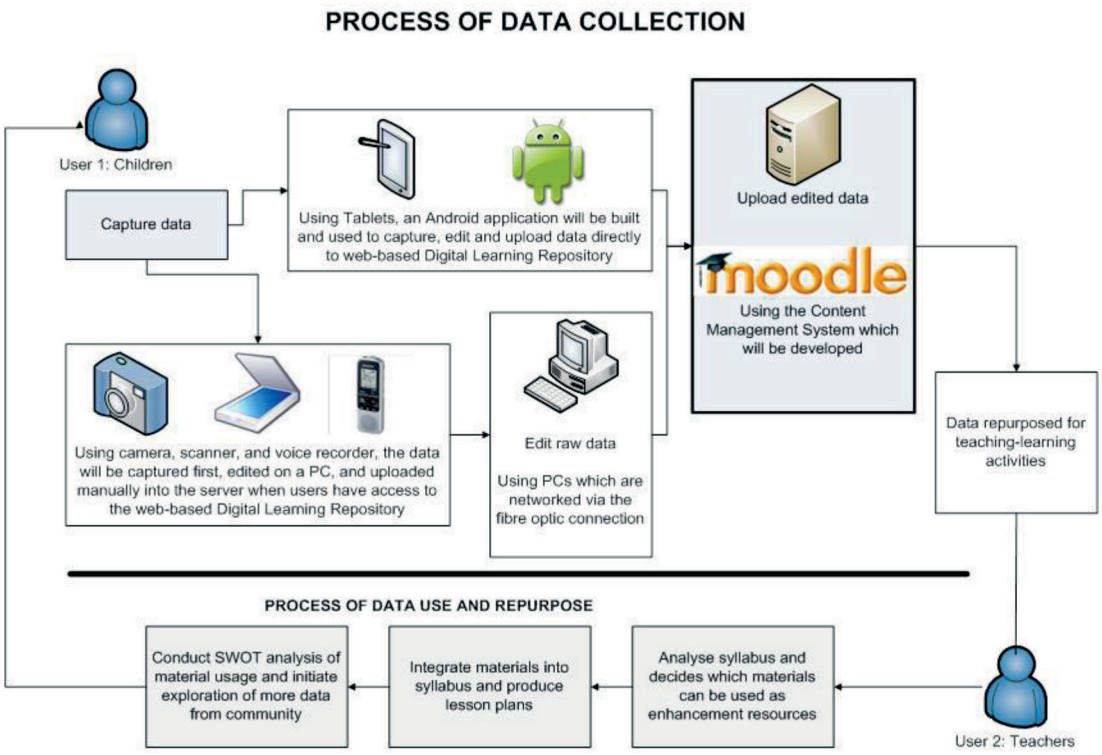


Figure 2-2-5: Process of Data collection

2.2.6.2 e-Health Check system

The e-Health check system for this project is designed to record basic health data (height, weight and blood pressure) of the local population. The system is developed by researchers in JAIST, and it was introduced to children and young adults in the community to raise awareness about regular health checks which need to be performed periodically to detect and monitor common illnesses.

During the installation of the system, community members from a village called Ulong Padang in Bario learned how to use all the health equipments packaged in the E-Health Check system. They were also taught how to create a health check database, which records individual weight, height and blood pressure measurements of people in the local community. Using the fiber optic network, the data collected from users could be transmitted to the local health clinic, and the medical officers could be alerted if there was any anomaly in the data. With a systematic database of information available, dissemination of important health information and interventions can be deployed in a more strategic and sustainable manner.

2.2.7 Benefits of Introduction

2.2.7.1 e-Education

The project enabled the children of a remote rural community in Bario to utilise technology to preserve elements of their culture, language, traditional songs, local myths and living legends into a digital form. The children are able to complement what they learn in school by adding on knowledge from their own local values and culture. The fibre network connection connected the children from their schools to the local telecentre, which opened new ways for them to connect with the rest of the world.

Their teachers at the schools also benefited from the availability of the mobile tools and applications and internet connection as well, because they are now able to use digital resources to

strengthen the contents of their lessons. With the children's activities using the mobile technology tools, the teachers are also able to tap into the children's digital products and integrate the contents with topics they teach in the classroom.

Children and teachers in Bario are encouraged to use the mobile tools as much as possible, and they are not confined to only activities designed for the programme, in order to maximise the potential of mobile learning for learning and teaching.

2.2.7.2 e-Health

The introduction of E-Health Check system which includes patient monitoring system, intends to promote health awareness among the communities in Bario. Since the elderly make up the majority of the local population, plus the lack of professional health personnel on a permanent basis in Bario, health monitoring is a key concern for Bario residents.

The Health Check system was designed by researchers in Japan, and it was deployed earlier at Tanah Datar province in West Sumatera, Indonesia. The same set was introduced in Bario, to enable the local community to conduct and manage their own health checks at their convenience. The Bario community has one health clinic established at the heart of Bario, and medical officers are flown in every two weeks to conduct physical checks on those in need.

With the introduction of the E-Health Check System, the community was excited to know about their health status. They were pleased that they were able to conduct their own checks, and data from the checks were transmitted to the Health Check database located at the local clinic. It enabled a systematic record of health checks, making it easier for medical officers to obtain records about the health of people in Bario.

2.2.8 Conclusion

This pilot project was the first trial to introduce fiber optic network into rural areas in ASEAN countries and indicated its effectiveness. The research team continues to learn and to seek solutions using ICT to help extend the indigenous knowledge and culture of these communities to enable them to prosper and improve their lives and well-being even when living in remote rural locations. The focus remains on developing the ICT literacy skills and knowledge of children in remote rural areas, because these children are the hopes of their unique communities to propel their social, economic , cultural and intellectual developments into the future.

2.3 e-Environment Solution in Indonesia

-APT J2 in Indonesia: "Exploration of ICT's Potential in Peatland Environmental Conservation to Address Climate Change"

-APT J3 in Indonesia: "Promotion of e-environmental community with ICT solution in Central Kalimantan, Indonesia"

2.3.1 Background of the Project

In the later half of 1990's the development of peatland in Central Kalimantan, Indonesian Government planned and executed Mega Rice Project (MRP) as a measure in tackling poverty issue. However, it caused environmental destruction of peatland that entailed the social issue of the restoration and conservation of peatland.

Failure of the MRP was caused by unrealistic dimensions of channels, ignoring local knowledge and culture, and it has consequently affected peatland to become very dry in dry season and very susceptible to peat fire, which subsequently produced a large amount of CO2 every year. Thus, deforestation and the degradation of peatland have been the main causes for Indonesia being one of the world's largest emitter of greenhouse gases. Air pollution by peat fire smoke has been threatened human health of neighboring countries.

As the counter-measure to restore the peatland, University of Palangka Raya, through the Center for International Cooperation in Sustainable Management of Tropical Peatland (CIMTROP), has been working for the restoration of the peatland around the university premises for more than 15 years. One of its main activities is to construct the simplified dams on the canals to maintain the water level of the peat land to avoid peat fire from occurring.

However, researchers must personally attain access to the dam sites for observation and information or data gathering, whilst the sites are rigorously challenging to gain access to, and the effort is time consuming.

Thus, it is considered essential to establish a remote monitoring system using ICT technologies, which will make the process of the operations quicker, more efficient, and a set of data series could be recorded.

2.3.2 Objectives

To establish a remote monitoring system for dams and the peatland using ICT technologies, CIMTROP, KOMINFO (Ministry of Communication and Information Technology), and TTC performed APT J2 project APT J3 project.

The projects aims:

1) To conduct a feasibility study towards the establishment of the ICT remote monitoring system at rural area. The ICT remote monitoring system is to monitor a simplified dam and peatland so that the researchers can see the visual image of the dam and get the information of the water level remotely at the new data center where the research team of University of Palangka Raya has the facilities for his activities.
2) To encourage young researchers to become familiar with the remote monitoring system and also to enhance and improve their understanding, knowledge, and skills about ICT technologies
3) To integrate soil sensors at a new monitoring point and to make a test of a new firefighting agent that is expected to act as a preventive measure as well as a counter measure for peat fire.

4) To establish a telecenter where the students and residents will be educated on knowledge about ICT, for instance, the various uses of the Internet and the use of technology for environmental conservation.

5) To share the data collected from the system with joint researchers in the Asian countries.

2.3.3 Project Site

Figure 2-3-1: Location of the Project in Perspective to Larger Indonesian Map

The basic operation of this project is conducted at the site of University of Palangka Raya, in close proximity to Palangka Raya city, the capital city of Central Kalimantan Province, as shown in Figure 1. It takes around 1.5 hours by plane from Jakarta to Palangka Raya. Based on 2010 population census, the population of the municipality stood at 220,223.

As shown in Figure 2-3-2, the project site is located between the two big rivers; Kahayan River and Sabangau River, and canals that were made to drain the water to those rivers from the peatlands that were designated to be developed into rice field as stated on Mega Rice Project objective. Therefore, the peat became dry and consequently it became susceptible to fire.

Figure 2-3-2: Map of Palangka Raya and Pulang Pisau Regencies

2.3.4 Partner Organization

・University of Palangka Raya (UNPAR)

・A center for international research collaboration for tropical peatland (CIMTROP).

・Ministry of Communication and Information Technology (KOMINFO)

・The University of Kitakyushu, Japan

・The Telecommunication Technology Committee (TTC), Japan

・Nippon Telegraph and Telephone Corporation (NTT), Japan

・NEC Corporation, Japan

2.3.5 System Configuration

The ICT Network configuration is shown in Figure 2-3-3. In the 2010 APT-J2 project, one Data Center and three monitoring points, A, B, and C have been constructed. The Data Center was established specifically with a data server to compile the data sent from the towers. Four 25m Towers were erected, one at the Data Center and three at the designated measuring point A, B and C to establish radio link.

