

**Bangalore Water Supply and Sewerage Board, India
Cambodia, Siem Reap Water Supply Authority**

**Data Collection Survey on
Enhancement of DX Utilization and
Preparation of Digital Architecture for
Water Utilities**

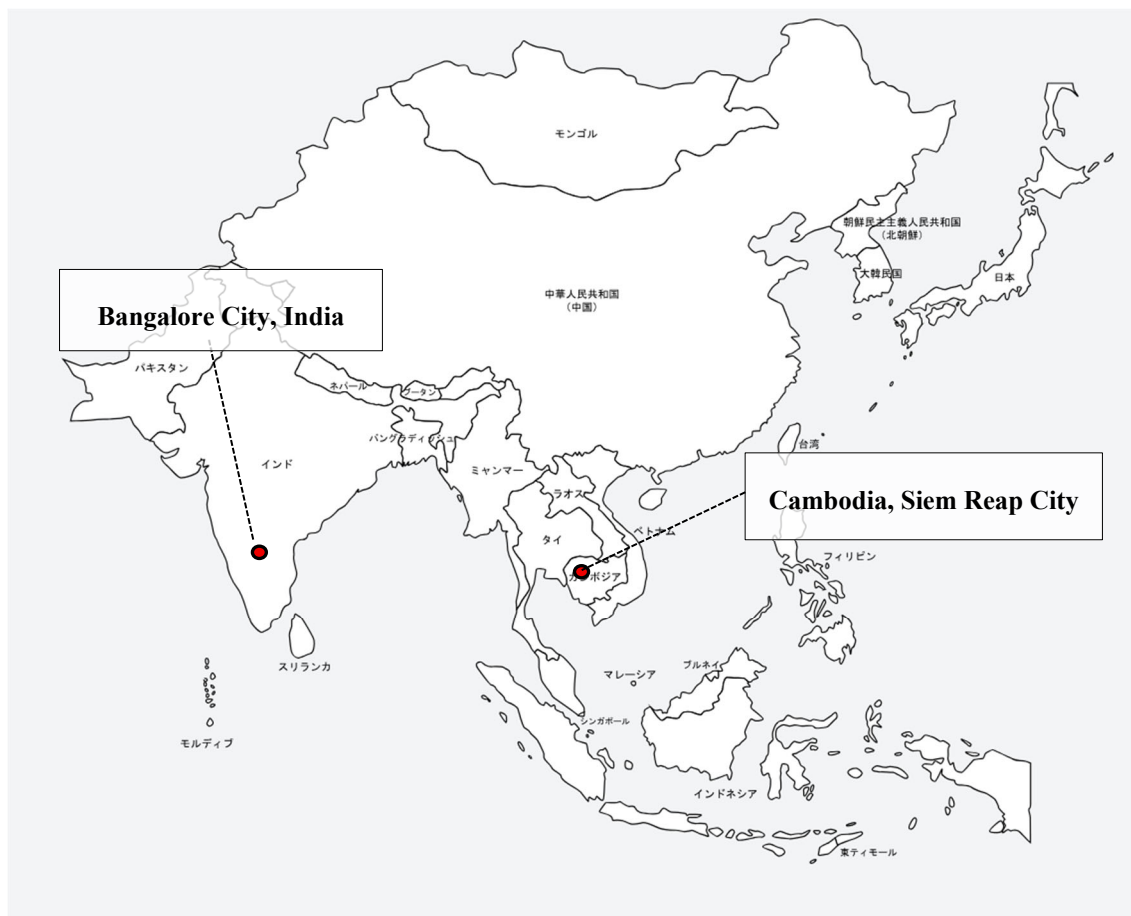
Final Report

February 2026

**Japan International Cooperation Agency
(JICA)**

Tokyo Engineering Consultants Co., Ltd.

GE
JR
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※ The border lines depicted on this map do not constitute any official recognition or intention to recognize.

Target Area Map

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List of Abbreviations

Abbreviations	English
AI	Artificial Intelligence
As-Is	As-Is
BWSSB	Bangalore Water Supply and Sewerage Board
CMMS	Computerised Maintenance Management System
CMS	Complaint Management System
DBO	Design-Build-Operate
DMA	District Metered Area
DLP	Data Loss Prevention
DX	Digital Transformation
EAM	Enterprise Asset Management
ERP	Enterprise Resource Planning
GIS	Geographic Information System
GLR	Ground Level Reservoir
HR	Human Resources
HRMS	Human Resource Management System
IT	Information Technology
IoT	Internet of Things
JGA	JICA Global Agenda
JICA	Japan International Cooperation Agency
JST	JICA Survey Team
KPI / KPIs	Key Performance Indicator(s)
KML	Keyhole Markup Language
KRSRAC	Karnataka State Remote Sensing Applications Centre
LC	Letter of Credit
MIS	Management Information Systems
MISTI	Ministry of Industry, Science, Technology and Innovation (Cambodia)
NOC	No Objection Certificate
NRW	Non-Revenue Water
O&M	Operation and Maintenance
OCR	Optical Character Recognition
ODA	Official Development Assistance
OTP	One Time Password
PF	Platform
PoC / POC	Proof of Concept
PPWSA	The Phnom Penh Water Supply Authority
QGIS	Quantum Geographic Information System
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operating Procedures
SRWSA	Siem Reap Water Supply Authority
STP	Sewage Treatment Plant
SUMS	Smart Utility Management Solutions
To-Be	To-Be
UPI	Unified Payments Interface
VAPT	Vulnerability Assessment and Penetration Testing
WMS	Work Management System
WTP	Water Treatment Plant

1. Survey Overview

1.1. Background and Purpose of the Survey

1.1.1. Background to the Survey

In order to address increasingly complex development challenges, the Japan International Cooperation Agency (JICA) has, since 2021, established 20 “JICA Global Agendas (thematic business strategies)” (hereinafter referred to as “JGA”). Under this framework, JICA has further strengthened its efforts by organizing prioritized groups of initiatives as “Cluster Strategies.” In the water sector, under the JGA “Ensuring Sustainable Water Resources and Water Supply,” JICA has formulated the Cluster Strategy “Supporting the Growth of Water Utilities.”

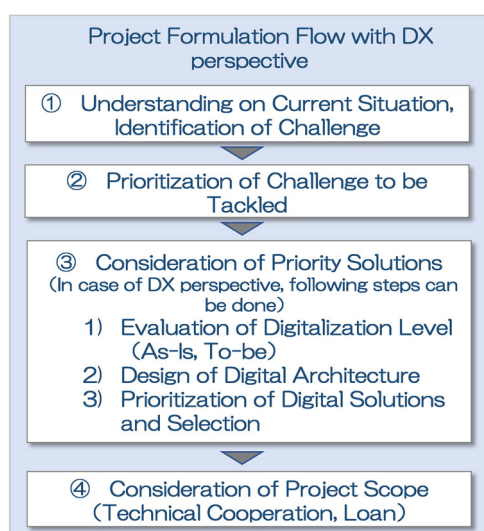
Under this Cluster Strategy, water utilities are categorized into four development types: (i) Human Security-oriented Type, (ii) Basic Service Improvement Support Type, (iii) Water Utility Growth Support Type, and (iv) Sector Governance Support Type. JICA’s policy is to support water utilities in progressing to the next development stage by adopting cooperation approaches tailored to each stage.

In order to promote the transition of water utilities across development stages, it is necessary to utilize the limited resources available to water utilities in an effective and efficient manner, as well as to maximize the effective use of limited Official Development Assistance (ODA) resources. Based on this recognition, JICA examined and developed the “Operational Reference Materials for Digital Utilization to Support the Development Stages of Water Utilities” (hereinafter referred to as the “Operational Reference Materials”).

The Operational Reference Materials outlines, inter alia, the organization of data generated through the operation of water utilities and the target level of digitalization to be achieved at each development stage. It also presents steps for analyzing the current level of digitalization of a water utility and for examining effective approaches. By utilizing this document, it is expected that the application of digital technologies to water utilities in developing countries can be examined in a more proactive and strategic manner, thereby contributing to an efficient and effective acceleration of their transition to higher development stages.

JICA plans to propose solutions that contribute to the efficient and effective development of water utilities by promoting digital transformation (DX) and enabling effective and appropriate use of digital technologies, to enhance utility growth in future. This will be undertaken through the utilization of the Operational Reference Materials in the formulation of all projects in the water supply sector, including both financial cooperation and technical cooperation.

On the other hand, the application of the Operational Reference Materials has been limited to date. Specifically, during its development in collaboration with the JICA DXLab, the in-house consultant responsible for its preparation applied the document to only two water utilities as part of a Proof of Concept (POC). There have been no application cases in other water supply projects thus far, and as a



Source: JICA Survey Team (JST)

Figure 1-1 Project Formulation Flow Including DX Perspective

result, there remains insufficient accumulated knowledge regarding the effectiveness and user-friendliness of the Operational Reference Materials.

1.1.2. Purpose of the Survey

This survey aims to verify the effectiveness of the operational reference materials and gather information for improving their usability. It seeks to contribute to project formulation, including from a business entity DX perspective, by analysing the digitalization level of the target water utilities using these materials.

This survey targeted the following two countries and two utilities:

- Cambodia: Siem Reap Water Supply Authority (SRWSA)
- India: Bangalore Water Supply and Sewerage Board (BWSSB)

1.2. Basic Policy of the Survey

The survey was conducted based on the three fundamental principles outlined in Table 1-1 .

Table 1-1 Basic Policy for Project Implementation

	Basic Policy	Specific Policy
1	Improving reference materials for executive duties to effectively contribute to "project formulation incorporating a DX perspective"	(1) Improvement of operational reference materials to effectively support the developmental stages of water utilities
		(2) Improvement of operational reference materials to be standardized and easily understandable for project development personnel
2	Improvements to Practical Operational Reference Materials	(3) Addition and utilization of information collection formats (information collection and evaluation)
		(4) Creation of a roadmap extending to the long-term future vision (Digital Architecture Development)
		(5) Addition of entity priority criteria (solution proposals)
3	Improving operational efficiency and speed for the entire survey	(6) Implementation of questionnaire surveys
		(7) Utilization of work management tools
		(8) Promoting commitment from the entity's management

1.2.1. Policy 1: Improving reference materials effectively contributing to "project formulation incorporating a DX perspective"

Firstly, the JICA Survey Team (JST) aims to improve the reference materials for executive duties to effectively contribute to "project formulation incorporating a DX perspective". Digital utilization is indispensable for the growth of water utilities, and project formulation actively incorporating a DX perspective (Figure 1-1) is increasingly necessary. Crucially, care must be taken to ensure that the

introduction of digital tools does not precede the prioritization of solving the utility's challenges. In other words, (1) digital solutions that effectively support the water utility's stage of development must be appropriately selected. Furthermore, the reference materials is designed with a focus on clearer, standardized steps and criteria, expressed in a manner more readily understood by those involved in project formulation.

1.2.2. Policy 2: Improving to Practical Reference Materials

To ensure operational reference materials become practical through investigative work, improvement proposals are considered for each of the following four stages: ① Information collection, ② Evaluation, ③ Digital architecture creation, ④ Solution proposal.

(1) Addition of an Information Collection Format

As it is unclear what information should be collected to facilitate digitalization level assessment and solution consideration, the JST proposes creating an 'Information Collection Format' for the business entity as part of the operational reference materials.

Furthermore, to propose more feasible solutions considering the entity's current situation, the format will be designed to enable the collection of necessary information regarding the target entity's management plans, strategies, and current digital utilization status.

(2) Creation of a Roadmap to the Future Vision

The JST will create a roadmap that bridges the gap between the current state (As-Is) and the future state (To-Be) of the digital architecture. This roadmap would enable verification of alignment with equipment readiness and human resource strategies while realizing digital utilization over a long-term timeframe. The proposed roadmap outlines the sequence and duration for solution implementation, structured to visually track progress and effects of digital utilization. Furthermore, technologies that are not proposed as priority solutions will also be incorporated within the roadmap to contribute to the ongoing development of projects.

(3) Review of Priority Criteria for Business Entities

When considering solution priorities, the operational reference materials stipulate prioritization based on two criteria: impact and feasibility. However, regarding solution implementation, even if impact and feasibility are high, sustainable improvement is unlikely without corresponding strategic priority or initiative from the business entity in the relevant field. The current operational Reference Materials states that "the weighting of each criterion should be determined in light of the business entity's individual circumstances and strategy," but this impression is unclear. Through the survey, the JST exchanged views with in-house consultants to clarify their approach and methods of application.

1.2.3. Policy 3: Streamlining Surveys and Coordination with Other Survey Activities

(1) Survey Efficiency

This survey has a limited timeframe and overall workload, and its subject matter represents a new approach focusing on DX. While information gathering via a desktop survey is anticipated, much data remains unpublished, and obtaining information specifically focused on DX is expected to be particularly challenging. Therefore, to ensure the necessary quality and quantity of information on the target entities, questionnaires were distributed in advance. Where possible, non-public information was obtained prior to on-site surveys to enable efficient analysis.