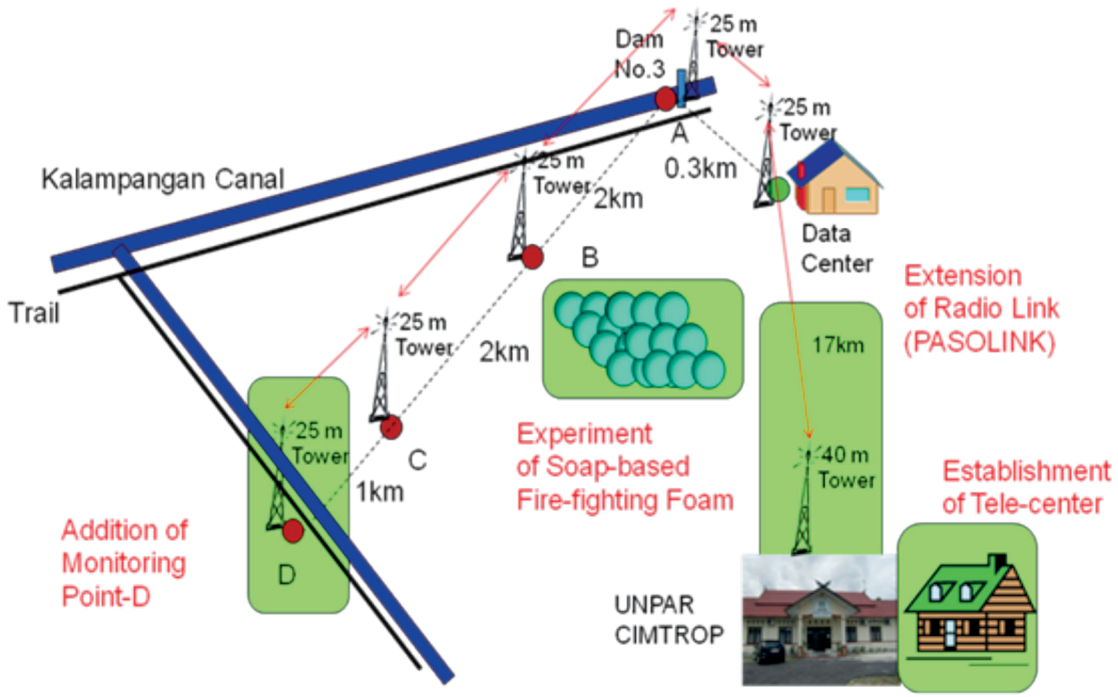


Figure 2-3-3. Network Configuration of Remote Monitoring System

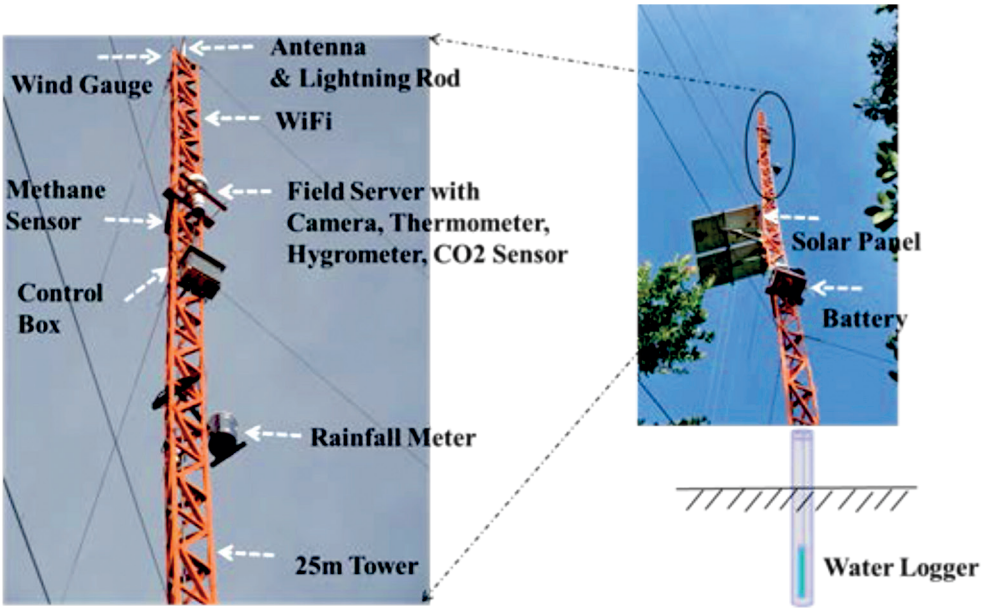


Figure 2-3-4: Tower at Measuring Point A,B and C

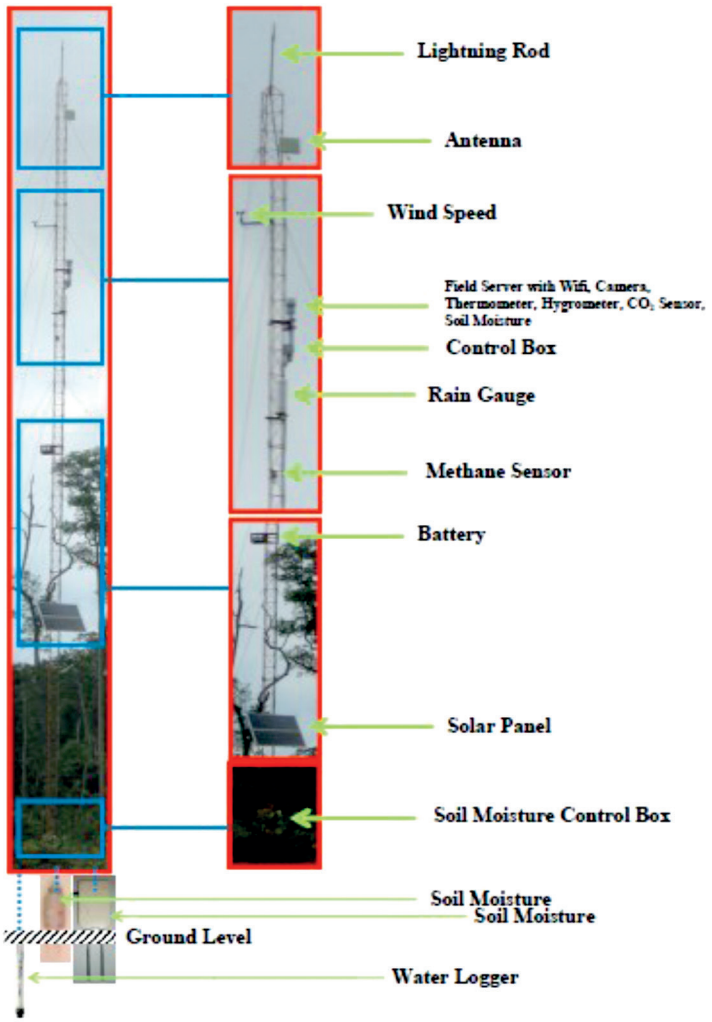


Figure 2-3-5 Tower at Measuring Point D

The equipment was mounted on each tower which consists of a water level sensor in the water, a field server, solar panels with battery, and WiFi equipment for radio system.

The field server is also equipped with WiFi interface and also consists of a thermometer, a hygrometer, a rain gauge, an anemometer, a CO2 sensor, a methane sensor.

In 2011APT-J3 project, Point D was newly provided, which lies on the extension of the straight line from Point A to C and is located in the natural forest near Taruna Canal. In order to evaluate the effect of the fire-fighting foam, the soil sensors were installed at Point D.

A high speed data link, which is called PASOLINK system, was installed to connect the Data Center and CIMTROP office, so that all the collected data at Data Center are transmitted to the data server in CIMTROP office.

The list of the equipment and materials provided in this system is shown in Table 1.

Table 2-3-1: Equipment and Materials List

No.	Item	Quantity
1. Field Server		
1.01	Field Server	4
1.02	Thermometer	4
1.03	Hygrometer	4
1.04	Rain Gauge	4
1.05	Anemometer	4
1.06	CO_2 Sensor	4
1.07	Methane Sensor	4
1.08	Solar Panel	4
1.09	Battery	4
1.10	Battery Charging Controller	4
1.11	WiFi Equipment	5
1.12	Software to Display the Collected Data	1
1.13	Accessories	1 lot
2. Hydrograph		
2.01	Water Level Sensor	4
2.02	Connecting Cable	4
2.03	RS232C-USB Conversion Cable & Software CD	1
3. Data Logger		
3.01	Data Logger	2
3.02	Soil Moisture Sensor	2
3.03	USB Adapter Cable	2
3.04	ECH2O Software CD	2
4. Data Server		
4.01	Laptop	2
5. 25 m Tower		
5.01	25 m Tower	4
5.02	40 m Tower	1
6. Soil Sensors		
6.01	Thermocouple Thermometer	3
6.02	Exchanger	3
6.03	Transmitter	3
6.04	50 m cable	2
6.05	Soil Moisture Sensor	3
6.06	25 m cable	4
6.07	5 m cable	3
6.08	Basic Logger	1
6.09	TDR Soil Moisture Sensor	1
6.10	Logger Net-software	1
6.11	Case	1
6.12	USB-RS232C Exchange Cable	1
6.13	Accessories	1
6.14	Nozzle for Fire Hose	1

6.15	Computer for Data Analysis	1
6.16	Magnetic Stirrer	1
6.17	Ultracold Freezer	1
6.18	pH Electrode	1
7. PASOLINK Subsystem		
7.01	Indoor Unit	2
7.02	Antenna High Performance Single Pole	2
7.03	ODU-IDU IF Cable	2
7.04	Rectifier Unit	2
7.05	Installation Materials	1
8. Data Server & Software for Telecenter		
8.01	Desktop PC as Data Server	1
8.02	Desktop PC as Data Server for Telecenter	1
8.03	Desktop for Telecenter	1
8.04	Contents Development, Equipment, and Consultation	1

2.3.6 Outline of the Solution

a) Through the APT J2 project and J3 project, a remote monitoring system that gets data from all measuring points without having to access the actual site was developed. The following components were completed in the J2 project.

- A new Data Center Building
- Five units of painted towers (25 m) with fence at the Data Center, with four measurement points at Point A, B, C, and D
- Four data loggers for water level measurements at Point A, B, C, and D
- The sensors for the measurement of temperature, humidity, wind speed, rainfall, methane amount, and CO_2 amount at Point A, B, C, and D
- Video camera at Point A, B C, and D; wireless equipment at each tower

b) The following components were monitored at each point and transmitted through WiFi radio link to the data server installed at the Data Center.

- Water level of the canal (at Point A) and of the peatland (at Point B, C and D)
- Rainfall, external temperature, humidity, wind speed, and CO_2 and methane amounts
- Soil temperature and water content (at Point D)

Table 2-3-2: Typical Data of Measured Components [temperature, humidity, wind speed, methane and rainfall]

Time	CH1	CH2	CH3	CH4	CH5	CH6	CH7
	Temp.	Humidity	Wind Speed	CH4	CO2	Rainfall	Water Level
	(°C)	*(RH%)*	*(m/s)*	*(ppm)*	*(ppm)*	*(mm)*	*(mm)*
28/12/2012 6:44	30.31	22.05	3.29	0.54	998.9	1215	167.58
28/12/2012 7:43	29.49	20.37	0	0.55	998.9	1215	176.97
28/12/2012 8:43	31.62	20.45	63.13	0.54	728.1	1215	185.03
28/12/2012 9:15	28.99	20.02	62.79	0.53	672.6	1215	179.46

28/12/2012 10:15	31.74	19.65	62.65	0.52	512.4	1215	188.61
28/12/2012 11:15	34.31	20.75	0	0.48	514.5	1215	203.95
28/12/2012 12:15	30.91	18.86	0.85	0.47	610	1215	189.99
28/12/2012 13:15	27.58	19.7	1	0.55	804.5	1215	173.36
28/12/2012 14:15	28.74	19.92	0	0.55	927.7	1215	175.73
28/12/2012 15:15	30.33	19.38	63.52	0.54	660	1215	185.5

Note: #Rainfall data is cumulative. The same rainfall value means there was no rain.
#Water level data is the depth from underneath the canal to the water surface.

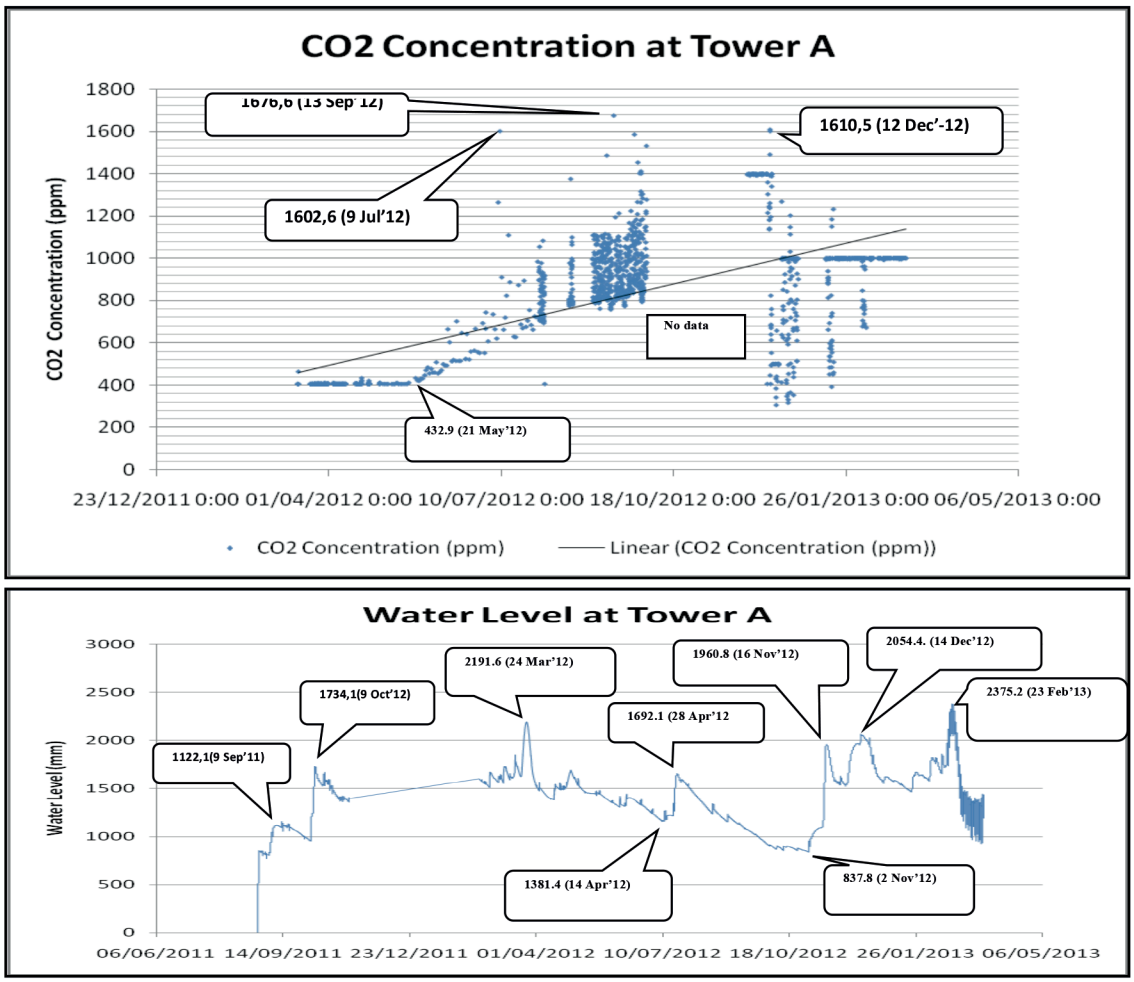


Figure 2-3-6: CO_2 Concentration and Water Level Fluctuation at Tower A

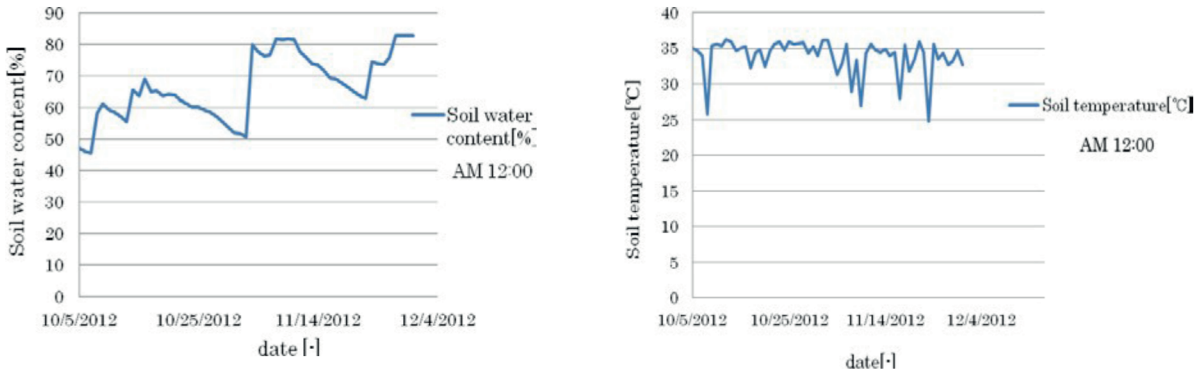
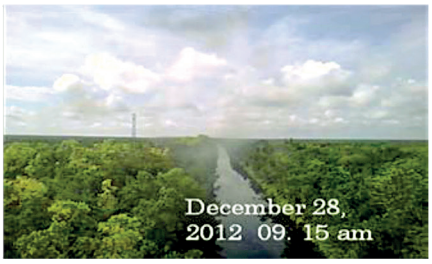


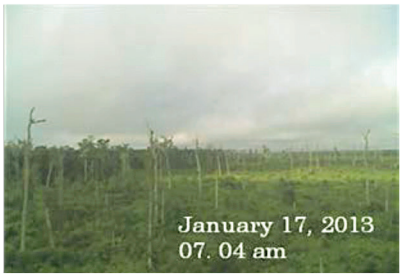
Figure 2-3-7: Soil Water Content and Temperature at Point D



Visual Image at Tower A

Visual Image at Tower B

Visual Image at Tower C



Visual Image at Tower D

Figure 2-3-8: Visual Image from the Tower at Each Measurement Point

c) A high speed data link, which is called the PASOLINK system, was established to connect the Data Center to the CIMTROP office so that all the data collected at measurement points A, B, C, and D may be monitored at the CIMTROP office in University Palangka Raya.

d) To test a new firefighting method, an experiment using soap-based firefighting foam was conducted on the peatland. The soap-based fire-fighting foam was newly developed in Japan and is expected to prevent and extinguish peat fire. The effect of the fire-fighting foam is monitored by the soil sensors installed at Measurement Point D.