(2) Coordination with Other Survey Activities

JICA conducted the *"Data Collection Survey through Management Guidance Based on the Global Cluster Strategy: 'Support for Water Utility Growth'"*. To foster a sustainable growth spiral for water utilities, the initiative is developing KPIs and analytical tools to understand their developmental stages and trends. In this context, DX is positioned solely as a tool to support the growth of water utilities. The concepts and tools developed under the aforementioned survey were applied appropriately to this survey as well.

1.3. Methodology of Survey

This survey adopted a phased survey process with the objective of systematically organizing the current status and challenges of DX at the target utilities and formulating highly feasible digital solutions. The survey methodology is outlined below.

(1) Desktop Survey

- Publicly available information obtained from the internet and other sources was utilized to collect information on each utility's overview, management challenges, water supply, financial conditions, organizational structure, as well as the status of digitalization and ICT system implementation.
- Specifically, business reports, annual reports, documents from relevant government agencies, and past JICA survey results were reviewed to comprehensively analyze the external environment surrounding the utilities and their management challenges. Through this process, key focus areas for subsequent questionnaire design and field surveys were clarified.

(2) Advance Information Collection through Questionnaires

- In order to complement detailed information that is difficult to capture through the desktop survey alone, questionnaires were distributed to each utility to collect advance information.
- The questionnaires covered items such as KPIs, the status of digitalization across business processes, an overview of implemented systems (including screen captures where possible), data management and utilization practices, and the IT human resource structure.

- This process aimed to improve the efficiency of interviews during the field surveys and to highlight key discussion points.

(3) First Field Survey

- Based on the results of the desktop survey and questionnaires, the first field survey was conducted.
- During the field survey, detailed interviews were carried out through visits to relevant departments, focusing in particular on issues that could not be fully understood through the advance information or where questionnaire responses were insufficient.
- In addition, the actual operational status of existing systems such as SCADA, billing and accounting, and operational management was reviewed to identify current practices, challenges, and areas for improvement.
- At the same time, a digital architecture (As-Is) was developed to the extent possible and discussed with the relevant personnel.

(4) Domestic Analysis Based on Survey Results

- Based on the results of the first field survey, the following analysis was conducted domestically:
 - ✓ Identification of management challenges based on KPIs
 - ✓ Assessment of the level of digitalization
 - ✓ Organization of the digital architecture (As-Is)
- A future digital architecture (To-Be) was then envisaged, and digital solutions required to realize this future state were identified and organized.
- Furthermore, digital solutions to be explained in detail during the second field survey were selected through scoring from the perspectives of impact and feasibility. Explanatory materials summarizing the digital technologies, expected effects, and other relevant aspects of the selected digital solutions were prepared.
- These materials were structured in a manner that was easy for senior management of the utilities to understand, taking into account management challenges and the operating environment, and were intended to serve as reference materials for future policy and strategy discussions.

(5) Second Field Survey

- Based on the results organized through the domestic analysis, the second field survey was conducted.
- During the second field survey, the results of the digitalization level assessment and scoring were explained, and comments were collected from the utilities, particularly regarding high-priority digital solutions.
- Based on these comments, the validity of the scoring results and the content of the proposed solutions was confirmed and revised as necessary.

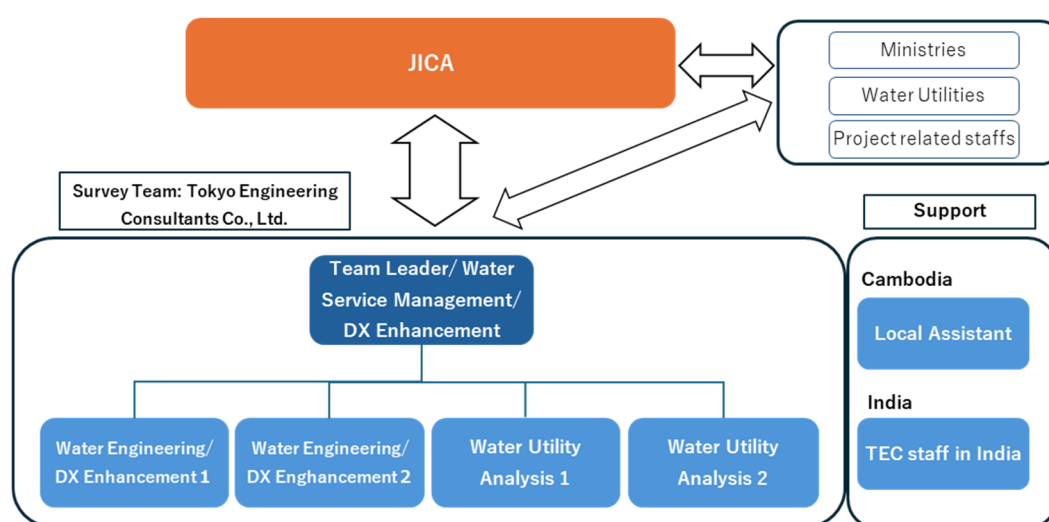
(6) Formulation of a Roadmap

- For the finalized digital solutions, an implementation roadmap was formulated from a medium- to long-term perspective, taking into account their priorities.
- The roadmap organizes the implementation sequence, timing, and prerequisites for each solution (including relationships with existing systems and human resource and organizational arrangements), enabling the utilities to promote DX in a phased and realistic manner.

1.4. Implementation Structure and Schedule for This Survey

1.4.1. Implementation Framework

The implementation structure for this survey is shown in Figure 1-2.



Source: JST

Figure 1-2 Implementation Structure of the Survey

1.4.2. Survey Process

The survey schedule for this investigation is shown at Table 1-2 .

Table 1-2 Survey Schedule

Category	No.	Work Item	2025								2026	
			6	7	8	9	10	11	12	1	2	
Work in Japan	[1]	Preparation of Work Plan and Explanation	■									
	[2]	Implementation of Desktop Survey		■	■							
	[3]	Preparation of 1st Field Survey			■	■						
	[4]	Discussion with JICA before 1st Field Survey			■							
Target countries	[5]	Implementation of 1st Field Survey			■	■						
Work in Japan	[6]	Development of Digital Architecture			■	■	■					
	[7]	Development of Digital Solutions and Scoring			■	■	■	■				
	[8]	Preparation of 1st Field Survey, Discussion with JICA					■	■				
	[9]	Discussion with JICA Inhouse Consultant						■	■	■	■	■
Target Countries	[10]	Implementation of 2nd Field Survey					■	■				
Work in Japan	[11]	Consideration of Improvement on Reference Materials						■	■	■	■	■
	[12]	Meeting for Exchange of Views										■
	[13]	Preparation of Final Report									■	■

Source: JST

1.4.3. Field Survey Schedule

The JST conducted the first survey in July–August 2025 and the second survey in October–November 2025.

Table 1-3 Field Survey Schedule

Survey	Date	Country	Schedule
First Survey	22 July		Departing Japan→
	23 July	India	→Arrive locally, kick-off meeting
	24 July		Field survey
	25 July		Field survey
	26 July		Site survey
	27 July		Internal Meeting/Document Organization
	28 July		Field survey
	29 July		Site survey
	30 July	India/Cambodia	Travel → Arrival at destination
	31 July	Cambodia	Kick-off meeting (SRWSA)
	1 August		Field survey
	2 August		Field Survey
	3 August		Internal Meeting/Document Organization
	4 August		Field survey
	5 August		Site survey
	6 August		Site survey
	7 August		Field survey, departure from site→
	8/8		→Arrival at Japan
	Total		18 days
Second Survey	24th October		Departing Japan→
	25/10	India	→Arrival on site, discussions and supplementary investigation

Survey	Date	Country	Schedule
	26/10		On-site discussions and supplementary investigation
	27/10		On-site discussions and supplementary investigation
	28/10		On-site discussions and supplementary investigation
	29/10	India/Cambodia	Travel → Arrival at destination
	30/10	Cambodia	Local discussions and supplementary investigation
	31/10		On-site discussions and supplementary research
	1/11		Internal Team Meeting/Document Organization
	2/11		Document organization
	3/11		On-site discussions/supplementary investigation, travel→
	4 November		→Arrival at Japan
	Total		10 days

Source: JST

2. Survey Findings

2.1. Results of Field Surveys (1st and 2nd)

2.1.1. Siem Reap Water Supply Authority (SRWSA)

(1) Discussions during the First On-site Investigation

During the first field survey, visits were made to the SRWSA headquarters, related facilities, and maintenance sites, with interviews conducted with departments involved in digitalization. This survey involved discussions on the operational status of existing digital systems at SRWSA (GIS, SCADA, billing, meter reading, etc.), inter-system integration, and the challenges and future direction of digitalization. The departments which were consulted and the topics which were discussed during the first on-site survey are outlined below. For details, please refer to Appendix 6-1.

Table 2-1 Discussions during the First On-site Survey (SRWSA)

No.	Date / Time	Topic / Dep.	Participants	Key Discussion Topics
1	Jul 31, 2025 07:50–08:15	SRWSA Kickoff Meeting	MISTI: H.E. Khut Vuthiarith; Mr. Phea Sinat; Mr. Kong Sovan / SRWSA: H.E. Chan Sengla; Mr. Yay Monirath; Mr. Kot Nimol; Mr. Sok Hout; Mr. Pheng Bunhor / JICA Cambodia Office: Mr. Munakata Atsushi; Mr. Seng An Youk	• Project overview and schedule • Coordination with SRWSA for their availability • Staff absence due to external workshop • Adjustment of meeting participation
2	Jul 31, 2025 08:30–09:20	AQUA Crew and IT Section	Mr. Pheng Bunhor; Mr. Luon Soknoun; Mr. Somphos Vichhai Chhon	• AQUA Crew PC allocation and usage • Data scope (network, meters, customers; no WTP) • Manual data updates and CSV handling • Network simulation dependency on vendor (.inp) • No system integration with SUMS
3	Jul 31, 2025 09:20–10:20	Commercial Department	Mr. Pheng Bunhor; Commercial Dept. staff	• SUMS functions and vendor support • Fully manual meter reading and billing process • License cost and limited concurrent users • Constraints to digitization (cost, devices) • High collection rate and strict disconnection policy
4	Jul 31, 2025 10:35–11:30	Accounting Department	Mr. Pheng Bunhor; Ms. Thap Seila	• Inventory and asset management via SUMS • Approval-based workflow and audit trail • Automated depreciation and monthly reporting • Post-COVID financial pressure and cost increase • Capacity–demand gap and expansion financing
5	Jul 31, 2025 11:35–12:00	Complaint Management and Others	Mr. Pheng Bunhor; Customer section staff	• Complaint categories and intake channels • Manual recording and Excel-based tracking • Coordination with repair teams • Payment behavior (cash vs mobile app) • Access constraints during rainy season

No.	Date / Time	Topic / Dep.	Participants	Key Discussion Topics
6	Jul 31, 2025 14:30–15:40	Kickoff with MISTI	SRWSA: H.E. Chan Sengla; senior management / MISTI: H.E. Khut Vuthiarith et al.	• DX and system integration policy direction • Fit-to-capability system design • Business-oriented utility management • Importance of training and capacity building • Smart meter pilot and future support
7	Jul 31, 2025 16:15–17:10	SCADA Room at WTP3	SRWSA technical staff	• WTP3 operational constraints and utilization • SCADA monitoring and control scope • Manual chemical dosing and limited sensors • Zone-level bulk metering and NRW concept • Water quality testing and data handling
8	Aug 1, 2025 08:30–10:00	MISTI	MISTI: H.E. Khut Vuthiarith et al. / SRWSA: Mr. Pheng Bunhor	• MISTI DX status and institutional setup • KPI framework and data collection process • Public vs private water operator issues • Regulatory approach to private operators • Expectations for donor support
9	Aug 1, 2025 10:40–11:00	Distribution Department	Mr. Meng Hengkim Lin; Mr. Luon Soknoun; Mr. Kheav Kimleng; Mr. Pheng Bunhor; Mr. Kot Nimol; Mr. Horm Sophany	• NRW definition and manual calculation • Distribution department structure and roles • Leak detection and response procedures • Pressure management and valve operations • SCADA use and lack of system integration
10	Aug 1, 2025 11:30–12:00	Leak Detection Section	Mr. Pheng Bunhor; Mr. Kheav Kimleng	• Network history and expansion phases • Leak detection policy and night surveys • Data-based prioritization (MNF, SCADA, pipe age) • Annual inspection coverage and ad-hoc surveys • Capacity building through JICA support
11	Aug 1, 2025 14:30–15:30	Project Planning & Management Dept.	Mr. Pheng Bunhor	• Ongoing and planned network expansion projects • WTP capacity vs actual production • Smart meter interest and NRW management limits • Loan repayment constraints and grace period • IT/GIS staffing and limited system integration
12	Aug 1, 2025 16:10–17:00	SCADA Room at WTP1 & WTP2	Mr. Pheng Bunhor; SRWSA SCADA staff	• SCADA architecture and control limitations • Differences between WTP1 and WTP2 control • Manual operation of pumps and chemical dosing • Multi-plant operation challenges in one network • Vendor support gaps and obsolete components
13	Aug 4, 2025 09:00–10:00	Head of Accounting Department	Mr. Pheng Bunhor; Ms. Meas Vichana	• Current and upcoming business plans • SUMS module expansion (HR, payroll, customer service) • HR management challenges and recruitment limits • Manual payroll process using Excel • Staffing adequacy and future adjustments
14	Aug 4, 2025 10:00–11:00	Head of Commercial Department	Mr. Pheng Bunhor; Mr. Sam Senghan	• Commercial department structure and roles • Meter reading workload and staffing limits • Meter accuracy standards and replacement cycles • Revenue constraints and customer behavior issues • Tariff revision policy and billing rules