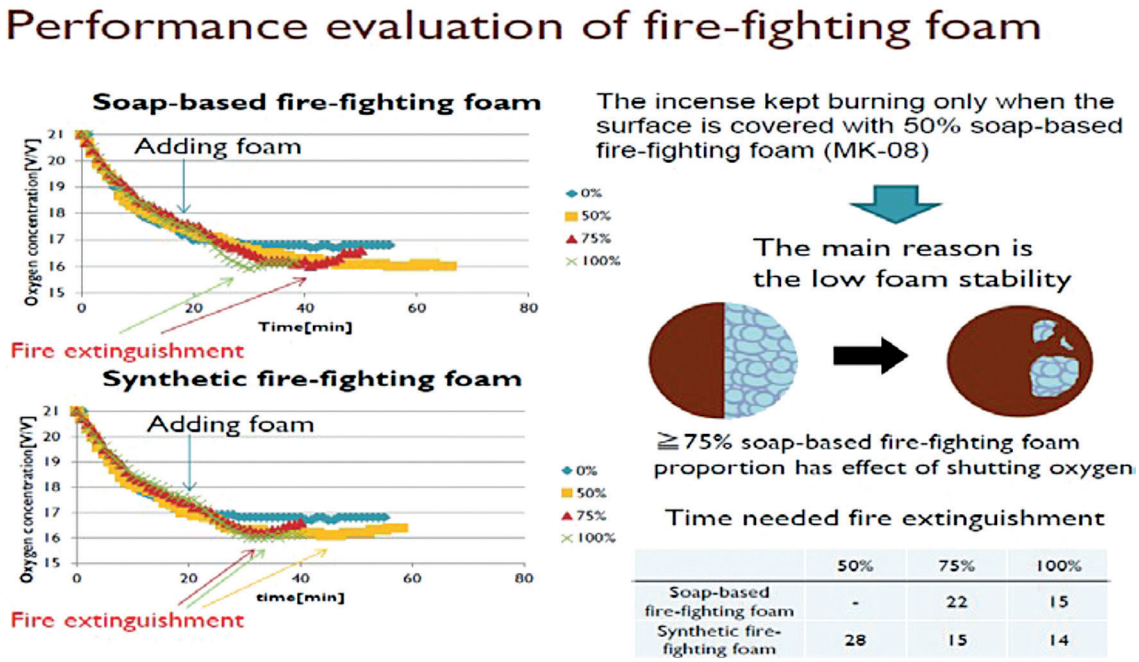


Figure 2-3-9: Performance Evaluation Between Soap and Synthetic Firefighting Foam

e) A Telecenter was established in the building next to the CIMTROP office to provide e-Education services to the residents who live near the peatland.

Participants from Senior High School

Residents from the Villages

Figure 2-3-10: e-Education Services for the Residents

2.3.7 Benefits of Introduction

a) Using the ICT remote monitoring system, the researchers can see the visual image of the dam and get the data collected by various sensors for the measurement of water level, temperature, humidity, wind speed, rainfall, methane amount, CO_2 amount, soil temperature, and soil moisture without having to go to the peat land site.

b) The monitored data from each measurement point will be useful in designing the dam and blocking the canal to restore the hydrological status of the damaged peatland.

c) The project team conducted a feasibility study towards the establishment of an ICT remote monitoring system in a rural area. The team could also make young researchers and scholars of the University of Palangka Raya to be familiar to the remote monitoring system. The system provides them opportunities to enhance their understanding, knowledge, and skills about ICT technologies and to implement ICT technologies for environmental monitoring.

d) At the Telecenter, e-Education services were provided to the residents who live near the peatland. We have conducted classes for farmers, students in elementary school, students in high school, and college students. They were taught introduction to the internet and basic knowledge on e-Education, and also to understand the environment and the importance of peatland conservation.

e) Based on the experiment using soap-based firefighting foam, it was proven that the firefighting foam shuts off oxygen and radiant heat so that the surface fire can be extinguished, but the soil underground was still smoldering. Based on the analysis of the collected data, we will continue to improve its efficiency and conduct more experiments using firefighting foam in the peatland.

2.3.8 Future Prospects

a) Utilizing the results of the APT-J2/J3 project activities, it is expected that in the future, the Indonesian Government (Central and Local) through the University of Palangka Raya would establish a wide-area remote monitoring system for the restoration of the peatland.

b) These activities could demonstrate the successful promotion of an e-Environment community with ICT solutions that will be recognized as a best practice to be replicated and scaled-up in rural areas in Indonesia and other APT members' countries to bridge the digital divide in remote and rural communities.

c) In considering who will be responsible for the maintenance of the regionally and globally important monitoring systems established, we should consider how we can work and contribute together so that this facility will continue to work and collect data so that we do not lose the investment.

2.4 e-Healthcare Solution in Indonesia

- APT J3 in Indonesia: "Promotion of e-local community with ICT solution in Indonesia" ICT Development Programme for Supporting ICT Pilot Projects in Rural Areas 2008 [J3]

2.4.1 Background of the Project

The TTC Promotion Committee is engaged in providing system solutions to the challenges of the modern society, such as digital divide and economic disparity in rural areas of Southeast Asia, through the SHARE concept.

This Project studied methods to improve healthcare services in Tanah Datar, West Sumatra, Indonesia, where 350, 000 people are living but with only one hospital and some small local clinics. The number of doctors is about 50 and they work without any PCs or databases connected to the network. All departments in the hospital and clinics operate independently from one another and all medical documentation processing was handled manually.

This Project established the "Health Checkup Service" that allows automatic collection of the height, weight, and blood pressure data from measuring instruments and puts them into a database, as well as the "Healthcare Contents Distribution Services" that provides prevention of epidemic diseases such as Pandemic Influenza, dengue fever, etc.

2.4.2 Objectives

The overall objective of this project is to demonstrate the successful promotion of e-local community with ICT solutions that will be recognized as a best practice to be replicated and scaled-up in rural areas in Indonesia and APT member countries to bridge the digital divide in remote rural communities.

The project aims:

1) To develop and implement a community-based wide area network by connecting a hospital, a healthcare center, a telecenter, a university, high schools, and junior high schools with a broadband access system to utilize e-healthcare, e-education, and e-agriculture solutions by providing the internet accessibility to rural communities.
2) To evaluate the effectiveness, efficiency, and sustainability of this community-based broadband telecenter and try to propose the best practice of the telecenter to be replicated and scaled up in the other rural communities in Indonesia and other APT member countries.
3) To enhance and improve implementation and maintenance skills among prefectural government staff to successfully establish and sustain ICT infrastructure and applications.

2.4.3 Project Site

Tanah Datar Regency, West Sumatra Province, the Republic of Indonesia has been chosen as the project site for the "Promotion of e-local community with ICT solution in Indonesia".

Tanah Datar, located at the heart of West Sumatra Province, is the smallest of the 19 regions in this province. Fig 2-4-1 shows the geographical location of the Regency.

General information on Tanah Datar Regency:

a. Regency government office location: Batusangkar

b. Administrative units: 14 Sub-districts, 75 Villages, 395 Small Villages

c. Population: 343, 993

d. No. of households: 86, 424

e. Area: 1333.3 sq km

f. Average temperature： 20~25 degrees Celsius (Highlands)

g. Main industry: Agriculture (70% of the population)

h. Regency's GDP: IDR 3.39 Trillion (2006)

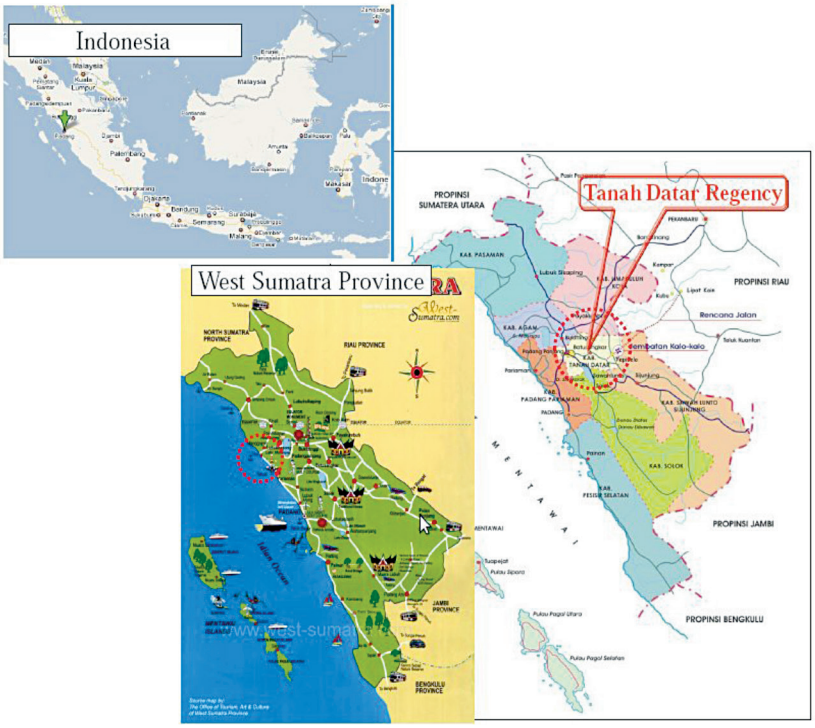


Figure 2-4-1: Location of Project, Tanah Datar Regency, West Sumatra, Indonesia

2.4.4 Partner Organization

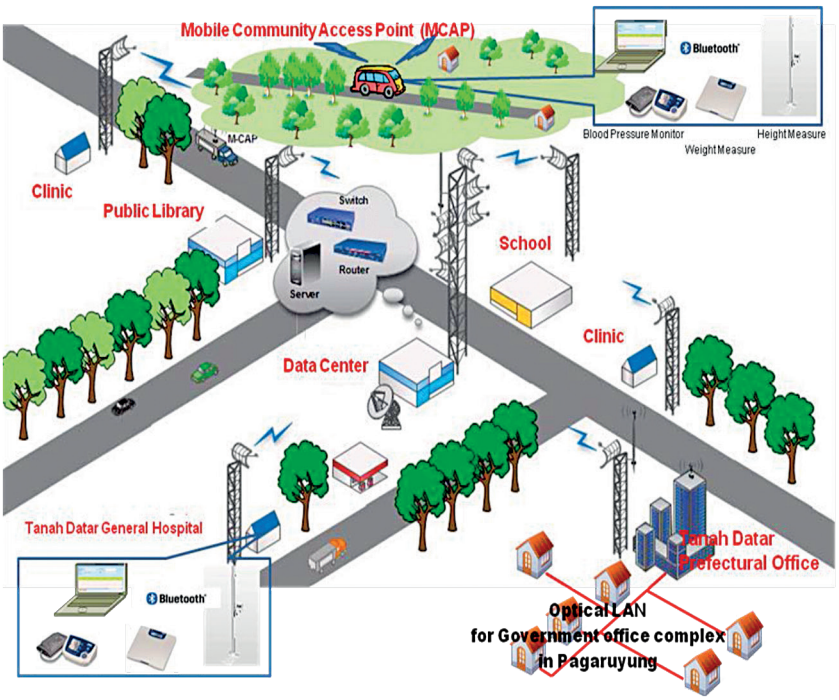
- Ministry of Communication and Information Technology (KOMINFO)
- The Telecommunication Technology Committee (TTC)
- Oki Electric Industry Co., Ltd. (OF Networks Co., Ltd.)
- Fujikura Ltd.
- Dinas Hub, KOMINFO (ICT Management Division) of local government in Tanah Datar Regency
- Dinas Kesehatan (Health Agency) of local government in Tanah Datar Regency
- PT Jaring Lawah Cyber (PT. JL Cyber)
- PT. Fujitsu Indonesia
- International Office, Nippon Telegraph and Telephone East Corporation (NTT-EAST)
- The National Institute of Informatics (NII)

2.4.5 System Configuration and Installation Sites

The project provides a very basic health check-up system in remote rural areas for the trial of a

centralized health data management system with simple health consultancy and disease information services, which is also the public information service for the local community.

Wi-Fi system is adopted as an access network for this pilot project in Batusangkar, Tanah Datar, and optical LAN system is installed by using FTTH technology at Tanah Datar Prefectural Office and Government Office Complex in Pagaruyung. System configuration and the sites of installation are as shown in Fig 2-4-2.



Antenna Unit Installation

Antenna Tower at Data Center

Preparation of Tower Installation

Equipment Installation

Figure 2-4-2: System Configuration and the Sites of Installation

The system specification, network equipment, and construction period of the Wi-Fi system and optical LAN are as shown in Table 2-4-1.

Table 2-4-1: System Specification, Network Equipment, and Construction Period of the Wi-Fi System and Optical LAN

	System specification	Network Equipment		Construction Period
Wi-Fi System	Maximum Distance: 4500 m Transport speed: 27 Mbps, Best Effort	- Wireless Tower - Lightning protection - Wireless Radio Access Point - 5.8 GHz Antenna - 2.4 GHz Access Point - 2.4 GHz Antenna		40 days
Optical LAN	Total Distance: 4.1 km 1st construction: 1.3km 2nd construction: 2.8km Transport speed: 100 Mbps, Best Effort	Optical Outside Plant	- Telephone Pole - Single mode optical cable for aerial installation - 1:8 Optical Splitter	1st Construction: 14 days 2nd Construction: 14 days
		Network Equipment	- 19" Rack system - GE-PON OLT - GE-PON ONU - Layer 2 Switch	1st Construction: 3 days 2nd Construction: 2 days
Server system		- 19" Rack system - GENSET 5000 Watt for Data Center - UPS 3000VA for Data Center - Computer Server for Data Center - Router Management for Data Center - Switch for Data Center		

One of the reasons that made it easier to successfully implement both Wi-Fi system and optical LAN is that a single agency is responsible for issuing permissions or licenses for both Wi-Fi system and optical LAN.