No.	Date / Time	Topic / Dep.	Participants	Key Discussion Topics
15	Aug 4, 2025 11:10–12:00	Accounting Department	Mr. Pheng Bunhor; Mr. Sam Senghan	• Customer classification and active connections• Interest in digital meter reading (OCR pilot at PPWSA)• Expected efficiency gains from digitization• Uncertainty on pilot maturity and transferability• Concerns on scalability of manual operations
16	Aug 4, 2025 (time n/a)	Site Visit – Pipe Construction & Avenza Use	SRWSA field staff	• AQUA Crew data export limitations• QGIS–KML–Avenza workaround workflow• Manual feedback loop to AQUA Crew• Data version inconsistency and security concerns• Zone-based data handling due to file size
17	Aug 5, 2025 08:30–10:10	AQUA Crew	Mr. Pheng Bunhor; Mr. Luon Soknoun	• AQUA Crew as master network/customer dataset• CSV data adjustment for SUMS import• Semi-annual data synchronization with SUMS• Dependence on vendor for network analysis data• Ongoing discussion on system integration cost/benefit
18	Aug 5, 2025 10:10–11:00	Water Supply Dept. (O&M)	Mr. Pheng Bunhor; Mr. Kimleng	• SOP-based O&M practices• Excel-based maintenance and leak records• Valve operation and preventive maintenance• Daily bulk meter data sharing via Telegram• Internal capacity for QGIS/EPANET analysis
19	Aug 5, 2025 11:10–11:40	Stock Yard Status	Mr. Pheng Bunhor; Accounting Dept. staff	• New stock yard setup and asset relocation• Manual stock in/out recording and Excel summary• SUMS-based inventory control requirements• Approval workflow for material usage• Separation of customer meters and other assets
20	Aug 5, 2025 14:30–16:00	WTP Monitoring & Site Visit	Mr. Pheng Bunhor; Mr. Meng Hengkim Lin; Ms. Seang Ravy	• Monitoring scope differences among WTP1–3• Use of remote desktop instead of SCADA linkage• Current WTP3 operating hours and utilization• Intake condition updates vs past issues• Distribution status by zone
21	Aug 6, 2025 09:40–10:10	Accounting Department	Mr. Pheng Bunhor; Accounting Dept. staff	• Current SUMS functional coverage• Financial, billing, asset, and inventory modules• Additional modules starting Jan 2026• Screen-level confirmation of system scope
22	Aug 6, 2025 11:10–12:10	Kitakyushu Water Service (KWS)	Mr. Pheng Bunhor	• MOFA-funded integrated platform for PPWSA• SUMS, GIS, and smart meter integration issues• High license cost and vendor lock-in risks• PPWSA smart meter and NRW management cases• Implications and lessons for SRWSA DX
23	Aug 6, 2025 15:30–16:00	Findings Explanation to SRWSA Management	H.E. Chan Sengla; Deputy Directors; Mr. Pheng Bunhor	• Step-by-step DX approach emphasized• Importance of human resource development• Benchmarking against PPWSA• Need for realistic transition roadmap• Alignment on future discussion and proposals

(2) Key Points (Results) from the First Survey

The main points confirmed in the first on-site survey results are outlined below.

- Direction for DX Implementation
- ✧ MISTI

- There is an understanding of the necessity for efficiency gains through DX, with a direction to promote DX across the entire water sector
- Prioritizing operational efficiency and technology-based services
- Business-oriented water services will be crucial
 - ✓ Improving efficiency, utilizing data, ensuring rapid response, securing profitability, and reinvesting profits
 - ✓ System design aligned with staff capabilities is vital, alongside workforce development
- There is no documented DX strategy for MISTI

✧ SRWSA

- Fundamentally positive direction for promoting DX
- Partial digitalization initiatives exist, but there is no overarching digital strategy, policy, master plan, or roadmap
- To fully utilize digital systems and tools, personnel with greater expertise (operational staff) are required
- While there is expectation for DX utilization, it is recognized that a step-by-step introduction is important, rather than a sudden leap forward

(3) Discussions during the second on-site survey

During the second on-site survey, discussions were centered around KPI analysis based on collected information, digitalization level assessment results, digital architecture, the digital solutions list and scoring outcomes, and proposed priority DX solutions derived from the scoring results. Attempts were also made to gather information on-site that could not be collected prior to the second survey.

The departments which were consulted and the topics which were discussed during the two on-site surveys are listed below. For details, please refer to Appendix 6-2.

Table 2-2 Discussions during the Second On-site Survey (SRWSA)

No.	Date	Consulting Departments, etc.	Participants	Main Discussion Topics
1	30 October 2025 09:00–11:30	2nd Meeting: Explanation of 1st Survey Results & Q&A	MISTI: H.E. Khut Vuthiarith; Mr. Phea Sinat; Mr. Ly Chansothea / SRWSA: H.E. Chan Sengla; Mr. Seak Pengkeang; Mr. Pheng Bunhor	• Explanation of the 1st Survey Results • Confirmation that the survey results accurately reflect SRWSA's current situation • The high cost of smart meters and the practicality of utilizing existing meters • The importance of human resource development in DX implementation • The relationship between the DX Roadmap and SRWSA's Master Plan

No.	Date	Consulting Departments, etc.	Participants	Main Discussion Topics
2	31 October 2025 10:00– 11:00	Follow-up Discussion	Mr Pheng Bunhor	• Customer communication methods (Telegram and mobile-centric) • Status of online payment environments and bank integration • Monitoring status of water purification and distribution volumes (managed individually per WTP) • Asset management, maintenance, and renewal plan implementation • Inter-departmental communication centered on Telegram and constraints on IT personnel
3	31 October 2025 14:30– 16:00	Technical Discussion on Proposed Solutions (SCADA & WTPs)	Mr Meng Hengkim Lin; Ms Seang Ravy	• Priority for SCADA upgrade at WTP1 and centralized monitoring at WTP3 • Operational policy based on remote control constraints and on-site operation • Zone-specific water pressure differentials and risks during future expansion • Differences in water treatment unit costs between WTPs 1–3 • Constraints on tariff revisions, energy efficiency, and renewable energy case studies

(4) Key comments and questions from SRWSA and MISTI during the second field survey

Following the delegation's presentation, the main comments received from SRWSA are outlined below. Refer to Table 2-16 for the solution numbers and their descriptions.

➤ Comments and questions from SRWSA

- The survey results accurately reflect SRWSA's current situation
- (Solution No. 2) In the current scenario, as smart meters are costly, we consider it more practical to implement the proposed meter reading system utilizing existing meters.
- (Regarding Solutions in General) We consider staff development to be crucial when implementing DX solutions.
- (Solution Nos. 12 & 5) (SCADA Operator Manager & Water Quality Manager) Updating and integrating the WTP SCADA system is considered a high priority. The sequence should prioritize updating WTP1 first. At WTP3, remotely controlling WTP1 and WTP2 would be more efficient and beneficial as it would increase management efficiency by staff reduction. Concerns exist that communication issues with WTP1 and WTP2 could arise, potentially making remote control difficult.
- It would also be beneficial to introduce water quality monitoring functionality. Installation points would be: ① Raw water intake, ② Outlet of the WTP reservoir, ③ Flow meter locations in each zone.

- (Question) Regarding the relationship between the master plan currently progressing in the detailed planning phase and the findings of this DX survey, as well as its consistency with the DX master plan to be developed.
 - ✓ The JST conveyed that, based on information received from JICA (though the JST itself cannot make definitive statements), some outcomes of this DX survey may potentially be incorporated into the currently ongoing master plan. However, it was also reiterated that the content of the DX master plan differs fundamentally from that of the standard master plan.
 - (Question) Regarding the implementation sequence for the 14 DX solutions presented this time.
 - ✓ The JST responded that they plan to create a simplified roadmap in the future, within which the implementation sequence can be indicated to some extent. They stated that the final report will be submitted to JICA around January next year and requested that this be reconfirmed at that time.
- Comments and questions from MISTI
- MISTI was able to reconfirm the current status of SRWSA. They fundamentally agree with the findings of the investigation.
 - MISTI will consider incorporating digital transformation into the national strategy going forward and will closely monitor technological advancements.
 - As SRWSA conducts training for neighboring water utilities, MISTI wishes to use SRWSA and PPWSA as models to establish a foundation for nationwide expansion of DX.
 - MISTI hopes to continue discussions with JICA regarding the DX Master Plan and the implementation of pilot projects.
 - Human resource development is essential for DX implementation. MISTI wishes to understand in greater detail the equipment and machinery required for each proposed solution, the expected benefits, and the maintenance and management costs.
 - Across Cambodia, water utilities prioritize expanding distribution networks. Consequently, they are concerned about increased operational and maintenance costs resulting from DX implementation. This is particularly challenging in the water sector, where tariff adjustments are difficult.
 - The primary challenge in DX implementation is financial constraints.

2.1.2. Bangalore Water Supply and Sewage Board (BWSSB)

(1) Discussions during the first field survey

During the first field survey, visits were made to BWSSB headquarters and related facilities, with interviews conducted with the departments involved in digitalization. Discussions covered the

operational status of existing digital systems at BWSSB (GIS, SCADA, billing, MIS, etc.), inter-system integration, challenges in digitalization, and future directions. The departments consulted and topics discussed during the first on-site survey are outlined below. For details, refer to Appendix 6-3.

Table 2-3 Discussions during the First On-site Survey (BWSSB)

No.	Date / Time	Topic / Dep.	Participants	Key Discussion Topics
1	July 23, 14:40–15:40	Kick-Off (Cross-departmental)	Mr. Sanath Kumar (Chief Engineer, QA, IT & B) Mr. V.B. Maheswarappa (Additional Chief Engineer, MIS & IT) Mr. Chandrasekhar (Executive Engineer, Design Section) Ms. Lakshmi Yadav K (Executive Engineer, IT Section) Ms. Kavita (IT Department) Ms. Ashwini (Technical Assistant)	- Objectives and scope of the project - Existing IT structure and digital responsibilities - Current digital initiatives (Kaveri on Wheels, IoT borewell pilot) - Human resource and operational constraints - Absence of formal digital strategy document - Coordination methods for surveys and site visits
2	July 25, 11:00–12:30	Billing System and GIS (IT Section)	Ms. Shilpa V. (Executive Engineer, IT Section – Billing & GIS)	- GIS system architecture and KRSRAC hosting - GIS update procedures and mapping limitations - SAJALA billing system functions - Tariff structure and online payment methods - Meter reading and collection practices - Meter replacement and defective meter handling - IT staffing constraints and outsourcing needs - MIS data access and sharing
3	July 25, 12:40–14:15	BWSSB's initiatives related to digitalization	Mr. V.B. Maheswarappa (Additional Chief Engineer, MIS & IT)	- IoT and AI concepts for water operations - Online consumer connection systems (Sakala, Jaladhare) - Digital billing, biometric payments, and spot billing - MIS reporting and dashboards- SCADA modernization under CP-24 - NRW monitoring using bulk meters - GIS-based certification linked to payments - Cybersecurity and data center arrangements
4	July 25, 15:15–16:00	IoT Borewell Monitoring and Kaveri on Wheels (Design Section)	Mr. Chandrasekhar (Executive Engineer, Design Section)	- IoT deployment for borewell monitoring - Real-time monitoring platform and pump protection - Pilot implementation and IISc collaboration - Kaveri on Wheels tanker digitization system - Market, social, and environmental impacts - Operator resistance and adoption challenges- Future initiatives (smart meters, prepaid meters) - Lack of integrated digital master plan