2.4.6 Outline of the Solution

2.4.6.1 Health Checkup Application

The measuring instruments for health checkup service consist of blood pressure meters, weight scales, and height scales. These pieces of equipment have the Bluetooth communication capability (Class 1, Version 1.2). Measured data are sent automatically to a local PC via Bluetooth and stored in a local database of the PC and also copied to an integrated healthcare database at Data Center. Bluetooth connectivity can lessen the burden to local workers of coping with new and additional tasks for medical checkup and facilitate the familiarization process with the operating instructions. The application was optimally customized and developed for data analyses and to assist the progress of the local people.

The health checkup operation procedure is composed of the following 3 steps:

Step1: Registration of patient
Step2: Measurement
Step3: Measured data entry

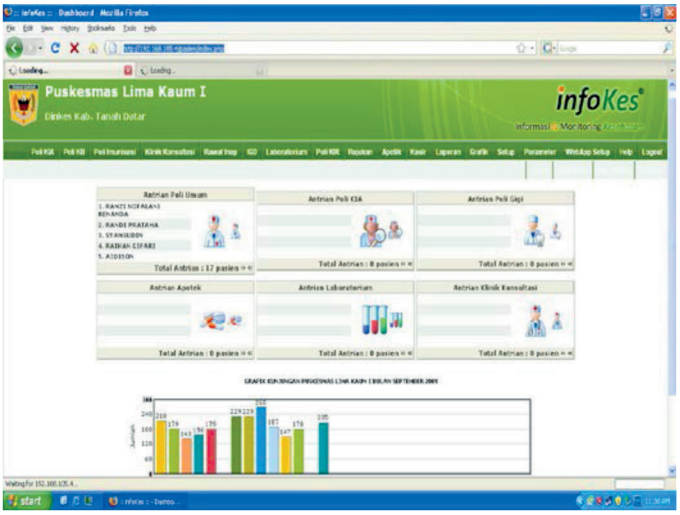
According to the evaluation results of this procedure, it typically takes 3 minutes to complete the procedure for revisiting patients and 7 minutes for first visits.

2.4.6.2 Administrative Cloud Service

By utilizing the network infrastructure consisting of Wi-Fi network and optical LAN, Tanah Datar Regency installed the Financial Information System (SIMDA) developed and provided by KOMINFO as an administrative cloud service to improve the work efficiency of associated workers in every regency.

The objectives of "SIMDA" are to support the realization of good governance and a clean government in the regional economic administration especially in financial implementations, and to realize professional, transparent, and responsible regional government facilities connected with the optical LAN infrastructure established by the project. Associated workers have been able to use this networked "SIMDA" on an online basis.

The functions of 'SIMDA' include compiling financial reports as part of financial management accountability using budget credit balance reports, cash flow reports, and notes to the financial statement according to the government regulations on standard government accounting; and producing other comprehensive financial reports such as statements of regional financial position, financial performance and regional government accountability on regional financial management, and the Internal Affairs Minister Regulation on regional government management guideline.



The Health Checkup Application Used on Clinics

The Administrative Cloud Service Program

2.4.7 Benefits of Introduction

Throughout the project, clinics, schools, and governmental agencies in Tanah Datar Regency are networked and connected to each other over Wi-Fi system and optical LAN. As a result of the implementation of the applications described in Section 2.4.6, improvement of administrative services was observed and recognized among residents and local government agencies.

a) Establishment of fundamental computerization for local community with ICT solutions

b) Introduction of necessary infrastructure for expansion of health or medical services

c) Improvement and upgrading of work efficiency at local government, and introduction for expansion or upgrading of administrative services to be provided to local community

2.4.8 Conclusion

APT J3 project in Tanah Datar was successfully handed over and its report was completed and submitted to the APT Secretary.

In the Tanah Datar case, the local governor conducted this project as one of the most important policies and formed a special team for the project. This team has been making great efforts to maintain the infrastructure and applications working normally. Two years after the completion of the APT-J3 project, the local government decided to expand the optical LAN and it was implemented successfully with the project members' support.

Throughout this project, Indonesia's 1st implementation of a municipality-based solution model, Health Checkup and Administrative cloud service is achieved.

Regarding its future prospects, Tanah Datar Regency plans to keep working together in cooperation with TTC in utilizing ICT development in the region.

2.5 e-Disaster Risk Management in Philippines

-APT J2 in Philippines: "Broadband wireless for disaster operations: resilient networks and reconfigurable information systems for rapidly deployable disaster response" 2012 APT J2

2.5.1 Background of the Project

In 2013 alone, natural disasters in the Philippines included Typhoon Haiyan, known locally as typhoon Yolanda, the deadliest Philippine typhoon on record, and a magnitude 7.2 earthquake that caused great destruction in Bohol province. In response, DOST-ICTO and the Ateneo de Manila University spent a considerable time looking for various ways to address communication problems resulting from damaged communication networks caused by natural disasters. In times of calamities, there is a need for immediate communication of information in order to minimize damage and loss of human life, and to provide evacuation updates and other vital information to those concerned.

2.5.2 Objectives

We envisage the design of a BBW (broadband wireless) network that is very resilient and rapidly deployable for quick end to end information flow from affected areas right up to the war room. The system has to be able to carry effective broadband content, to prepare communities, especially persons with disabilities (PWDs), during the critical pre-disaster planning and preparation periods, and for effective response immediately upon the onset of disasters and over the long term recovery effort. There is a critical need for systems designs that offer broadband access solutions to disaster risk management, assessment, rescue, medical treatment, survivor support system, resource allocation, and long term recovery.

2.5.3 Project Site

This project was planned and conducted in the laboratory in Ateneo de Manila University, Philippines.

2.5.4 Partner Organization

- ICT Office, Dept. of Science and Technology-DOST, Philippines
- Philippine Long Distance Telephone Company (PLDT), Philippines
- Ateneo Innovation Center (AIC) and ECCE Department, Ateneo de Manila University, Philippines
- Advanced Science and Technology Institute (ASTI), DOST, Philippines
- Vastnet Inc., Philippines
- Ionics Inc., Philippines
- Keio University, Japan
- Oki Electric Industry Co., Ltd, Japan
- Mitsubishi Electric, Japan

Other partners that were gained over the course of the project include:

- Daisy Consortium; Assistive Technology Development Office (ATDO), Japan

- National Council for Disability Affairs (NCDA); National Library of the Philippines (NLP)
- RBI - Resources for the Blind; Physicians for Peace, Philippines

2.5.5 System Configuration

Figure 2-5-1 shows a future system architecture for a possible Phase II(*) implementation, highlighting the different components of an information network suitable for disaster risk reduction and management. In this architecture, War rooms are the disaster information sources and have the function of delivering such information to disaster sites and other sites. War room can be constructed by IPTV headend equipment and/or ISDB-T narrow band broadcasting system (shortly, ISDB-T Narrowcast). The disaster related information to the disaster sites includes timely critical information for evacuation and short searchable video of survivors. ISDB-T narrowcast may broadcast several channels as survivors, rescue, relief, and so on.

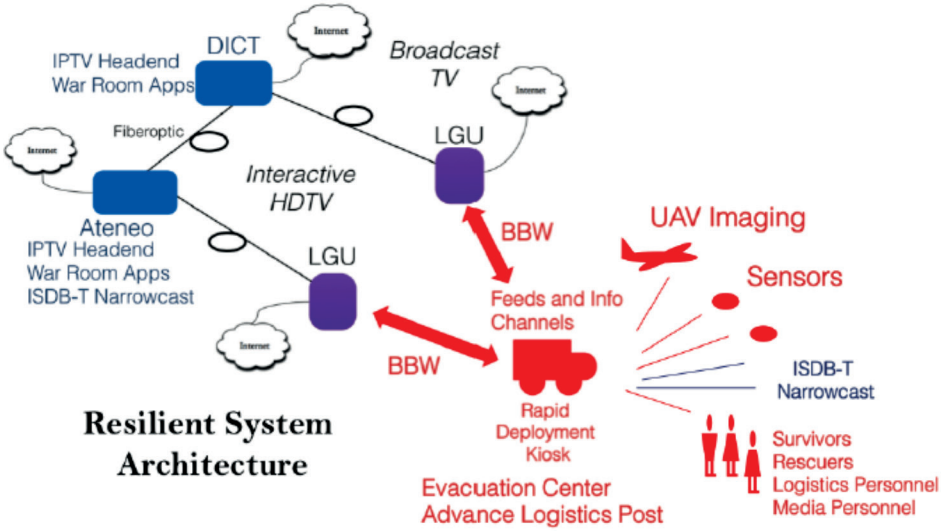


Figure 2-5-1: Future Wireless System for Pre-Disaster Preparation and Post Disaster Rescue and Recovery

NOTE - Phase I means this project. Phase II is the successor of Phase I. There is not any concrete plan as of February 2015.

Figure 2-5-2 details the sub-systems necessary for an end-to-end information delivery system that incorporates in a hybrid manner many key wireless and broadband technology components that can prove critical for our application: one set communications, IPTV standards based content delivery, WiFi and other wireless (such as TV white space), as well as headend technologies that include realtime encoding, web streaming, rapidly deployable mobile media servers and transcoders. Rapidly deployable components such as laptop based media servers (instead of rack mounted technologies), mobile transcoders, and one segment receivers.

Figure 2-5-3 shows the terminal devices that received Wi-Fi and ISDB-T narrow band broadcasting in Figure 2-5-2.

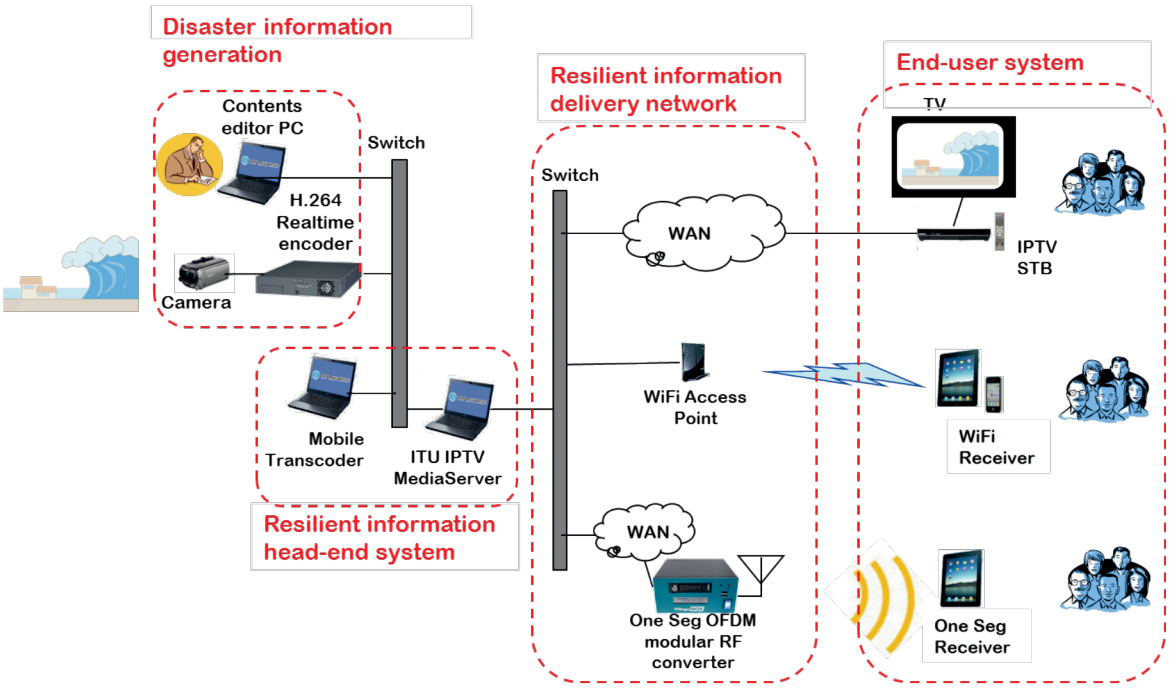


Figure 2-5-2: Proposed Experimental System for Test Deployment at the Ateneo de Manila University Testbed Site

Figure 2-5-3: Mobile Terminals That Receive ISDB-T Narrow Broadcast and IPTV streaming Over Wi-Fi in the Testbed Site.

For the system architecture, the following key components have been identified:

(1) End to end standards based system software and hardware

(2) Rapidly deployable and transportable components

(3) Low power content appliances at the deployment site

(4) Ability to provide necessary content even in low bandwidth environments

(5) Inclusive content design and delivery, PWDs are a critical part of the community addressed

2.5.7 Benefits of Introduction

To meet these design goals, we have put together a series of proof of concept sub-systems that have the necessary capabilities and concluded the project with the following accomplishments:

1. Standards based (ITU) IPTV platform head-end architecture

2. Near-cloud edge architecture
3. TV White space non-commercial-frequency wireless platforms
4. A hybrid approach that marries current technologies and standards based approaches in a mission critical capable content streaming platform: iptv.ateneo.edu.
5. A successfully concluded consultation and needs analysis process culminating in an international conference.

The IPTV platform was architected to function either as a head end or as a rapidly deployable node, utilizing ISDB-T standard and portable components. At the edge of the deployment, small form factor low power (<10 Watt) near cloud capable network appliances with full-up computer capabilities deliver and gather information at full bandwidth while updating metadata via the narrowband pipes often available in remote rural areas or in post disaster recovery sites. With the lead of the ICT Office of DOST, a test deployment using TV White Space frequencies, a developing standard, was implemented in post-earthquake areas in Bohol Island. While all this design and development work was ongoing, we configured a publicly accessible streaming capability via the iptv.ateneo.edu site to test new content and engage the DRRM community. In parallel we started a consultation process with multiple stakeholders, such as post disaster camp managers and the PWD community, which culminated in a UN ESCAP Sendai International Conference which was participated in by the PWD Community with remote online participation in panel discussions by the Manila Group, convened by this APT Project Team.

2.5.8 Conclusion (Future Prospects)

APT J2 project in Philippines was successfully handed over and its report was completed and submitted to the APT Secretary.

In this Philippines case, an Academia, Ateneo de Manila University, and a government organization, DOST, conducted this project as one of the most important topics regarding disaster information delivery. The project installed a prototype system of RESILIENT NETWORKS AND RECONFIGURABLE INFORMATION SYSTEMS based on an international standard based IPTV system and ISDB-T narrow band broadcasting system.

Throughout this project, the team identified design goals and we have put together a series of proof of concept sub-systems that have the necessary capabilities and concluded the project with the accomplishments.

Regarding its future prospects, the project members plan to keep working together and to consider utilizing ICT development in the region, such as e-learning for hospitals based on IPTV (patient safety topics), and so on.

3. Summary of ICT Solutions

CATEGORY	SUB CAREGORY	e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
1. Overview of the solution		e-Aquaculture systems is a remote environment monitoring system using M2M sensor network at the fish pond in order to suspend the fish kill due to lack of oxygen. 1) M2M sensor network M2M network was built with sensors measuring water temperature, pH, dissolved oxygen (DO), turbidity and conductivity around the lakeshore. 2) Improved the lack of oxygen in the water A water circulation system could be provided to improve the lack of the oxygen in the water. 3) Distribute information system Information distributed to fish folk through a portal site created by an expert. Distributed information includes water parameter, disaster information, market price and cooking information etc.	e-Education provides a wide variety of functions according to the target area situation and requirement. 1) Introduction of ICT technologies into schools: Introducing internet access environment, school internal network (LAN), PCs and other networked display and operation devices, electronic whiteboards and education-related application systems etc. 2) e-Education materials Multimedia education materials which are delivered via video and still image database, interactive tools and digital playground concept. 3) e-Learning system Self-study systems provided through servers and communication networks, which allows students to study by themselves, remotely and at any time if necessary, using e-Education materials. 4) Remote communication Realizing remote communication environment among children and students, or with teachers, through networks and display devices.	e-Environment is a remote environment monitoring system using M2M sensor network in the peatland. 1) It is also effective for dam designs and area maintenance, prediction of fire occurrence, and protection of the peatland. 2) By designing and constructing the monitoring system, the local young ICT engineers have the opportunity to enhance their technical skills on ICT technologies. 3) Using the ICT system, the e-Education service can provide the local residents a venue to understand the importance of peatland conservation and introduction to internet operations.	e-Healthcare system provides healthcare –related information, services, and products to patients using the Internet and other relevant networks. The following are cases of e-Healthcare services in rural area. 1) Health checkup service It allows the automatic collection of height, weight, and blood pressure from the scales and puts them into a database. 2) Healthcare Contents Distribution Services It provides opportunity to raise awareness against epidemics such as Pandemic Influenza, dengue fever, etc. by using the e-learning system application contents.	e-Disaster risk management system provides a broadband wireless network that is very resilient and rapidly deployable for quick end to end information flow from affected areas right up to the war room.. 1) Resilient network Resilient network consists of the different component of information network such as broadband and wireless network. 2) Disaster information Disaster information includes pre-disaster planning, preparation periods, disaster situation and recovery information. 3) Head-end system IPTV head-end for broadband and ISDB-T system for wireless are included in the system.

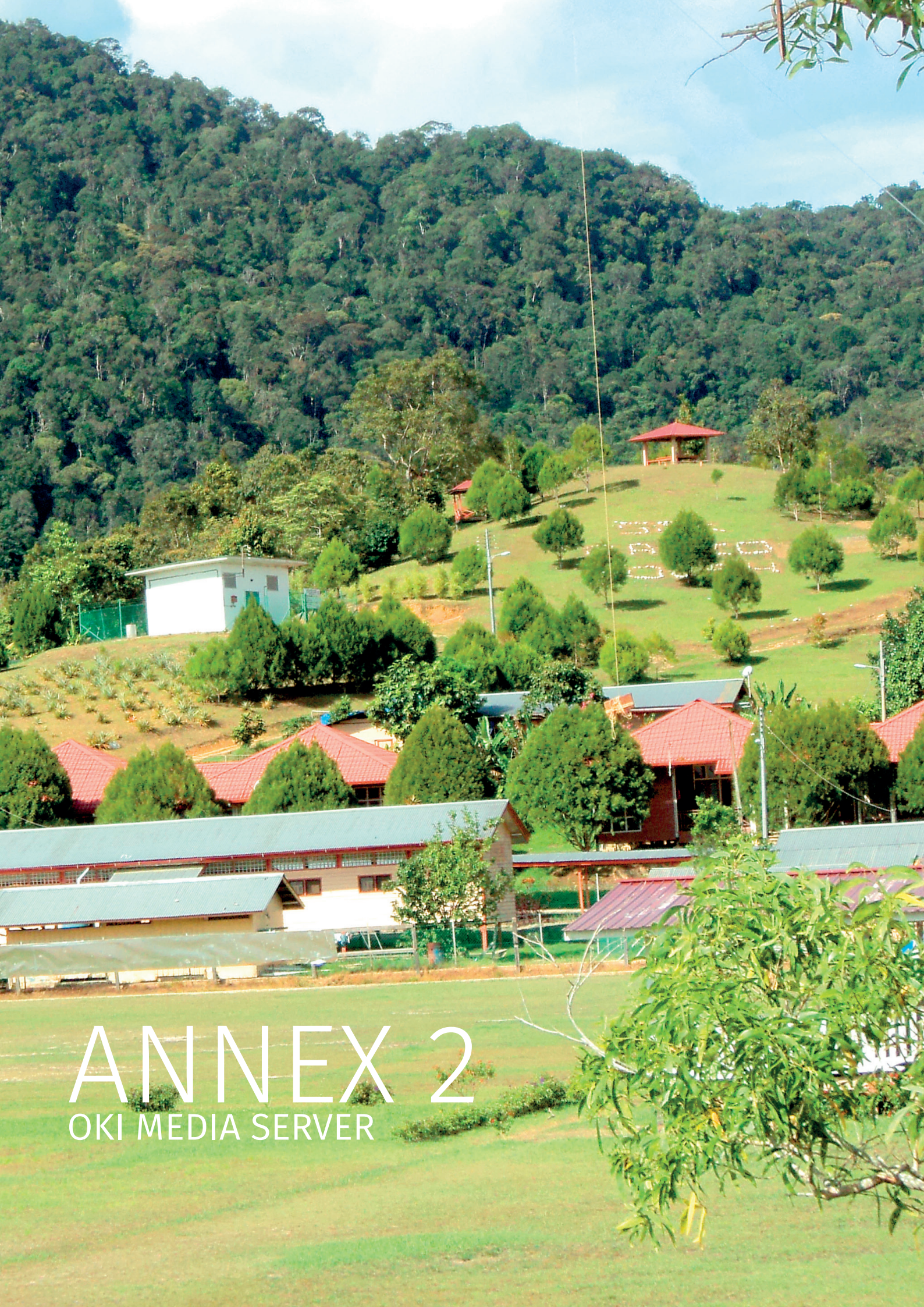
CATEGORY	SUB CAREGORY	e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
2. Analysis of the situation and status	a) Purpose and Environment	A series of surveys are conducted to analyze contextual conditions, which will be instrumental in deciding requirements for e-Aquaculture system - main reason of fish kill - which kind of sensor is needed (water temperature, pH, DO etc.) - location of monitoring Survey existing ICT system such as communication networks and PC equipment	A series of surveys are conducted to analyze contextual conditions, which will be instrumental in deciding requirements for e-Education systems. - Existence of Internet environment or ICT penetration level in the target area - Analysis of rate of child labor - Analysis of school attendance rate (necessary to determine readiness for self-study, and the current rate of truancy due to child day- time labor or local economic situation, etc.) - The number of teachers per capita (necessary to determine readiness for self-study, from the perspective of teachers) - Scope of geographical area where one school should cover (necessary to determine readiness for remote/distance learning) - Number of children or students in the area (necessary to determine communication environment among children across a distance) - Social surroundings like existence of zoological or botanical gardens (providing alternate education materials for children without such study environments)	A series of surveys are conducted to analyze contextual conditions, which will be instrumental in deciding requirements for e-Environment system - Construction area - Water level in the canal / peatland - CO_2 / methane concentration - Rainfall - Temperature and humidity - Wind speed - Local environment setup Survey existing ICT system such as communication networks and PC equipment	A series of surveys are conducted to analyze contextual conditions, which will be instrumental in deciding requirements for e-Healthcare system. - Presence of local Internet access services, and Internet penetration rate - Demographic composition by age, literacy rate etc. - Ratio of medical institutions (hospitals and clinics) per household and area coverage per medical institution (hospitals and clinics) (to determine the need for remote healthcare services) - Availability of regular health checkup services and checkup consultation rate - Availability of health insurance schemes - Availability of medical office automation - Identification of most common diseases, and records on presence of endemic diseases	A series of surveys are conducted to analyze contextual conditions, which will be instrumental in deciding requirements for e-Disaster risk management system. - Existence of broadband access for IPTV services - Existence of digital broadcasting for wireless services - Frequency of natural disaster in the target area (country) - Availability of mobile terminal devices such as smart phone to receive ISDB-T. - Availability of IPTV terminal devices such as STB and TV with IPTV functions
	b) Measures and effect	Based on the above survey, decide what kind of sensor system is suitable and necessary. - Number of fish kill using the system. - Improving the income of fish folk.	Based on baseline data, decisions are made to determine the type of e-Education solution which best fit the contextual needs and challenges identified. . Relevant reference indices are determined to indicate the quantitative effect or impact of the project goal.	Based on the above survey, decide what kind of systems is suitable and necessary.In case of its application to the peatland - Effective for prediction of fire and its protection - Use of the canal dam design for recovering water supply Also set up some reference indexes and consider the quantitative effect.	Based on baseline environmental survey, decisions are made to determine the type of e-Healthcare systems or services needed. In addition, selection of specific targets to perform a quantitative review of the results of the implementation.	Based on baseline environmental survey, decisions are made to determine the type of e-Disaster risk management system or services needed. In addition, selection of specific targets to perform a quantitative review of the results of the implementation.

<table>
<tr><th>CATEGORY</th><th>SUB CAREGORY</th><th>e-Aquaculture</th><th>e-Education</th><th>e-Environment</th><th>e-Healthcare</th><th>e-Disaster Risk Management</th></tr>
<tr><td rowspan="4"></td><td>c) Business Model</td><td>Survey relevant conditions including the following items to generate and assess a business model for e-Aquaculture services.
- Considering the purpose of deployment, necessary system and benefits to be expected should be clarified.
- How much fish harvest was improved using the system and solution.
- Reduction of manpower costs by saving the time in measuring environmental data
- Benefits to enhance technical skills of local young ICT engineers and to provide e-Education service to the local residents
- Costs of system deployment, operation, and maintenance
- Financial support: who will operate and maintain the system.</td><td>Survey relevant conditions including the following items to generate and assess a business model for e-Education services.
- At this stage, it is necessary to determine the economic situation of local government or schools, i.e. whether they are able to keep up with the cost of system introduction and run it as local government or school services sustainably.
- If it is determined that difficulty is predicted in sustaining and managing the project, it is necessary to identify potential financial support from the central government, grants, or other countries.</td><td>Survey relevant conditions including the following items to generate and assess a business model for e-Environment services.
- Reduction of manpower cost by saving time in measuring environmental data
- Benefits of getting useful data on a timely basis (ex. the data for dam design, fire prediction, and rapid fire-fighting for environment conservation).
- Benefits of enhancing the technical skills of local young ICT engineers and to provide e-Education service to the local residents
- Costs of system deployment, operation, and maintenance
- Economic strength of local governments in the region
- Financial support of the central government or other countries</td><td>Survey relevant conditions including the following items to generate and assess a business model for e- Healthcare service.
- Economic readiness of the local residents (whether service fees could be collected from local residents will be sufficient to cover costs for system implementation, operation, and maintenance, etc. As such, it is to be determined if private commercial businesses ran by medical institutions are feasible operators to sustain the e-Healthcare services in the future).
- Economic readiness of local municipalities and medical institutions (whether the system deployment, operation, and maintenance costs can be covered by municipalities if fees collected from the local residents are insufficient; whether municipalities are capable of the continuous management of the system).
- Availability of central government or foreign financial aids (whether financial support could be obtained from the central government or other governments if both service fees and municipalities cannot cover the costs).</td><td>Survey relevant conditions including the following items to generate and assess a business model for e- Disaster risk management service.
- Availability of ISDB-T including head-end system and terminals to deliver emergency information when disasters happens
- Availability of IPTV services (broadband, head-end and terminals) to deliver emergency information when disasters happens</td></tr>
<tr><td rowspan="3">d) Cost estimation</td><td colspan="4">Survey electricity in the environment (existence or possibility of a power supply, quality of electricity)</td><td></td></tr>
<tr><td colspan="4">Survey existing communication network environment (existence and reliability of wired or wireless broadband access)</td><td></td></tr>
<tr><td>Survey and compare the damage of fish kill and the investment for system implementation, operation, and maintenance.</td><td>Survey conditions and estimate the cost of introduction, operation, and maintenance of e-Education systems.
- Required type of systems and services to be introduced, and necessary facilities such as servers and buildings</td><td>Survey conditions and estimate the cost of introduction, operation, and maintenance of e-Environment system.- Presence (or supply potential) of the power supply and</td><td>Survey relevant conditions including the following items to estimate costs associated with e-Healthcare system implementation, operation, and maintenance.</td><td>Survey relevant conditions including the following items to estimate costs associated with e-Disaster risk management system implementation, operation, and maintenance</td></tr>
</table>