No.	Date / Time	Topic / Dep.	Participants	Key Discussion Topics
5	July 25, 16:05–16:30	Current Digitalization Status of BWSSB	Mr. K.N. Rajiv (Chief Engineer, Project Department)	- Stage VI project scope and monitoring systems - SCADA and flow meters across supply chain - Hydraulic modeling using WaterGEMS and AutoCAD - Energy efficiency improvements - Smart metering plan for non-domestic consumers - PPP-based implementation model - Management of illegal connections
6	July 28, 10:30–12:00	CP-24 Centralized SCADA Integration (PMC Interview)	NJS: Mr. Pradipto Sarkar (Director) Mr. Nizamuddin Ahmed (Sr. VP)	- CP-24 project scope and objectives- Integration of WTPs, STPs, GLRs, and UFW SCADA - Current implementation status and constraints - Legacy system compatibility issues - Power supply and automation challenges - Long-term roadmap (analytics, AI, digital twins)
7	July 28, 11:50–13:15	MIS, Kaveri on Wheels, GIS and Digital Services(IT Section)	Ms. Lakshmi Yadav K. (Executive Engineer, IT Section)	- MIS initiatives and service improvement programs - Kaveri on Wheels operational model and results - System architecture and platform stack - GIS-based asset management and updates - Integration with Sakala and complaint systems - Hosting on private cloud - Future upgrades and documentation sharing
8	July 28, 13:15–14:45	Financial Systems, WMS, HRMS, ERP(Accounts Section)	Mr. Prakash (Accounts Section)	- Work Management System (WMS) implementation - Integration with Oracle financial system - HRMS and e-filing rollout - Audits- Revenue platforms and dashboards - GIS integration and asset management - Defect Liability Period (DLP) automation - ERP convergence and data security
9	July 28, 16:30–17:00	Bulk Flow Meters and NRW Monitoring (UFW-II Department)	Ms. Nalini (Executive Engineer, UFW-II Department)	- Bulk flow meter monitoring practices - NRW/UFW calculation by subdivision - DMA formation under JICA Phase 2 projects - Legacy data handling and CP-24 integration - Roles of UFW division and subdivisions - Internal monitoring web portal demonstration
10	July 29, 11:00–13:00	CP-24 Central SCADA System Overview (Central SCADA Center)	Mr. Srinivas, Executive Engineer, BWSSB, Mr. Sachin Jawale, GM Automation), Chavare Engineering Pvt. Ltd. (System Integrator) , Mr. Salauddin, NJS Engineers India Pvt. Ltd. (PMC)	- CP-24 SCADA architecture and commissioning - Integration of water and sewerage facilities - Data acquisition, alarms, and dashboards - Cybersecurity and redundancy measures - DMA pilot projects for distribution monitoring - Future data analysis and forecasting

No.	Date / Time	Topic / Dep.	Participants	Key Discussion Topics
11	July 29, 13:00–14:00	Detailed SCADA Operations and Visualization (Central SCADA Room)	• Mr. Sachin Jawale, GM Automation, Chavare Engineering Pvt. Ltd. (System Integrator)), Mr. Salauddin, NJS Engineers India Pvt. Ltd. (PMC)	- SCADA data collection and MQTT communication - Visualization of flows, pumps, and reservoirs - Alarm logic and escalation mechanisms - Maintenance tracking and pump efficiency analysis - Reporting and data export functions - Mobile app development and pilot control plans
12	July 29, 15:45–16:30	NRW Reduction (UFW-II Department)	Mr. Purushothama BG (Additional Chief Engineer, UFW-II Department)	- History and outcomes of NRW reduction projects - SCADA and bulk meter utilization- Pipeline replacement strategies - Smart metering limitations and costs - Power supply and human factors challenges - Step-by-step approach to digitalization

(2) Key Findings from the First Survey (Results)

The main points confirmed in the first on-site survey results are outlined below.

- Direction Regarding DX Implementation
- ✧ 1. Promoting DX in line with reforms by the Indian Central Government and State Governments
 - There is a direction to promote operational efficiency through DX implementation
 - DX enables real-time data access and ensures transparency (both internally and for the general public)
 - Enables long-term cost reduction and data-driven management
- ✧ BWSSB's Direction
 - While there are partial digitalization initiatives, there is no overarching digital strategy, policy, master plan, or roadmap
 - Aligned with central and state government directives, digitalization and automation are being promoted
 - DX initiatives will be advanced in collaboration with the Karnataka State Government (e.g., Sakala, K-GIS, online water connection)

(3) Discussions during the second on-site survey

During the second on-site survey, discussions centered around KPI analysis based on collected information, digitalization level assessment results, digital architecture, the digital solutions list and scoring outcomes, and proposed priority DX solutions based on the scoring results. Attempts were also made to collect information that could not be gathered prior to the second on-site survey.

The departments consulted and topics discussed during the two site surveys are listed below. For details, please refer to Appendix 6-4.

Table 2-4 Discussions during the Second On-site Survey (SRWSA)

No.	Date / Time	Dep.	Participants	Key Discussion Topics
1	Oct 27, 2025 (10:45–11:25)	IT section	Ms. Lakshmi Yadav K (Executive Engineer, IT Section)	- Tariff and financial performance - KPI data gaps and annual report - Comprehensive IT strategy - IT maturity and cybersecurity - Centralized IT/AI governance - Review of potential solutions
2	Oct 27, 2025 (11:30–12:05)	IT section	Mr. V.B. Maheswarappa (Additional CE, MIS & IT); Ms. Lakshmi Yadav K (Executive Engineer, IT Section)	- KPI data requirements and validation - Metering rate and performance metrics - Staffing efficiency indicators - DX maturity and cybersecurity readiness - Risks of outdated data
3	Oct 27, 2025 (12:20–13:10)	IT section	Mr. Sanath Kumar V (Chief Engineer, QA, IT & B); Mr. Maheswarappa V B (Additional Chief Engineer, MIS & IT); Ms. Lakshmi Yadav K (Executive Engineer)	- Proposed DX solutions - Central control room concept - Integration of IT initiatives - Ongoing DX projects - IT manpower requirements - GIS automation and demand forecasting - Cybersecurity strengthening
4	Oct 27, 2025 (13:20–15:05)	IT section	Ms. Lakshmi Yadav K (Executive Engineer, IT Section)	- Cybersecurity awareness and SOC plan - IT staffing policy (in-house vs outsourcing) - Data architecture gaps - Smart metering and IoT roadmap - AI-based leak detection pilot - Asset and maintenance management - Change management
5	Oct 27, 2025 (15:10–16:00)	Accounts Section	Mr. Prakasha (Accounts Section)	- ERP program overview (HRMS, WMS) - HRMS/WMS implementation status - Integration with SCADA and GIS - Dashboards, transparency, and funding - Risks and dependencies
6	Oct 27, 2025 (11:30–12:30)	Monitoring Section	Monitoring Team Members	- DMA monitoring and flow meters - NRW calculation method - Meter types and data frequency - Operational use of SCADA data - Maintenance and replacement - CP-24 integration issues
7	Oct 27, 2025 (13:00–13:20)	IT section	Ms. Lakshmi Yadav K (Executive Engineer, IT Section)	- Solution evaluation framework - Priority DX and NRW solutions - NRW automation prerequisites - Smart metering strategy - Report schedule

(4) Key Comments from BWSSB During the Second Survey

Following the JST's presentation, the main comments received from BWSSB are outlined below.

- Establishing a forward-looking IT operational framework is essential. Currently, management is fragmented across different IT-related departments, leading to dispersed information.
- It is considered necessary to consolidate the operation and maintenance of DX under a single department, such as an IT Cell. This is to ensure a smooth transition after each project and guarantee sustainability.
- CE suggested a proposal to build a Centralized Control System. The concept involves managing SCADA, meter reading/billing, and other information on a single integrated platform (akin to a central dashboard). Alarm information from the dashboard would enable more efficient management.
- As DX advances and expands, increasing IT personnel is necessary. Strengthening this capability should be considered through either direct employment or outsourcing.
- Enhancement of water quality management, GIS, and facility management is required.
 - ✓ Expand central monitoring and control functions for chlorine injection equipment.
Replace gas chlorine systems with new technologies.
 - ✓ Centralizing GIS operations via a portal will improve accuracy and efficiency.
- A formalized, organization-wide DX strategy is required, encompassing IT strategy, KPI frameworks, and AI implementation strategy.
- To secure external financing and support, financial statements alone are insufficient; operational reports and dashboards incorporating KPIs are required.
- An AI-based leak detection pilot project is underway. Utilizing underground sensors, it is being demonstrated over approximately 1 km in sections deemed highly vulnerable.
- NRW automatic calculation is scheduled for implementation with the next SCADA upgrade, but this assumes 100% metering coverage
- Preparations are underway to establish a Security Operations Center as a cybersecurity measure.
- Implementation of an integrated core system (ERP) encompassing personnel management, work management systems, and asset management is underway. Aiming for full operation by April 2026, the start of the next fiscal year, implementation is progressing in phases.
- BWSSB wish to consult with the JICA office on how to proceed with digitalization going forward, taking into account the proposed digital solutions.

2.2. Overview of Water Services and Water Business Operations at Target Water Utility

2.2.1. Siem Reap Water Supply Authority (SRWSA)

(1) Overview of Water Services and Water Utility Operations

1) Desktop Survey and Questionnaire Survey

2) Water Supply Operations from the Perspective of Key Performance Indicators (KPIs)

3) Current Status and Challenges in Water Supply Operations

(2) Assessment of Digitalization Level

The digitalization level assessment was conducted in the following two steps.

Table 2-11 Steps for Digitalization Level Assessment (Common to SRWSA and BWSSB)

Step		Content
1	Current Status and Issue Identification	- Based on the findings from the first on-site survey interviews, the current state and challenges in the digital domain were organized according to each management element outlined in the reference materials. - The digitalization level assessment comprises six perspectives. Consequently, the JST organized how the obtained content should be considered and evaluated across these perspectives.
2	Assigning Evaluation Points	The evaluation was conducted based on the definitions for each of the five digitalization levels.

Source: JST

1) Current Status and Challenges

Table 2-13 Current Status and Challenges (Digitalization Level) ①

Management Elements			Current Status and Challenges in Digitalization	Digitalization Level Assessment	
Major Categories	Sub-category				
Capital Expenditure Strategy	1a	Project Planning	• For pipeline planning/hydraulic calculations, QGIS is utilized rather than Aqua Crew → Should hydraulic calculations be performed in Aqua Crew, the model must be created by the developer → Data must be transferred manually (SHP files) from Aqua Crew to QGIS	④	Data Analysis and AI
	1b	Asset Management, Facility Design, LC Management	• While a pipeline electronic register (Aqua Crew) exists, there is no facility equipment register. (Only a fixed asset register is available) → Facility inspections, etc., are planned using Excel → There is no register comprehensively recording equipment specifications, drawings, inspection results, etc.	④	Data Analysis and AI
	1c	Project Execution and Management	None		
	1d	Equipment, Materials, and Procurement Strategy	• The current warehouse is equipped with customer meters, but when retrieving data, it is recorded in a handwritten notebook and subsequently organized in Excel. → After paper approval, they are registered in SUMS.	③	Digital Business Processes
Operations Maintenance	2a	Operations	【WTP1・2】 • WTP1 has 16 wells, but the 8 wells added by SRWSA are not connected to SCADA and require manual operation on-site. (Some older pumps also have issues with remote control) • At WTP1, out of the five sand filtration tanks, the two added by SRWSA are not displayed in SCADA. • Lime and chlorine dosing is performed via on-site operation. SCADA enables monitoring of their status. • The SCADA system employs a server-client architecture; however, client terminals are malfunctioning, making simultaneous access by multiple users difficult. Consequently, Microsoft Remote Desktop is being used as a workaround, but only one operator can access it at a time. • Key water quality parameters are monitored, but some sensors are faulty or uncalibrated. Additionally, the automatic alert function when standards are exceeded is problematic. • Monitoring is possible from WTP1 to WTP2, but not vice versa. • WTP2 is almost entirely remotely operable, though pump frequency control requires manual setting. • Reporting functions and other features also have issues, but the vendor has withdrawn from Cambodia, so support is unavailable. 【WTP3】 • Equipment within the water treatment plant can be monitored, controlled, and operated via the SCADA system. • The intake pump cannot be remotely controlled via SCADA; only local operation is possible. • Chlorine and lime dosing are manually adjusted. • Water quality is managed by comparing sensor-based water quality data with analysis results from the water quality testing laboratory. → Water quality test results are saved in Excel, with one file created per year. • For WTP1 and WTP2, only distribution flow rate and pressure can be monitored; other parameters cannot be verified. • The SCADA system enables real-time monitoring of water pressure and flow rate at each bulk meter. • By comparing usage from individual household water meters, the difference between inlet (supply volume) and outlet (usage volume) can be calculated, though data integration is performed manually.	③ ④	Digital Business Process Data Analysis and AI
	2b	Maintenance	• NRW can calculate the difference between inlet (supply) and outlet (usage) by comparing inflow to zones with customer usage, but data is integrated manually. • Staff in the department responsible for NRW measures and new connections use the free version of Avenza Maps to verify GIS data in the field. → Data conversion and import into the application requires the sequence: Aqua Crew → QGIS → Avenza. → While the paid version offers cloud functionality, the free version necessitates downloading data onto individual smartphones as required. → Furthermore, due to the data being large, only the necessary ZONE is downloaded. • Leak investigation results are reflected and managed within Aqua Crew. → Other records, such as cleaning logs, are managed in Excel.	③ ④	Digital Business Processes Data Analysis and AI