CATEGORY	SUB CAREGORY	e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
			for them; communication network equipment, terminal devices, education materials, and so on. - Coverage of area size, population density and distribution - Readiness of available teachers or education expert resources in the target area - Challenges to establish maintenance system for ICT and e-Education systems	power quality - Necessary ICT system (center building, communication equipment / terminal equipment) - Coverage area and construction difficulty of ICT equipment maintenance system	- General description of required system (service details), facilities (center building, telecom facilities, terminal equipment, instruction materials, etc.) - Coverage of area size, population density and distribution - Readiness of local community members to sustain the e-Healthcare system after deployment - Challenges to establish maintenance system for ICT and e-Healthcare systems	- War room specification that delivers the emergency information and also collects the personal and disaster area information. - Coverage of area size, population density and distribution. - Readiness to regulate a small broadcasting system to broadcast disaster information to specific areas.
3. Target data, Collection and Analysis		Collection of the following data. - Water temperature - pH - Dissolved oxygen (DO) - Turbidity and conductivity around the lakeshore. - Water circulation - Ecology of fish and water pollution	Collection of the following data - Academic performance of students in local schools - Rate of basic literacy and arithmetic knowledge - Knowledge about local culture - Ability in creative thinking skills - General student satisfaction rate about learning within the target context	1) Collection of the following data. - Climatic conditions, carbon dioxide / methane (CH4) concentration - Rainfall, temperature, humidity and wind speed - Local environment appearance (in case of the application to peatland) - Canal construction area - Water level in the canal and peatland - Fire generation and frequency 2) Storage technology for the above data and appropriate analysis skills	Collection of the following data - height - weight - body fat percentage - temperature - blood pressure - pulse rate, and so forth.	Collection of the following data - Disaster area (potentially dangerous area) - Disaster type - Disaster date, time - Route to Evacuation - Number of dead people, their names and other personal information
4. Appropriate technology	a)Communication Technologies	Between fisherman household (Telecenter) and fishing community center or university (knowledge center). Needed broadband capacity	Select the communication technologies by considering the cost of introduction and usage of each technologies, taking into account the environmental conditions, existing facilities, and possibility of shared usage with other appropriate services, etc. At this juncture, relevant system s are decided to meet the required performance in a cost-sensitive way, not necessarily with regard to leading edge technology. < Area and long distance >	Communication tool (Wi-Fi and millimeter wave technology)	<Regional/wider geographic area> - Optical fiber/metal cable/microwave + wireless LAN - Satellite communication - Mobile phone (data communication) services <Situational customer-based premise>	ISDB-T, WiFi and IPTV

CATEGORY	SUB CAREGORY	e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
			- Optical fiber and PON*1 system, metal, microwave and WiFi *1 PON: Passive Optical Network - Satellite communication - Mobile phone data communication service < School connection requirements > - Wired LAN or WiFi - Cable system for broadcast		- Wired/wireless LAN - Broadcasting system	
	b) Sensor network Technologies	1) Sensor and measuring equipment (Dissolve oxygen, air & water temperature, pH, humidity, and imagery, etc.) 2) Radio wave (such as WiFi) technology 3) Power equipment (solar panel and battery)	(Normally not applicable)	1) Sensors and measuring equipment (Water level, CO_2 / methane concentration, rainfall, temperature, humidity, wind speed, etc.) 2) Radio wave (such as WiFi) technology 3) Power equipment (solar panel and battery)	1) Measuring equipment to provide health checkup service (height scale/ weight and body fat scale/ thermometer/ blood-pressure gauge/ pulse counter) 2) Short range wireless communication technology (Bluetooth) for the data collection of health checkup service.	N/A
	c) Center Facility	1) Server technology for storage of collected data 2) Internet server capability to respond to remote area	1) Data server and storage machines 2) Broadcast server or head-end 3) e-Learning systems (application systems and contents) 4) Relevant multimedia educational materials including pictures, video, sounds, text, etc., interactive tools and digital playground space, etc.	1) Server technology for storage of collected data 2) Internet server capability to respond to remote area	1) Data server and storage machine 2) Multimedia electric learning materials database 3) e-Learning systems (application systems and contents)	1) Data survey and storage machine 2) ISDB-T and IPTV head-end system to deliver information
	d) Terminal devices	Personal computers and smart device including GPS function.	1) Personal or shared computers (desktop, laptop or tablets, smart phones, etc.) 2) School devices (displays, sound systems, electronic whiteboards, etc.)	Personal computers (desk top type)	1) Personal or shared computers (desktop, laptop or tablet, smart phones, etc.) 2) Facilities of medical institutes and administrative institutes (visual displays, audio equipment)	ISDB-T terminal WiFi terminal IPTV terminal
5. Human resource		Personnel who operate ICT system (Refer to the category 4 - Appropriate technology)				
		Personnel who maintain ICT system (Refer to the category 4 - Appropriate technology)				
		In order to realize sustainable	In order to realize sustainable	In order to realize sustainable	In order to realize sustainable	In order to realize sustainable

CATEGORY	SUB CAREGORY	e-Aquaculture	e-Education	e-Environment	e-Healthcare	e-Disaster Risk Management
		implementation of e-Aquaculture system, the following human resource should be ensured and cultivated. - Experts for design and construction of M2M monitoring system - Maintenance personnel of e-Aquaculture system; experts for data analysis - Teachers or education experts for ICT training and environment education of local ICT engineers and residents	implementation of e-Education systems, the following human resource should be ensured and cultivated. 1) Teachers or education expert resources 2) Maintenance personnel for e-Education systems	implementation of e-Environmental system, the following human resource should be ensured and cultivated. 1) Experts for design and construction of M2M monitoring system 2) Maintenance personnel of e-Environment system ; experts for data analysis 3) Teachers or education experts for ICT training and environment education of local ICT engineers and residents	implementation of e-Healthcare systems, the following human resource should be ensured and cultivated. 1) Medical doctor or professional health services resources 2) Maintenance personnel for managing medical facility and services (remote medical checkup services)	implementation of e-Disaster risk management systems, the following human resource should be ensured and cultivated. 1) Maintenance personnel for IPTV and ISDB-T equipment to deliver disaster information 2) Maintenance personnel for creating effective disaster information to government and persons in disaster areas



ANNEX 2
OKI MEDIA SERVER

IPTV/OTT service platform

OKI MEDIASERVER

4K Ready

ITU-T H.721 (2015) Support

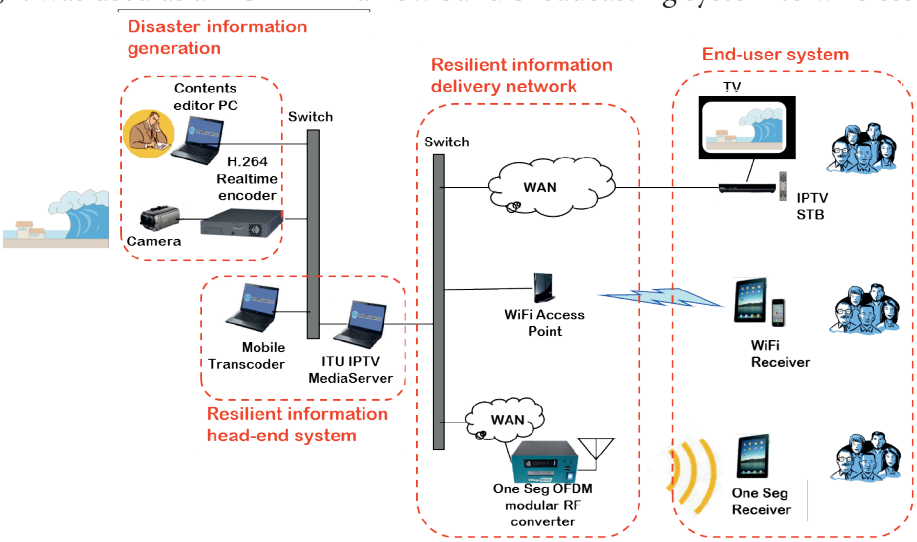
A Scalable Platform that provides a Total Solution for High-Quality Video Content Distribution

Contribution to the e-Disaster Management

OKI MediaServer is an IPTV platform system that was adopted by an e-disaster management project, because it supports several international standards that is including ITU-T H.721 "IPTV Terminal devices: Basic model". Project name was "Broadband wireless for disaster operations: resilient networks and reconfigurable information systems for rapidly deployable disaster response" 2012 APT J2 in Philippines. * APT Report on "Handbook to Introduce ICT Solutions for the Community in Rural Areas", [APT/ASTAP/REPT-13 (Rev.1)], August 2014 Revision September 2015.

In 2013 alone, natural disasters in the Philippines included Typhoon Haiyan, known locally as typhoon Yolanda, the deadliest Philippine typhoon on record, and a magnitude 7.2 earthquake that caused great destruction in Bohol province. In response, the Information and Communications Technology Office of the Department of Science and Technology (DOST-ICTO) and the Ateneo de Manila University spent a considerable time looking for various ways to address communication problems resulting from damaged communication networks caused by natural disasters. In times of calamities, there is a need for immediate communication of information in order to minimize damage and loss of human life, and to provide evacuation updates and other vital information to those concerned.

In the project, OKI MediaServer was used as the server of video stream over IP network and wireless network. OKI MediaServer delivers disaster information video to several types of terminals such as STB, smart phone, and tablet over IP network. By combining with ISDB transmitter, it was used as an ISDB-T narrow band broadcasting system to wireless terminal.



IPTV/OTT service platform

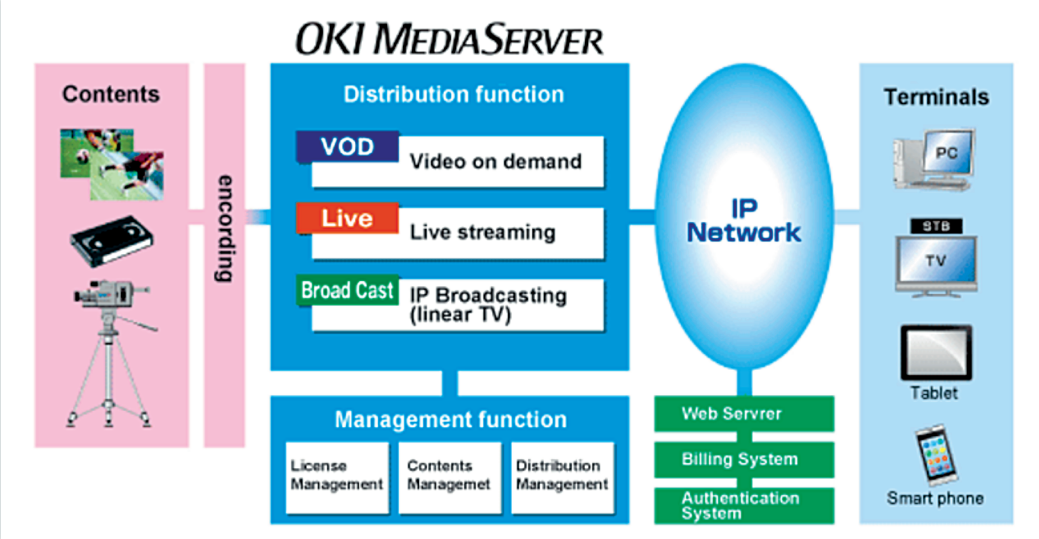
OKI MEDIASERVER

4K Ready

ITU-T H.721 (2015) Support

A Scalable Platform that provides a Total Solution for High-Quality Video Content Distribution

◆ System architecture



◆ Features

1. Integrated IPTV Platform

- OKI MediaServer can be used for several IPTV services such as VOD(Video-on-Demand), live streaming, IP broadcasting (linear TV) and their combined services.

2. Standard specifications based system

- ITU-T IPTV standards, H.721, H.701 compliant
  → H.721 compliant connected TV can be used as a terminal.
- De-facto standard, IETF HLS, compliant
  → Most of smart phone, tablet, smart TV (e.g., iPhone, iPad, Android terminals) can be used.
- New standard (MPEG-DASH) conformity
  → Future smart phone, tablet, smart TV

3. It supports the video service that we can watch anywhere anytime

- In VOD service, viewers can rewind or forward the program by remote control anytime
- In IP broadcast service (linear TV), viewers can choose a program by channel designation
- "Start over Function" that can reproduce during the broadcast seeing and hearing anytime as VOD from a beginning

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OKI

Oki Electric Industry Co., Ltd.

http://www.oki.com/en/streaming/

IPTV standards and OKI MediaServer

ITU-T IPTV standardization activity

ITU-T established the Focus Group IPTV (FG IPTV) in April 2006 to promote and start coordinating for the establishment of an international IPTV standard. A total of 1,300 participants attended and 20 resulting documents were output from the seven meetings conducted by FG IPTV, the sheer number of which was due to the fact that participation was not limited to ITU. Members were open to any individual or organization from any member country of the ITU. In December 2007, IPTV Global Standard Initiative (IPTV-GSI) was established as a consequence, with the preparation of recommendations starting in January 2008 based on the resulting documents and discussions by the Study Group (SG) at ITU on the relevant topics. General descriptions of the major recommendations are classified into categories of "Architecture and Services", "Middleware, Applications, Content Platforms" and "End Systems".

IPTV basic terminal standard, ITU-T H.721

Terminals used to receive IPTV services are stipulated by documents of the H.720 series. A general description is provided in H.720 and consideration is being given for the preparation of recommendations for various terminals in the documents of series 721 and thereafter. Of these, H.721 (Basic terminal) is a recommendation based on the specifications of the IPTV Forum Japan, a standardization organization for IPTV in Japan. A feature of this recommendation includes the specification of IPTV terminals that accommodate conformity to existing digital broadcast receivers in Japan, which make it possible to receive services not only with a set top box but also with the IPTV terminal function built into television receivers Currently, television sets with features based on these specifications are actually available on the market in Japan. H.721 (2015) was extended to support H.265 codec and 4K television.