Source: JST

Table 2-14 Current Status and Challenges (Digitalization Level) ②

Management Elements			Current Status and Challenges in Digitalization	Digitalization Level Assessment	
Customer Service	3a	Meter Reading	• Meter reading results are manually entered into the system (meter reading billing has not been digitized) → There is recognition of the need to introduce digital tools such as handheld terminals or mobile apps, but cost is a barrier to implementation → Smart meters similarly face cost issues → PPWSA is running trials for an 'AI meter reader' (presumably OCR) and intends to implement it if effective • The SUMS system used to input meter readings suffers from sluggish performance due to outdated hardware	③	Digital Business Processes
	3b	Billing and Collection/Tariff Setting	• 30% of customers pay at service counters, while 70% make payments via ACLEDA Mobile	②	Digital Engagement
	3c	Customer Information	• Customer information is managed in SUMS. → Aqua Crew also maintains customers' geospatial data, along with contract documents (PDF format) and photographic records.	③	Digital Business Process
	3d	Debt Recovery	Data on customers' arrears and non-payer's information are maintained within the SUMS system	③	Digital Business Process
	3e	Customer Service	• Complaints are recorded by hand, collated in Excel, and shared monthly with the management group via Telegram. • Reports detail complaint types and resolution status, enabling the management group to expedite responses and coordinate between departments. • Complaint handling operations involve a significant amount of manual work overall, resulting in inefficiency.	② ④	Digital Engagement Data Analysis and AI
Support Functions	4a	Finance/Accounting	• SUMS has high license fees and a limited number of users	③	Digital Business Processes
	4b	Human Resources/Talent Development	• Since 2007, all HR-related operations have been managed using Excel. → Plans are in place to implement additional SUMS modules.	⑥	Digital Organization, Talent, and Working Styles
	4c	Supply Chain Management	• Each department submits requests for materials, etc., via application forms; once approved, transactions are entered into the system. • All transactions are documented, signed and printed for auditing and reference purposes.	③	Digital Business Process
	4d	Information Technology/Digitalization	• Digitalization is recognized as a priority in the following areas: → Leak detection (however, the current situation involves significant pipe losses due to roadworks rather than ageing) → Reduction of NRW → Billing and customer management • Furthermore, there is an aspiration to introduce smart meters and an integrated monitoring dashboard in the future • The SRWSA senior management requests that realistic steps be outlined to achieve the goal of moving closer to PPWSA standards. • [MISTI reference] The view is that system design suited to staff capabilities is crucial, and developing the skills of personnel who can utilize it is essential. (Particularly in data analysis/system operations) → SRWSA shares this view, noting that maximizing digital systems requires additional personnel. • A new IT department was established in FY2022-2023, with four staff members dedicated to digitalization promotion: two in HR/Administration and two GIS officers in the Project Planning Department. • Staff members demonstrate high motivation towards digitalization, including those creating macros (with UI) using VBA to search customer information and those self-studying Python for data analysis/AI and machine learning implementation.	① ⑥	Digital Strategy Digital Organization, Personnel, and Working Practices
	4e	Other Legal Affairs, Environmental Protection...	None	-	-
Other	5a	Policy, legal framework, regulatory bodies	None	-	-

Source: JST

2) Awarding of Evaluation Points

Table 2-15 Digitalization Level Assessment Results(SRWSA)

Parameter	Level 1	Level 2	Level 3	Level 4	Level 5	Remarks
1  Digital Strategy		2.0				-While senior management recognizes the importance of digital strategy and the challenges in its implementation, and partial digitalization initiatives exist, there is no overarching digital strategy, policy, master plan, or roadmap. -At the departmental level, initiatives such as the SUMS expansion plan and trials to integrate AquaCrew and Sums are underway.
2  Digital Engagement		2.5				-Mobile devices for meter reading, etc., have not been introduced for SRWSA staff. GIS maps are pre-downloaded by staff for use in the field. -Channels for water users are limited to telephone, email, and the website. A dedicated customer mobile app for bill payments has been introduced.
3  Digital Business Processes		2.0				-Digitalization is advancing in specific areas such as SCADA, AquaCrew, and finance, but has not progressed in meter reading operations, customer service, performance management, or human resources management. -Facility information and O&M-related data are not being effectively utilized.
4  Data Analytics and AI		2.0				-Analysis using AI technology is not particularly conducted. -Although SCADA is present, it is used for monitoring and generating daily/monthly reports via Excel outputs. Analysis and utilization of collected digital data are rarely seen. NRW rates are calculated in Excel by cross-referencing individual data (distributed volume, billed volume), with no integrated data analysis platform.
5  Digital Infrastructure and Security		1.0				-Security measures are implemented in silos by department. There is no organization-wide standard. Each of the three water treatment plants' SCADA systems has different usernames/passwords set. -GIS maps are accessed by downloading the Avenza app onto personal smartphones. -No automated data backup system exists. Data is exported manually
6  Digital Organization, Talent, Ways of Working		2.0				-An IT department was established in 2022/23, with a total of two dedicated IT staff. They manage the main systems, AUQA Crew and SUMS, and promote digitalization. Outside the IT department, some staff were self-studying Python for personal use in creating VBA macros and implementing data analysis/AI and machine learning.

Source: Prepared by the JST based on reference materials for official duties

(3) Process for Formulating the Digital Architecture and Draft Proposals

The process for formulating the digital architecture is shown below.

- 1) Organizing information required for creating the digital architecture (As-Is):
- 2) Drafting the initial version of the Digital Architecture (As-Is):
- 3) Updating the Digital Architecture (As-Is)
- 4) Creation of the Digital Architecture (To-Be)

Details for each process and key considerations for establishing the digital architecture are outlined below.

- 1) **Organizing information required for creating the digital architecture (As-Is):**
- 2) **Drafting the Digital Architecture (As-Is):**
- 3) **Updating the Digital Architecture (As-Is)**
- 4) **Creation of the Digital Architecture (To-Be)**
- 5) **Key Considerations for Digital Architecture Development**
- 6) **SRWSA Digital Architecture (As-Is)**
- 7) **SRWSA Digital Architecture (To-Be)**

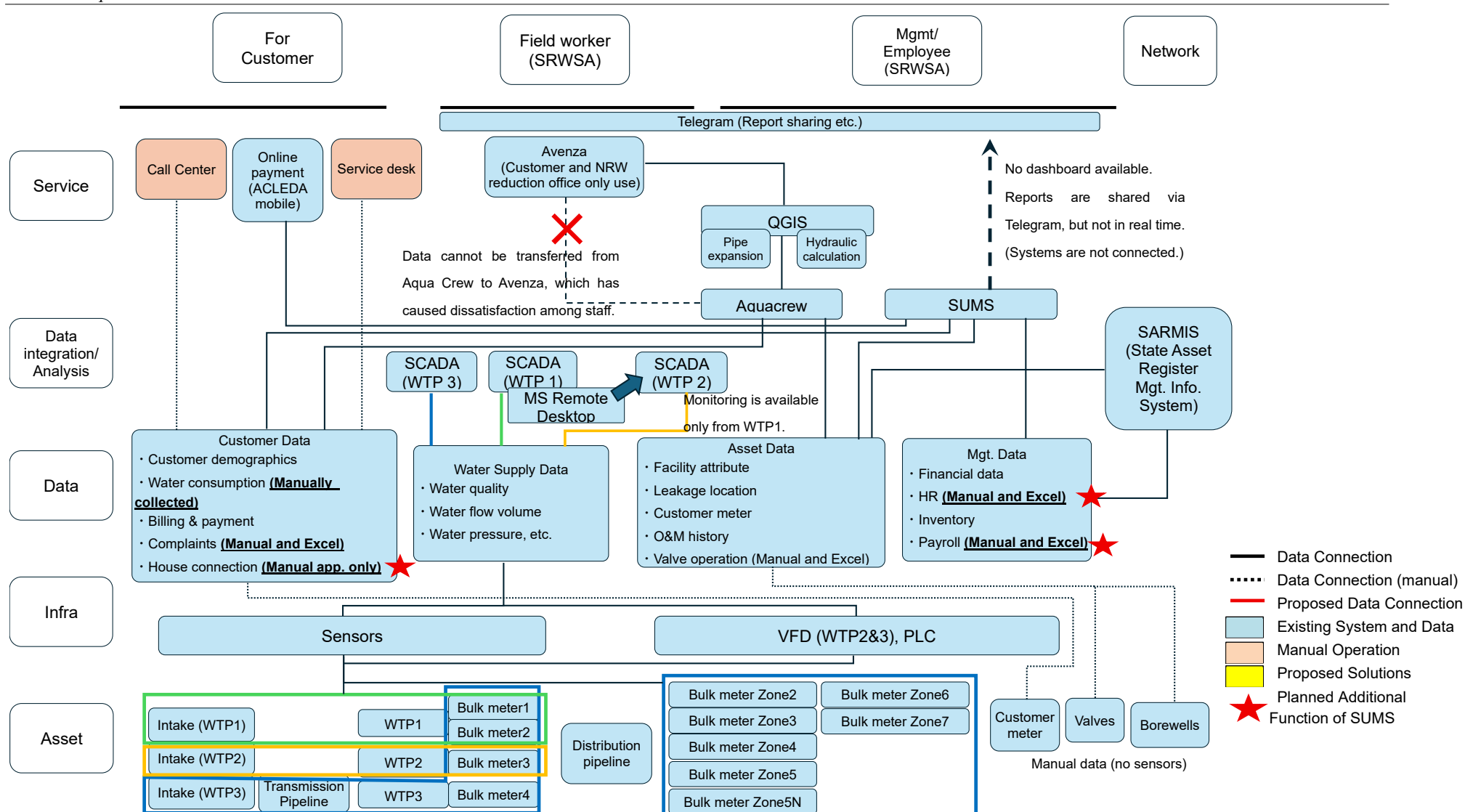
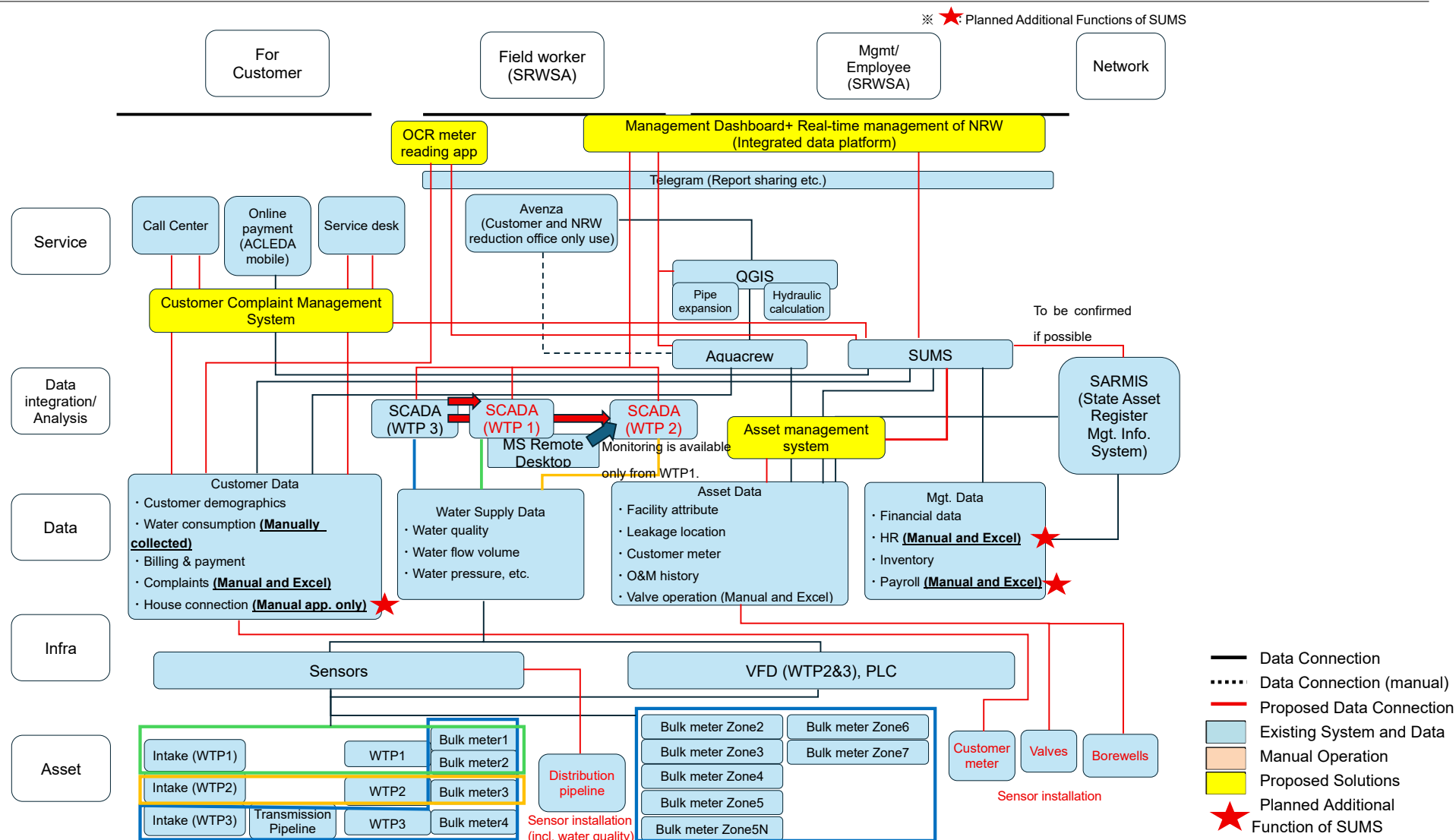


Figure 2-3 Digital Architecture (As-Is) (SRWSA)

Source: JST



Source: JST

Figure 2-4 Digital Architecture (To-Be) (SRWSA)

(4) Formulation Process and Outcomes of the Digital Solutions List

In considering digital solutions, the JST comprehensively organized the management challenges (business challenges) faced by SRWSA as the starting point, integrating the results of the digitalization level assessment and the existing digital architecture (As-Is) (current state of systems, data, and operations). Based on this, the JST extracted digital solutions that directly address the challenges, progressively elevate SRWSA's digitalization level, and contribute to improving the growth spiral.