Advantages of ITU IPTV Standards Implementation

ITU IPTV standards assume the existence of multiple service providers on a network, and a user is able to receive services from several providers through a single terminal. As a result, service providers need not prepare terminals for each new service, thus advancement in introduction of new services can be expected. By adopting the standards, countries or regions planning to introduce IPTV can easily implement terminals and contents used elsewhere to reduce implementation time and cost.

Overview of ITU IPTV Standards Testbed I3GT

To advance the adoption of the above ITU IPTV standards, Oki Electric Industry Co., Ltd. (OKI) and Hokkaido Television Broadcasting Co., Ltd. (HTB) launched "ITU IPTV IPv6 Global testbed (I3GT)" in October 2012.

The testbed setup consists of the ITU IPTV standards-compliant video distribution system "OKI MediaServer" in the cloud environment of the JGN-X network, which was built and is operated by the National Institute of Information and Communications Technology (NICT). Using an IPv6 network, I3GT is intended to provide a worldwide testing environment for the ITU IPTV standards. The testbed can be used to verify (1) a network has the bandwidth and quality (delay, loss) capable of IPTV video distribution; (2) the interactive functionality of applications with video/still image/text of ITU-T H.762 compliant contents; and (3) the interface during terminal development, thereby enabling a better understanding of the standards' value. The testbed is built on a server located in NICT's JGN-X. OKI MediaServer, considered an ITU standards compliant reference, is utilized as the IPTV platform.
National institutes and universities in several countries used I3GT and they are listed in ITU-T Web site,

http://www.itu.int/en/ITU-T/C-I/interop/I3GT/Pages/default.aspx.

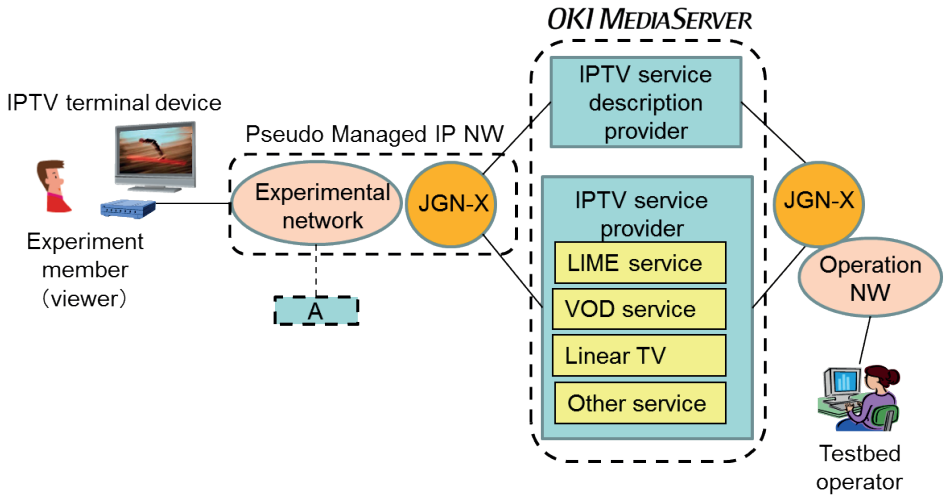


Figure : I3GT conceptual architecture

ANNEX 3

NEC PASOLINK SERIES INTELLIGENT AND HIGH CAPACITY WIRELESS TRANSPORT SOLUTION

Orchestrating a brighter world NEC

PASOLINK Series
Intelligent and High Capacity Wireless Transport Solution

1. Contribution to the e-environmental community

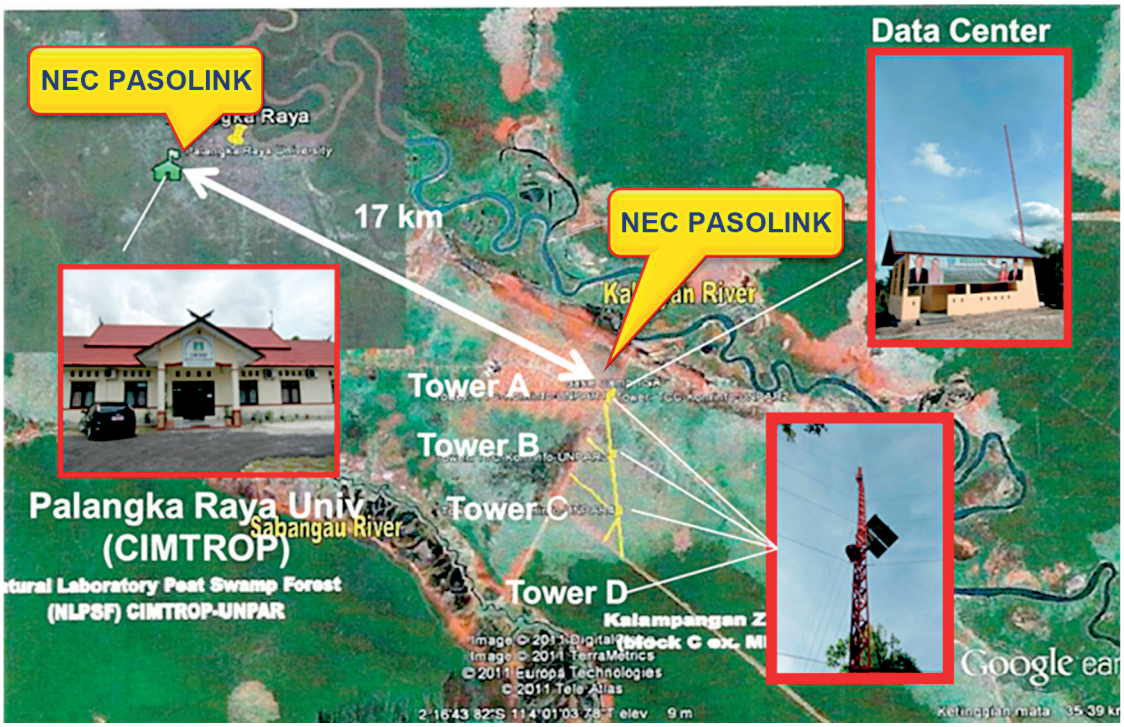
NEC has been in the forefront of developing and providing high field proven, reliable wireless solutions through NEC's PASOLINK series of Microwave Radios, for service providers all over the world.

Those technologies were also contributed to promotion of the e-environmental community in Central Kalimatan (Palangkaraya, Indonesia, 2012).

In Central Kalimatan, in order to avoid the occurrence of peat fire, maintaining process of the water-level in the peat-land shall be made quickly and efficiently.

Using the ICT remote monitoring system including NEC's PASOLINK, the researchers can easily see the visual image of the dam and get the data collected at each points for the measurement of water level, temperature, humidity, wind speed, rainfall, methane amount, CO2 amount, soil temperature and soil moisture, without accessing to the peat land site.

A high speed data link using PASOLINK system has been installed to connect the Data Center and CIMTROP (Centre for International Co-operation in Sustainable Management of Tropical Peatland) office of Palangkaraya University (located 17km far from the Data Center), so that all the monitored data at each measuring points are quickly transmitted to the data server in CIMTROP office and utilized for the dam design for maintaining the water-level in the peat-land.



2. High Quality Smart Radio Solution “PASOLINK”

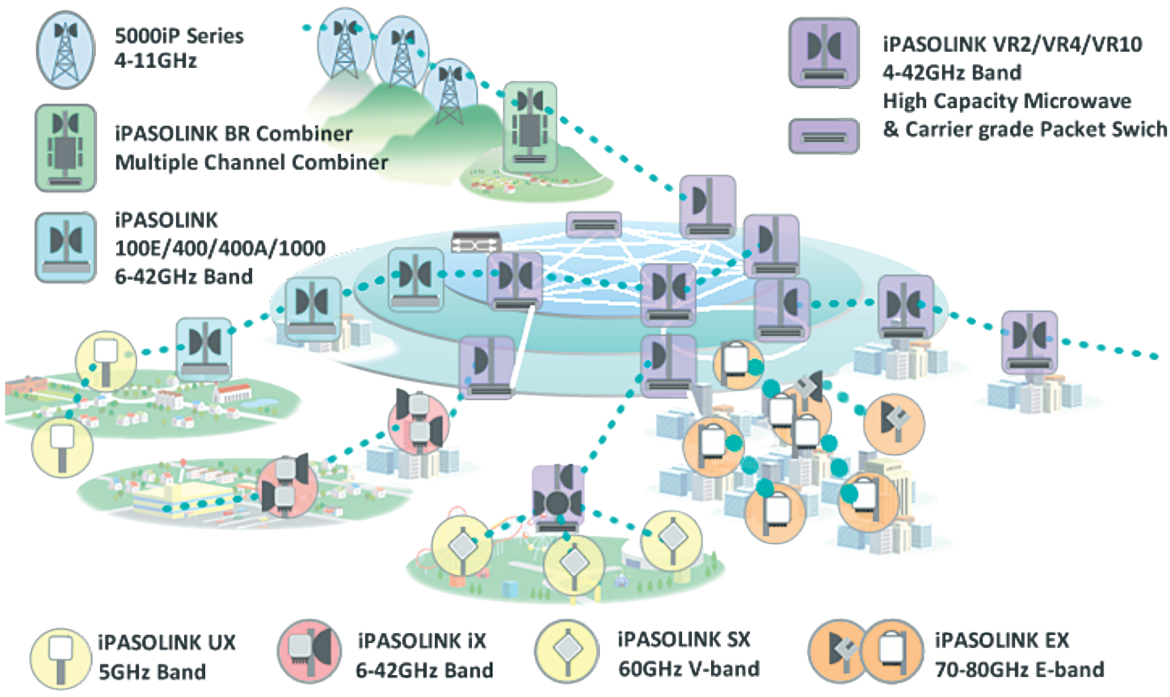
The growing adoption of 4G and beyond mobile wireless service, is challenging the mobile service providers with the need of rapidly deploying high speed, flexible, scalable and highly reliable backhaul with CAPEX and OPEX optimized for ensuring least TCO (Total Cost of Ownership) and high network performance. NEC has been in the forefront of developing and providing high field proven, reliable wireless backhaul solutions through NEC's PASOLINK series of Microwave Radios, for service providers all over the world.

(1) Mobile Backhaul Solution

As mobile service evolves beyond LTE, it is paramount to provide solutions that realize high capacity, effortless connectivity, and ease of maintenance to all stakeholders equally and affordably, with flexibility to adapt to their diverse needs and requirements.

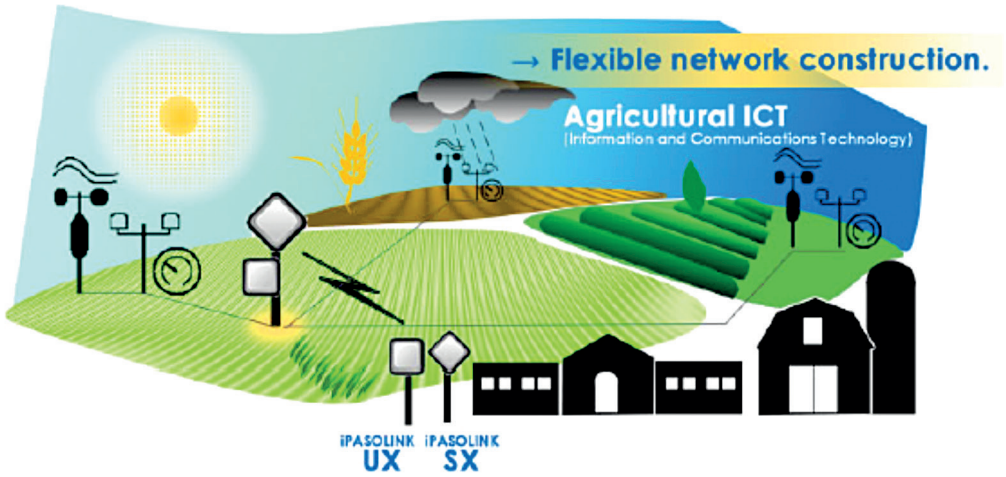
NEC strives to provide advanced transport solutions that build on expertise in microwave, IP, and optical technologies, which contribute to the establishment of safe, secure, and versatile network that brings together everyone and everything throughout the world. The foundation for a connected society.

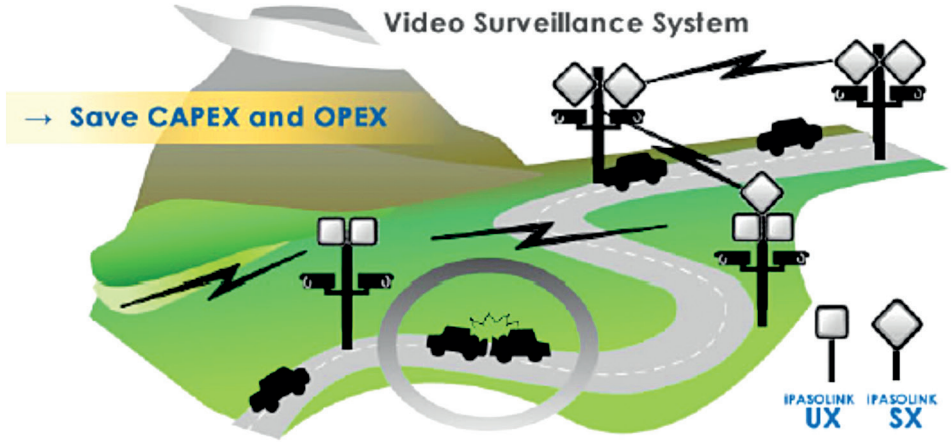
NEC’s microwave transport has offered unmatched reliability throughout the years. Together with advances in radio technology and leading SDN expertise, NEC provides highly dependable and intelligent converged solutions that satisfy current and future mobile requirements.