Table 2-16 outlines each proposed solution alongside current issues (fragmentation, manual processes, reliance on specific individuals, obsolescence, etc.). Concurrently with the digital solution review, consideration was also given to the future desired digital architecture (To-Be).

Table 2-16 Digital Solution List (SRWSA)

No.	Digital Solution Proposal	Solution Description	Current Issues to Be Addressed by the Solutions
1	Formulation of the DX Master Plan (Medium-to-Long-Term Plan)	Formulate an organization-wide digital strategy (DX roadmap) for SRWSA, clarifying short-, medium-, and long-term objectives. Conduct regular progress reviews to ensure alignment with the business master plan.	Currently, only individual initiatives such as SUMS and AquaCrew exist within each department; there is no organization-wide DX plan. System implementations are also carried out by individual departments, lacking mutual coordination and prioritization, making it difficult to maximize investment returns.
2	Establishment of an Integrated Data Platform	Centralize management of dispersed data (SCADA, SUMS, GIS, complaint management, etc.) on an integrated platform. Utilize this for real-time monitoring and analysis, enabling cross-functional visualization of metrics including NRW, asset utilization, finance, and complaints.	Data remains fragmented by department and system, necessitating manual Excel consolidation for NRW calculation, facility management, and customer analysis. The lack of links between SCADA, SUMS, and GIS reduces analytical efficiency. Complaint information also relies on Excel and Telegram sharing, hindering cross-functional decision-making.
3	Establishment of Equipment Register (Asset Management Application Implementation)	Establish an application for integrated management of facility/equipment specifications, drawings, inspection/repair histories, and renewal cycles/costs. Visualize renewal timings and priorities to enhance long-term asset management.	Currently, only fixed asset registers exist, with equipment details managed in Excel. Equipment information, drawings, and inspection results are not centralized, resulting in an insufficient basis for repair and renewal planning. Management of ageing equipment is also personalized, with facility renewal decisions relying on experience.
4	Installation of monitoring sensors on new suburban water mains	Installation of flow, pressure, and water quality sensors in suburban expansion areas and integration into existing SCADA systems. Enable real-time monitoring of leaks and pressure anomalies for early intervention.	Newly installed distribution pipes lack monitoring capabilities, with anomaly detection reliant on field reports. The current GIS uses Avenza Maps (free version) for viewing, requiring manual updates and integration. Data capacity constraints limit viewing to partial areas, reducing field efficiency.

No.	Digital Solution Proposal	Solution Description	Current Issues to Be Addressed by the Solutions
5	Establishment of an integrated SCADA system enabling monitoring and control of WTP1 and WTP2 from WTP3	Updating of the the control systems of the ageing WTP1 and WTP2, establishing a centralized monitoring system with WTP3 at its core. Integration of pump operation, injection volume, and sensor management, enhancing operational efficiency and stability.	WTP1 and WTP2 are significantly aged, featuring extensive manual operations and numerous unconnected devices. WTP1 has tanks not displayed on SCADA and faulty sensors; client terminal malfunctions prevent simultaneous operations. Monitoring is unidirectional from WTP1 to WTP2 only, with no mutual monitoring capability. Vendor withdrawal has resulted in a lack of support.
6	Real-time NRW Management (NRW Management App Implementation)	Integrate SCADA, SUMS, and customer meter data to automatically calculate NRW (inlet/outlet difference) per zone. Visualize this on a dashboard and automatically propose leak investigation priorities.	NRW calculation is performed manually and integrated, with updates occurring monthly. Data collection from the field is also manual input, making real-time monitoring and immediate response difficult. The measurement of the effectiveness of NRW reduction measures is also not systematized.
7	Meter Reading and Billing Automation via OCR Meter Reading App	Meter readers photograph meters with smartphones → OCR automatically reads values → Immediate reflection in SUMS. Automated processing through to invoice issuance and delivery establishes a field-based operational model.	The current process is entirely manual: paper records → manual input into SUMS at the office → invoice printing and delivery. Each meter reader handles 2,000 to 3,000 accounts, leading to input errors and delays. Automation via OCR or similar is not implemented. Operations are also slow due to ageing hardware. Handheld terminals have not been introduced; consideration is being given to PPWSA's OCR tool as a reference, but the cost barrier is significant.
8	Implementation of a Customer Complaint Management System	Centralize complaint reception → automated distribution → response progress tracking → statistical analysis. Analyze complaint types and resolution speeds to identify bottlenecks.	Complaints are currently recorded by hand → aggregated in Excel → shared via Telegram. Tracking reports and response histories, along with statistical analysis, is manual, placing a heavy burden on staff. There is no system integration, making monthly aggregation time-consuming.
9	KPI Management via Management Dashboard	Create real-time dashboards shareable across management, technical departments, and field operations. Integrate SCADA, SUMS, and complaint data to automatically update KPIs (production, water pressure, NRW, customer satisfaction, etc.).	Current information sharing relies on Telegram and monthly Excel reports. SCADA reporting functions are also unstable, preventing cross-site oversight of operational and business data across multiple locations.
10	Implementation of an Inventory Management System	Database warehouse inventory and material usage history, digitizing dispatch and approval workflows. Integrate with SARMIS and SUMS (to be confirmed) for automated procurement and inventory updates.	Warehouse outbound operations involve manual processes: paper records → Excel transcription → SUMS registration. Approvals are handled via paper documents, causing update delays.
11	Enhanced Information Security Management	Deploy security software on all devices and establish organization-wide security rules. Conduct regular	Departments operate independently without unified standards. Risks of information leakage exist, such as using the free version of Avenza Maps on personal

No.	Digital Solution Proposal	Solution Description	Current Issues to Be Addressed by the Solutions
		diagnostics through external specialists.	smartphones. Company-wide security governance remains underdeveloped.
12	SCADA System Upgrade for WTP1 and WTP2 (Ageing Countermeasures)	Update the ageing SCADA systems at WTP1 and WTP2 to improve reliability and operability. Enable the use of currently inactive features such as alarm alerts and automated report generation.	At WTP1, eight wells are not connected to SCADA, and part of the sand filtration basin is also not displayed. Furthermore, at WTP2, terminal malfunctions have caused issues with the alert and reporting functions. Vendor support has ended, and assistance is unavailable.
13	Aquacrew data cloud storage and field application ※Feasibility to be confirmed	Manage Aquacrew data via cloud storage (confirmation required). Enable viewing of cloud data via a smartphone application. This would allow staff to access the latest data directly from the field, facilitating its use for NRW management and maintenance activities.	Aquacrew has vendor lock-in and cannot directly output Shape data. Data is first exported for viewing in QGIS, then imported into Avenza for viewing on staff smartphones. This involves multiple steps, and staff hold different data versions.
14	Establishment of an Internal Knowledge Management System	Develop digital content for applicable training modules and operate it via the internal intranet. Within the technical department, creating digital content before experienced training instructors retire is expected to contribute to a degree to continuous human resource development.	With a shortage of experienced in-house training instructors and increasing costs for internal training, the inheritance of specialized expertise has become a challenge.
15	Introduction of Real-Time Water Quality Inspection Sensors	Real-time sensors for water quality testing will be introduced to continuously monitor water quality changes via the SCADA system at water treatment plants.	Currently, water quality management in distribution pipelines relies on manual sampling and inspection verification. While flow rate and water pressure are monitored via sensors integrated into the SCADA system, water quality monitoring remains inadequate. The introduction of new sensors is expected to enable real-time management of water quality changes, facilitating early detection of abnormalities and optimization of treatment processes.

Source: JST

(5) Digital Solution List Prioritization Process and Outcomes

1) Solution Proposal Prioritization Process

2) Results of the prioritization

Figure 2-5 Solution Proposal Score Distribution (SRWSA)

Table 2-18 Digital Solution Proposal Scoring Results (SRWSA)

Digital Solution Proposals		Prioritization													
No.	Digital Solution Proposal	① Impact				② Feasibility									Overall Evaluation (Out of 6 points)
		Service Level			Eval	Implementation Framework				O&M Mngt System			Compatibility with Existing Systems	Eval	
		Water Supply	Customer	Finance		Comms Env./Data Access	Personnel	Skills	Initial CapEx	Personnel	Skills	O & M budget			
1	Formulation of the DX Master Plan (Medium-to-Long-Term Plan)	3.0	3.0	3.0	3.0		2.0	2.0	2.0	2.0	2.0	2.0		2.0	5.0
2	Establishment of an integrated data platform	1.0	1.0	2.0	1.3	2.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.3	2.6
3	Asset register maintenance (asset management application implementation)	1.0	1.0	3.0	1.7	3.0	3.0	2.0	2.0	3.0	2.0	2.0	2.0	2.4	4.1
4	Installation of Monitoring Sensors on New Suburban Water Distribution Mains	3.0	2.0	1.0	2.0	2.0	2.0	2.0	1.0	3.0	2.0	2.0	2.0	2.0	4.0
5	Establishment of an integrated SCADA system capable of monitoring and controlling WTP1 and WTP2 from WTP3	3.0	1.0	3.0	2.3	1.0	2.0	2.0	1.0	3.0	2.0	2.0	1.0	1.8	4.1
6	Real-time management of NRW (introduction of NRW management app)	1.0	1.0	3.0	1.7	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	3.8
7	Meter reading and billing automation via OCR meter reading app	1.0	3.0	3.0	2.3	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	4.4
8	Implementation of a Customer Complaint Management System	1.0	3.0	3.0	2.3	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	4.4
9	KPI management via management dashboard	1.0	2.0	2.0	1.7	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	3.8

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Digital Solution Proposals		Prioritization													
No.	Digital Solution Proposal	① Impact				② Feasibility									Overall Evaluation (Out of 6 points)
		Service Level			Eval	Implementation Framework				O&M Mngt System			Compatibility with Existing Systems	Eval	
		Water Supply	Customer	Finance		Comms Env./Data Access	Personnel	Skills	Initial CapEx	Personnel	Skills	O & M budget			
10	Implementation of inventory management system	1.0	1.0	3.0	1.7	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	3.8
11	Strengthening Information Security Management	1.0	3.0	3.0	2.3	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	4.4
12	WTP1・2 SCADA update (countermeasures against ageing)	3.0	3.0	1.0	2.3	2.0	3.0	2.0	1.0	3.0	2.0	2.0	2.0	2.1	4.4
13	Aquacrew's Cloud Storage and On-Site Utilization Application ※Feasibility to be confirmed with Geocraft	1.0	2.0	2.0	1.7	1.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	2.0	3.7
14	Development of an internal knowledge management system	1.0	1.0	3.0	1.7	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	3.8
15	Introduction of real-time water quality monitoring sensors (distribution pipelines)	2.0	2.0	1.0	1.7	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.5	4.2

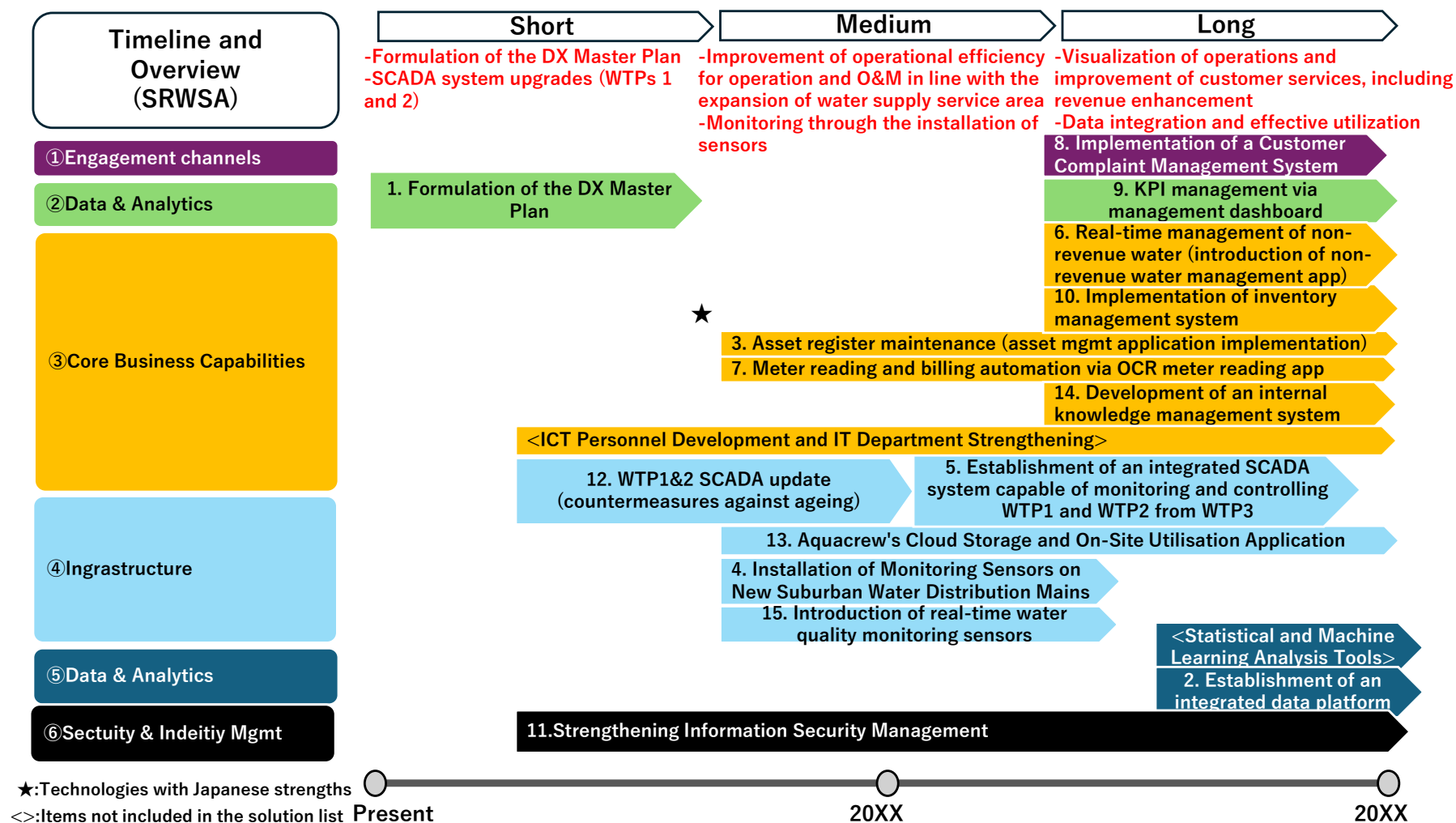
Source: JST

3) Results of Organizing Priority Digital Solutions

(6) Creation of a Roadmap

The roadmap visualizes the path for phased DX advancement by mapping the proposed digital solutions list onto a short-, medium-, and long-term timelines, based on the organization's management challenges and implementation priority (scoring results). The creation procedure is as follows.

- 1) Setting the Basic Framework for the Roadmap**
- 2) Classification of Solutions (Organized Vertically)**
- 3) Determining Implementation Timing (Horizontal Axis) Based on Scoring Results**
- 4) Mapping to the Matrix and Roadmap Development**
- 5) Adding Key Focus Areas for Each Period (Enhancing Reader Understanding)**
- 6) Supplementing necessary measures not included in the solutions (aligning with the JST's proposal guidelines)**



Source: JST

Figure 2-6 Roadmap (SRWSA)

2.2.2. Bangalore Water Supply and Sewage Board (BWSSB)

(1) Overview of Water Services and Water Utility Operations

1) Water Supply Operations from the Perspective of Key Performance Indicators (KPIs)

2) Current Status and Challenges in Water Supply Operations

(2) Assessment of Digitalization Level

The digitalization level assessment was conducted in two steps, as with SRWSA.

Table 2-29 Steps for Digitalization Level Assessment (Common to SRWSA and BWSSB)

Step		Content
1	Current Status and Issue Identification	- Based on the findings from the first on-site survey interviews, the current state and challenges in the digital domain were organized according to each management element outlined in the reference materials. - The digitalization level assessment comprises six perspectives. Consequently, the JST organized how the obtained content should be considered and evaluated across these perspectives.
2	Assigning Evaluation Points	The evaluation was conducted based on the definitions for each of the five digitalization levels.

1) Current Status and Challenges

Source: JST

Table 2-31 Current Status and Challenges (Digitalization Level) ①

Management Elements		Current Status and Challenges in Digitalization		Digitalization Level Assessment	
Major Categories	Sub-category				
Capital Expenditure Strategy	1a	Project Planning	Currently utilizing ArcGIS, but planning to introduce Bentley Systems (US headquarters) applications capable of hydrological analysis, etc.	④	Data Analysis and AI
	1b	Asset management, facility design, LC management	K-GIS in Karnataka State only supports linear mapping and does not support mapping curved water pipes.	④	Data Analysis and AI
	1c	Project execution and management	- An electronic filing system for internal documents is currently in operation. → Once the dedicated line is established, it will be available for use across all offices in Bangalore	②	Digital Engagement
	1d	Equipment and Materials, Procurement Strategy	- A GIS-based authentication process has been institutionalized. (To prevent fraud) → After pipeline maintenance is completed, field engineers input route data into the GIS system → Following acceptance of this data by the GIS officer, the accounts department processes payment to the contractor → GIS personnel utilize ArcGIS. → Certified information is reflected in KGIS and locked to prevent editing. - The new WMS automates the above workflow.	②	Digital Engagement
Operation Maintenance	2a	Operations	- Cauvery on Wheels enables monitoring of tank water levels via IoT sensors. - SCADA only acquires data from bulk flow meters on feeder lines with diameters exceeding 311mm within the DMA. - Design, construction, commissioning, and comprehensive operation and maintenance of a centralized SCADA center for monitoring and controlling water treatment plants and distribution systems are being carried out under a Design, Build and Operate (DBO) contract. → This enables the integration of water supply, distribution, and sewerage SCADA systems into a single centralized monitoring center and analytical dashboard. → Currently, NRW (Water Supply Division) utilizes NRW SCADA for DMA (District Metered Area) level monitoring and employs it to some extent for NRW calculation. Investigations are underway to integrate this system into the central system. Two pilot projects are also under consideration for small-scale distribution management areas (DMAs), aimed at valve monitoring, control, and planned operation within the distribution system. → The current scope of the CP-24 project is monitoring and data analysis; it does not focus on control. → Manual valve operation is still employed within the distribution system; automated distribution control does not yet exist due to compatibility issues with legacy hardware and power supply concerns. → Future plans envisage introducing AI analysis for NRW mitigation and implementing digital twins. → This necessitates strengthening the O&M team with analytical skills and other capabilities. → A mobile application is under development to enable authorized personnel to monitor GLR flow, pumping station data, alerts, etc.	③	Digital Business Processes
Maintenance	2b	Maintenance	- IoT sensors are installed in wells, enabling monitoring of water levels, water volume, energy consumption, etc., as well as online control (on/off switching). → Currently being installed in 3,000 wells as part of a pilot scheme. → Plans are in place to implement preventative maintenance based on the acquired data. 1,500 bulk meters are installed. Data is transmitted to a central server and actively utilized by both maintenance personnel and district-level staff to understand inflow and outflow trends. → There is no dedicated monitoring application; meter data can be viewed via a web portal, and SCADA data is also accessible. → The web portal displays real-time inflow and outflow data by zone, enabling calculation of NRW for each area. (Data synchronizes with the billing cycle) → The aforementioned system also enables detection of meter loss/failure and identification of consumption trends. → There is a future aspiration to integrate data into the SCADA Center to be established under the CP-24 project; however, compatibility issues exist due to the legacy nature of the systems. (Data is currently stored on local servers).	② ③ ⑤	Digital Engagement Digital Business Processes Infrastructure and Security
Customer Services	3a	Meter Reading	- Meter readers use handheld terminals with GPS functionality; when they read a meter, the information is transmitted to the server in real time, and the bill is handed over on site. (Location data is also sent to the server) - Previously, analog procedures such as manual meter reading and ledger entries were employed, but efficiency has improved since introducing SAJALA. - Plans are underway to install 100,000 smart meters out of BWSSB's approximately 1.2 million connections. → The target customers are large-scale and non-domestic customers. Considering cost-effectiveness, there are no immediate plans to introduce smart meters for domestic connections. → This is a public-private partnership model, with private organizations responsible for smart meter installation and maintenance.	②	Digital Engagement

Source: JST

Table 2-32 Current Status and Challenges (Digitalization Level) ②

Management Elements		Current Status and Challenges in Digital		Digitalization Level Assessment	
Major Categories	Sub-category				
Customer Service	3b	Billing and Collection/Pricing	- SAJALA can generate monthly/annual summary reports. (160–200 reports) →Example: Fee collection rates, meter reading records, fee structure classifications, etc... - An electronic payment system is also implemented, enabling collection via direct debit from bank accounts for specific customers.	③	Digital Business Processes
	3c	Customer Information	None		
	3d	Debt Recovery	None		
	3e	Customer Service	- Meter replacements, etc., can be applied for online via SAKALA. - For new connections, online applications can be made via Jaladhare (a feature of the BWSSB portal site). → Customers can also check progress, etc., via OTP authentication. - Payments can be made via kiosk terminals or electronic payment systems; cash handling is not available. → Payments can be made via the portal site, with secure biometric authentication guaranteed. (Net banking, credit cards, UPI) → Customers can make combined payments for other bills, such as electricity, via the Bangalore One-Stop Center. - A 24/7 call center is operational, with a complaint management system enabling real-time tracking of resolution status. Complaint details are also recorded on the server. - For areas without mains water connections, water delivery can be requested via Cauvery on Wheels. → Customers can check delivery status in real time. (Login via OTP authentication)	② ③	Digital Engagement Digital Business Process
Support Functions	4a	Finance/Accounting	- Only the ledger system utilizes Oracle Financial Software, with information entered via the work management software (WMS) being automatically sorted - The WMS is scheduled for full implementation from September 2025, integrating the entire workflow from quotations to payments to contractors. It will also enable the automatic generation of profit and loss statements and balance sheets in real time. → The WMS will automatically update K-GIS at the time of final payment. → WMS incorporates a real-time analytics dashboard	③ ④	Digital Business Processes Data Analysis and AI
	4b	Human Resources/Talent Development	Managing approximately 1,700 employees via the Human Resource Management System (HRMS) (payroll processing, hierarchical management, data entry, tracking) is currently being implemented/is planned	③	Digital Business Processes
	4c	Supply Chain Management	Managing approximately 1,700 employees via the Human Resource Management System (HRMS)		
	4d	Information Technology/Digitalization	- While no explicit digital strategy document exists, digitalization initiatives are progressing sequentially → Plans exist to integrate real-time operational data (WTP, STP, Billing, Complaints, etc.) into a centralized display hub. A TV dashboard is scheduled for installation in the department head's office for real-time monitoring. → Integration of water operations-related (SCADA) data is underway using JICA funding → System design based on cloud computing and enhanced cybersecurity (All digital applications operate on a private cloud managed in-house.) - In fiscal year 2023, an incident occurred where unauthorized access to the database resulted in the leakage of customer information. In fiscal year 2025, the portal site was also targeted, but no significant data breach occurred. →Annual vulnerability assessments are conducted through security diagnostics such as VAPT. →Billing data is supplemented by the Karnataka State Data Center, while GIS and financial record data are backed up in Noida, another city. → Further security measures are planned in collaboration with IT advisors. - It is recognized that a cultural transformation is necessary for the transition from manual to digital operations, and that continuous awareness raising is essential. The following challenges exist → Initial reluctance among field operators to share data (e.g. pump operating hours) → Manual workflows hinder the early adoption of IoT and SCADA → Resistance is diminishing as the system's value is demonstrated - A Work Management System (WMS), Human Resource Management System (HRMS), and electronic submission system for administrative documents are being developed by the State Government Agency's e-Governance Center.	① ⑤ ⑥	Digital Strategy Infrastructure and Security Digital Organization, Talent, and Working Practices
	4e	Other Legal Matters, etc.			
Other	5a	Policy, legal framework, regulatory bodies	- BWSSB appears to take pride in being a pioneer in IT-driven initiatives within India's public sector undertakings → Examples include asset verification, digital billing, and infrastructure information traceability. → As a tangible achievement, the GIS authentication system introduced around 2014–2015 has been adopted as a best practice by other departments at both state and national levels. - In 2009, it was awarded a National Award by the then President of India in recognition of its outstanding achievements in billing. (Evaluation points: Meter installation rate, billing process, efficient customer service)	①	Digital Strategy

Source: JST

2) Awarding of Evaluation Points

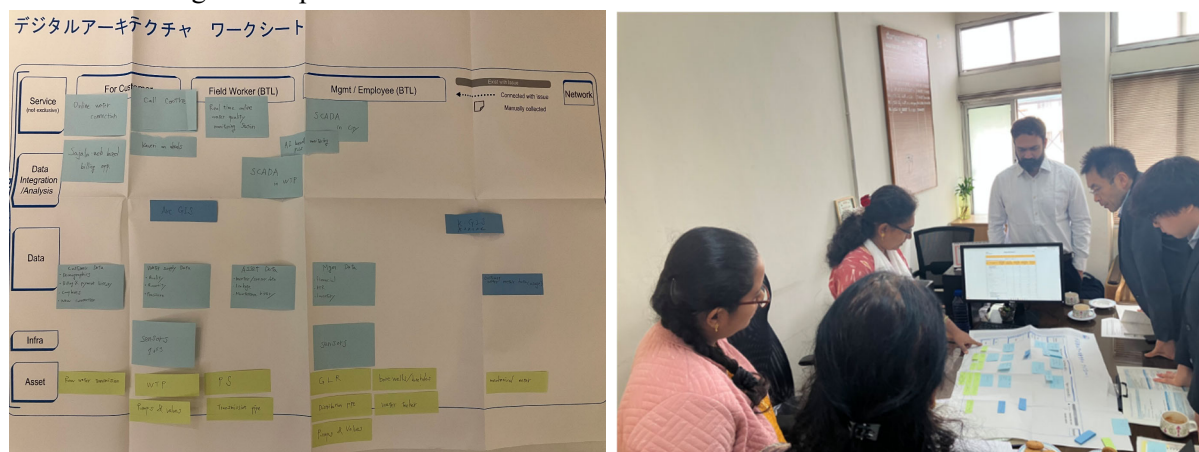
Table 2-33 Digitalization Level Assessment Results(BWSSB)

Parameter		Level 1	Level 2	Level 3	Level 4	Level 5	Remarks
1	 Digital Strategy		●				There is no overarching digital strategy, policy, master plan, or roadmap, but plans exist for system upgrades and data integration. Strengthening cybersecurity is stated as a policy objective. CE (QA,IT & B) has a policy of adopting digitalization wherever possible. Initiatives include AI utilization in the IT department and system integration in the finance department.
2	 Digital Engagement				●		Customers can perform new connections, meter replacements, etc., via a web portal. Most systems used by employees, such as portal sites and complaint management systems, are also digitalized. However, a unified, one-stop digital engagement service has not yet been introduced.
3	 Digital Business Processes			●			The majority of business processes are currently digitized. Cross-departmental integration, such as WMS and Scada Center, is also progressing. However, challenges remain, such as insufficient efforts in maintenance management, particularly regarding NRW countermeasures.
4	 Data Analytics and AI			●			An environment for sophisticated data analysis is developing, enabling dashboard monitoring of charges and financial status via portal sites, alongside centralized management of water operation data through Scada Center. This is expected to facilitate data-driven, preventive maintenance-based upkeep.
5	 Digital Infrastructure and Security			●			Incidents where databases and portal sites have been targeted for attack have occurred, and security awareness is high. Annual vulnerability assessments are conducted through security diagnostics.
6	 Digital Organization, Talent, Ways of Working			●			An IT department has been established and maintains an overview of IT projects being implemented across all departments.