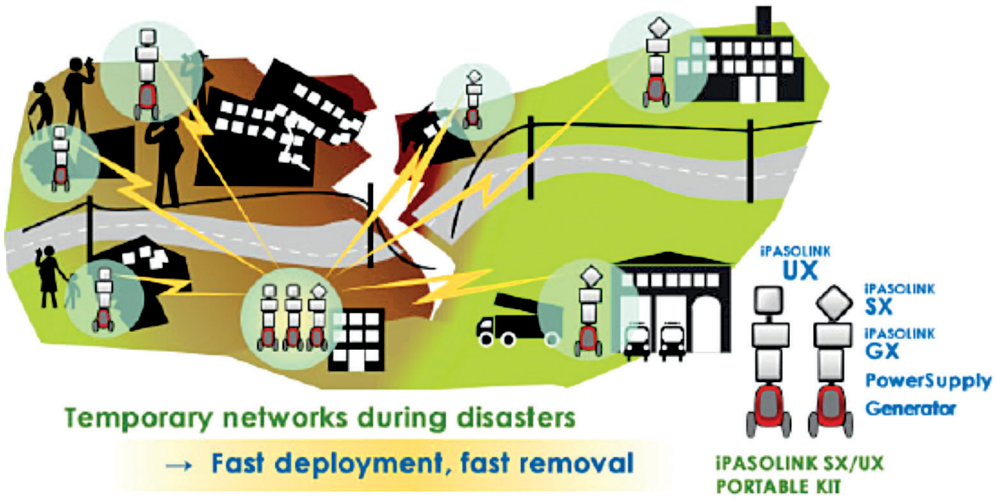


(2) Private link solution

Enterprises, utilities, and local governments can take advantage of high capacity and diverse range of NEC's radio solution. Private links can be easily established between campuses or offices separated by a few tens of kilometers, or purpose built networks can be rapidly deployed by setting up links across facilities owned by utilities or local governments, such as lampposts.







(3) PASOLINK series products overview

a) All Outdoor Radio Type

The short range and high capacity of E-band/V-band radios are suitable for high density and massive deployment .

This unique characteristics is also a perfect match for security and disaster control solutions, making them key elements in social infrastructure.

iPASOLINK iX

- 6-42GHz
- 2048QAM
- Flexible Configuration
- Middle-Long haul
- All in One
- 2 in 1

iPASOLINK EX

- E band 71-76 GHz/ 81-86 GHz
- 3Gbps, 10Gbps
- 256QAM-QPSK
- Full features L2 switch

iPASOLINK SX

- V band 59-63 GHz
- 256QAM-QPSA
- All In One Integrated Antenna

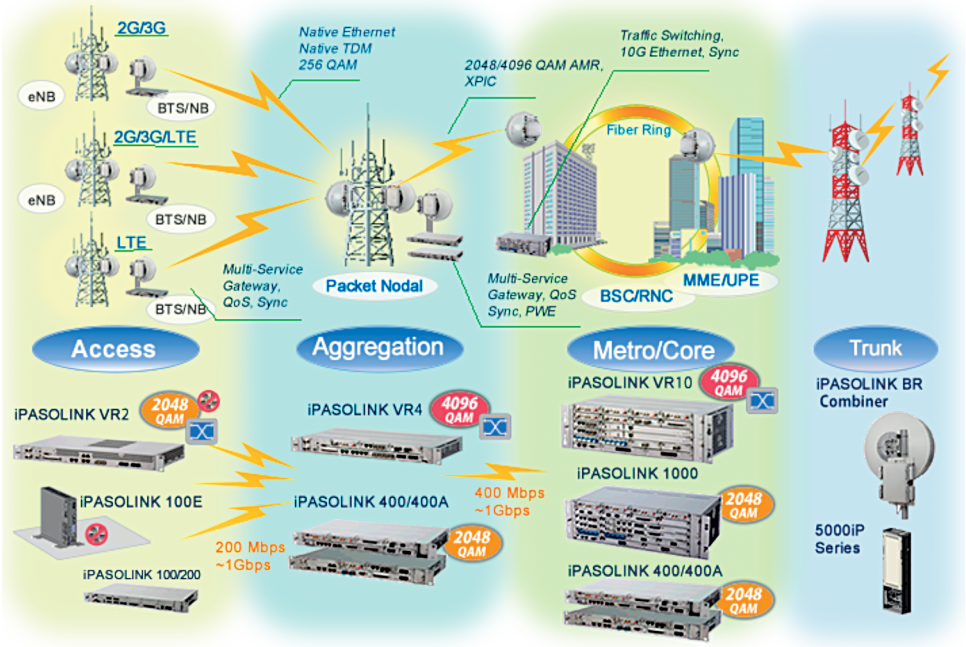
iPASOLINK UX

- 5GHz
- P-MP connectivity for all-purpose
- Compact and lightweight
- Easy and fast installation

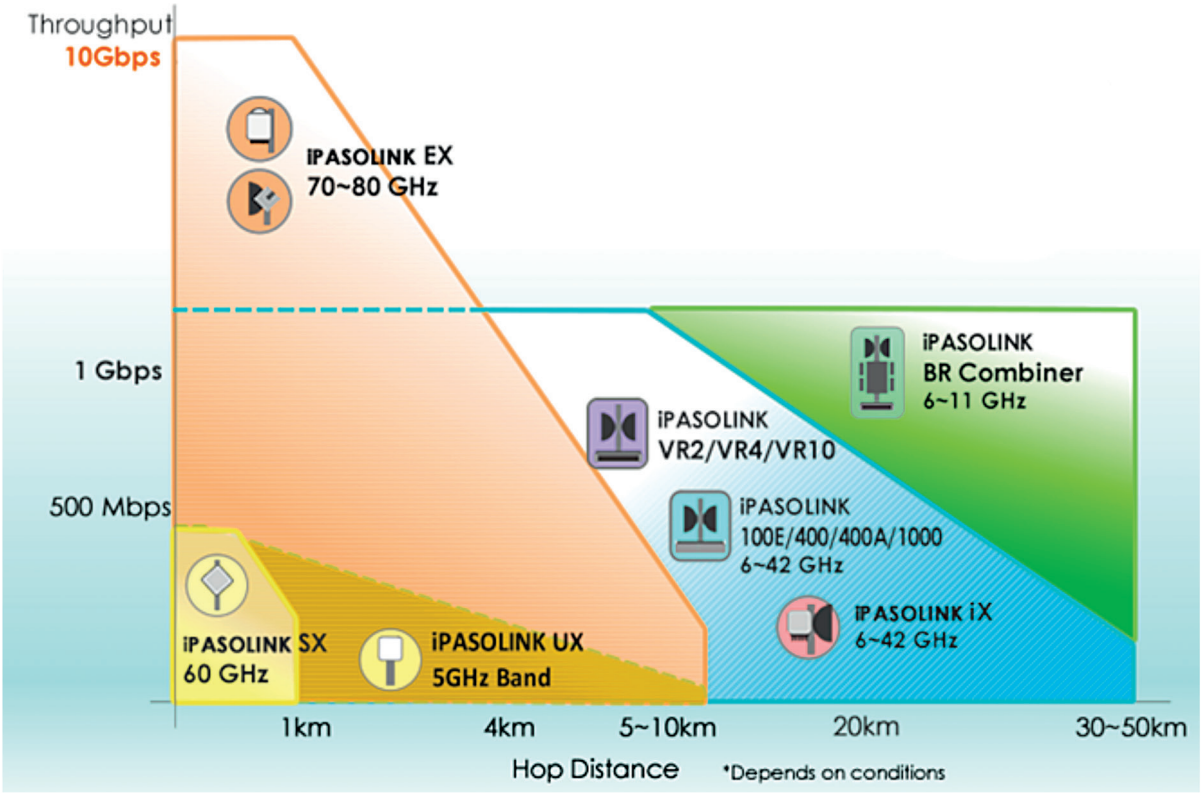
(b) Split Mount Type

NEC's Intelligent Converged Platform is designed to meet the capacity, topology, flexibility and intelligence requirements of next generation mobile backhaul.

It comprises the evolution of NEC's mobile backhaul solution portfolio and it builds on NEC's global market leadership.



<Hop Distance & Capacity>



<Reliability>

(4) Installation Reference

(a) Mobile Backhaul Solution for LTE Network

Czech

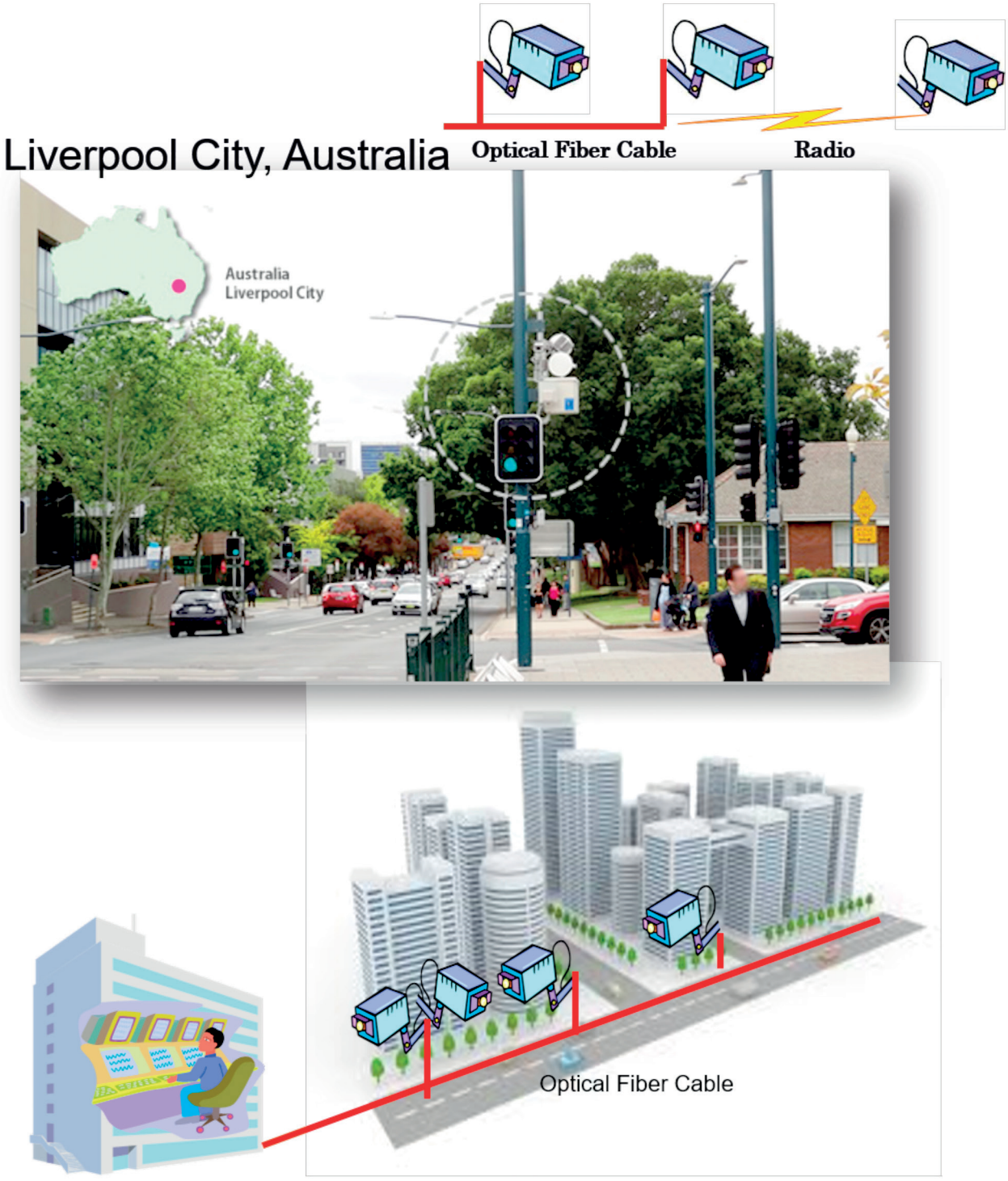
NEC
iPASOLINK

Kuwait

New York, USA

(b) Application to the Public Safety Network

Surveillance Camera



- Installed by Local Government
- Connected with IP Network
- Centralized Monitored by Police
- Web Camera : Open in Public thru Internet

(5) Supply Records

(5) Engineering and Customer Support

NEC stands for no concessions. We are continuously upgrading the capabilities of existing systems to their absolute peak of efficiency. Our management philosophy is more of being proactive to innovation, which ensures that the right idea is implemented at the right time.

Not only that, in order to satisfy and comply with the needs of each customer, NEC's commitment in a project includes everything from planning to implementation down to complete customer support such as testing, training, operation and maintenance.

Everything just doesn't end there! We don't wash our hands off the project after the hardware has been installed, and we follow through with comprehensive hands-on services. This on-going support assures the customer of a better service and a stable system.

Years of experience as a world leader in communications means that NEC offers the finest designs for new systems, as well as logistics support for the existing systems. Whatever your needs are, you can count on NEC's worldwide reputation for reliable and proactive customer service.

System Design Consultation

- Detailed assessment of customer's requirement
- Design proposal with the customer including future expansion plan
- Link analysis or path profiling and system availability with calculation
- NMS design

Site Survey

- Evaluation of site location plan considering the line of site of microwave path
- RF interference analysis
- Antenna height and location
- Local regulation review
- Consultation of frequency coordination

Factory Testing

- Quality inspection test ensuring customer's requirements

Delivery

- Delivery to customer-specified places implementing powerful and safe logistics support

Civil Works

- Site construction including access road, tower erection, etc. by highly qualified local contractors.

Installation and Testing

- Equipment installation and testing by highly qualified engineers

Commissioning

- Ensures excellent performance
- Meets design specification

Maintenance Support

- e-Help desk
- Regional and local support centers

Training

- On-site and class room training to impart the knowledge to customer's staff enabling them to be efficient in operating the equipment.
- Covers equipment and system operation as well as guide to troubleshooting and maintenance

Professional Support

- Network Enhancement / Optimization
- Performance Monitoring / Analysis
- DCN Design

About NEC Corporation

NEC Corporation is a leader in the integration of IT and network technologies that benefit businesses and people around the world. By providing a combination of products and solutions that cross utilize the company‘s experience and global resources, NEC’s advanced technologies meet the complex and ever-changing needs of its customers. NEC brings more than 100 years of expertise in technological innovation to empower people, businesses and society.

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