Source: Prepared by the JST based on reference materials for official duties

(3) The process for formulating the digital architecture and the draft created

The BWSSB digital architecture was formulated following the same process outlined in the formulation process in Section 2.2.1. The digital architecture drafted as a working document during the field investigation is presented below.



Source: JST

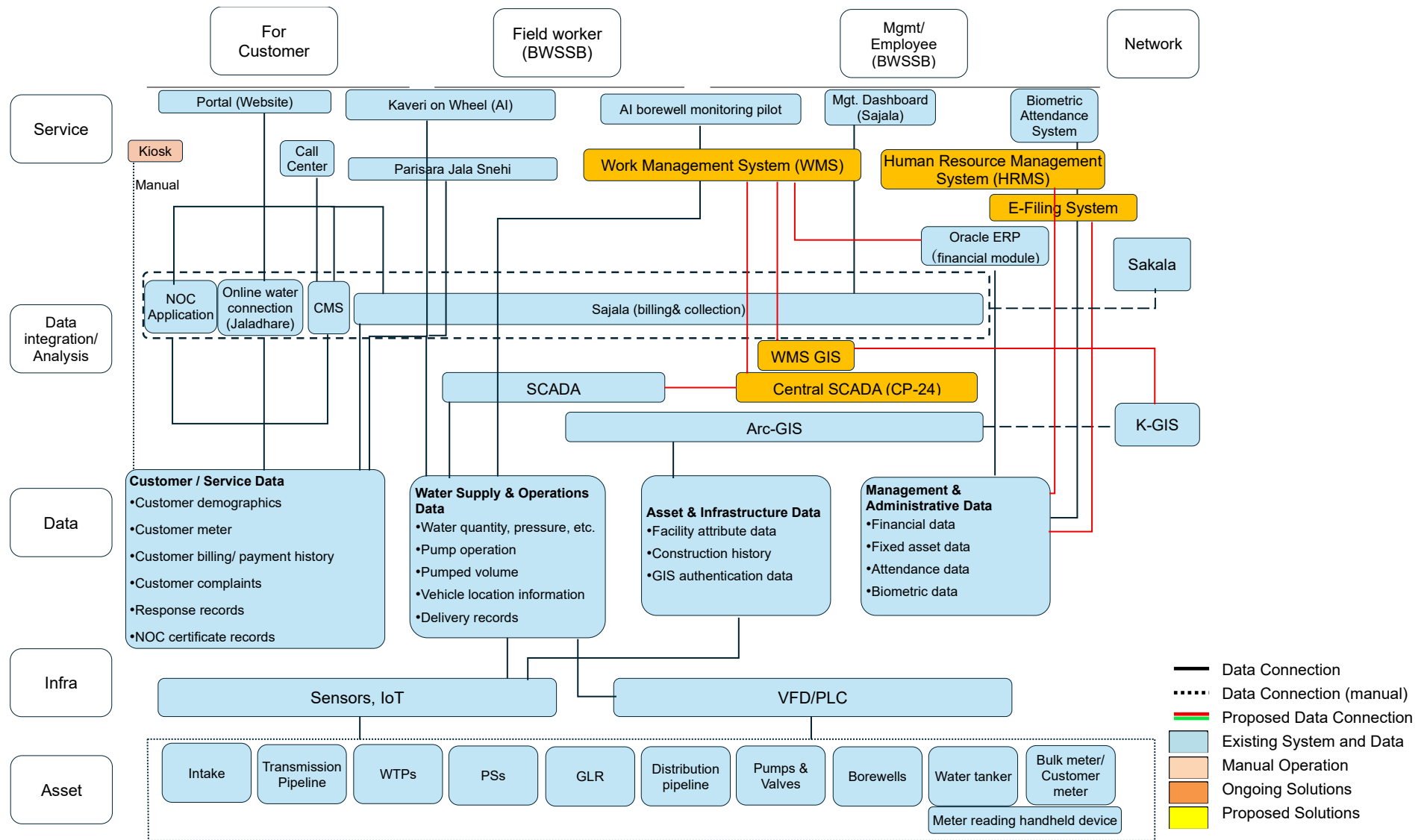
Figure 2-7 Draft Digital Architecture (BWSSB) and Scene of On-site Confirmation

The updated digital architecture is shown in Figure 2-8.

1) BWSSB Digital Architecture (As-Is)

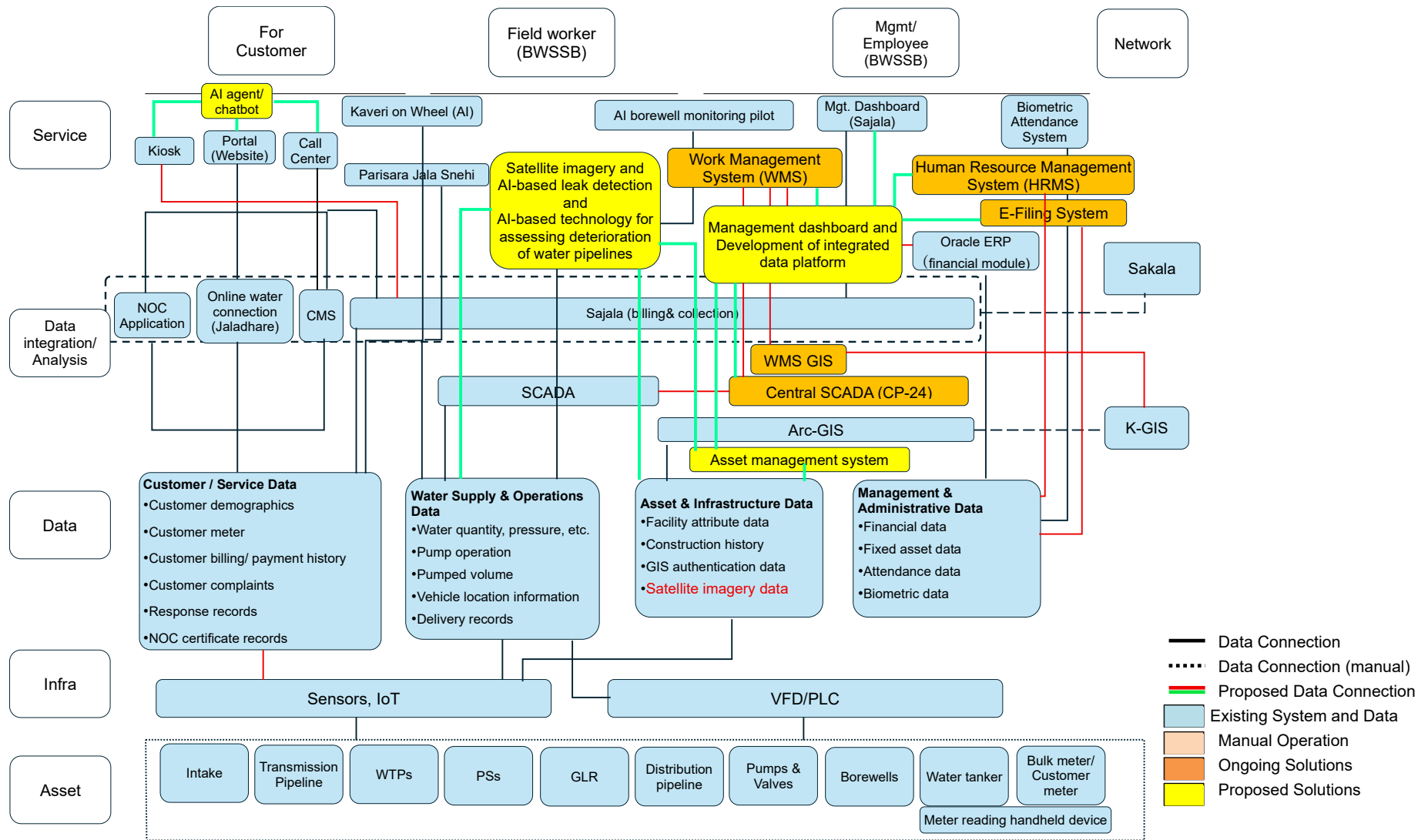
2) BWSSB Digital Architecture (To-Be)

- Establish an environment enabling real-time monitoring, analysis, and utilization of data collected across departments, promoting the establishment of data-driven operations and decision-making throughout BWSSB.



Source: JST

Figure 2-8 Digital Architecture (As-Is) (BWSSB)



Source: JST

Figure 2-9 Digital Architecture (To-Be) (BWSSB)

(4) Digital Solution List Formulation Process and Outcomes

In considering digital solutions, BWSSB's management challenges (business challenges) were taken as the starting point. These were then integrated with the results of the digitalization level assessment and the existing digital architecture (As-Is) (current state of systems, data, and operations). Based on this, digital solutions were identified that directly address the challenges, progressively elevate BWSSB's digitalization level, and contribute to improving the growth spiral.

Table 2-34 outlines each proposed solution alongside current issues (fragmentation, manual processes, reliance on specific individuals, obsolescence, etc.). Concurrently with the digital solution review, consideration was also given to the future desired digital architecture (To-Be).

Table 2-34 Digital Solution List (BWSSB)

No	Digital Solution Proposal	Solution Description	Current Issues to Be Addressed by the Solutions
1	Formulation and Progress Management of an Overall DX Master Plan	BWSSB has introduced various digital technologies, but lacks a medium-to-long-term master plan. To advance DX more effectively going forward, a plan will be formulated based on the current situation to promote future DX.	BWSSB has implemented multiple digital systems, including ArcGIS, SCADA, WMS, HRMS, and Oracle financial systems. However, there is no overarching medium-to-long-term DX plan or strategic document. Each system has been introduced individually, lacking clear interconnectivity and prioritization. The absence of an organizational 'digital policy' and 'progress management' is considered a key challenge.
2	Enhancement of the Customer Portal and Online Services	Implement AI agents and chatbots to enable customers to self-serve procedures such as payments, service activation, and fault reporting.	Currently, customers can use portal sites (Jaladhare, SAKALA) for new connections, meter replacements, bill payments, and complaint submissions, with OTP authentication and electronic payments also implemented. However, these remain isolated procedures; a 'self-service' support system using AI and automated responses, or a mechanism for an integrated customer experience, is not in place. This enables management to oversee operations in real time and facilitates more comprehensive, cross-functional decision-making.
3	Establishment of an Integrated Data Platform	Establish a centralized management platform for partially implemented systems including SCADA, SAKALA, operational data scheduled for integration (ERP, WMS, E-filing), AI well monitoring systems, water tanker tracking systems, and NRW management systems. This will create an environment enabling real-time monitoring, analysis, and utilization of data acquired by each department (), thereby promoting data-driven decision-making.	Partially integrated systems exist, such as SCADA system operational data and business systems (ERP, WMS, E-filing), alongside separate systems like SAKALA and the Unaccounted-for Water Management System. However, this data remains dispersed across departments and systems, with no established mechanism for integrated analysis and utilization.

No	Digital Solution Proposal	Solution Description	Current Issues to Be Addressed by the Solutions
4	Strengthening Cybersecurity and Digital Infrastructure	Continue security diagnostics (Vulnerability Assessment and Penetration Testing (VAPT)), aiming to improve vulnerability assessment, data backup, and the security of cloud infrastructure.	BWSSB's new water connection application portal suffered a cyber attack. The attack was detected on 11 th April 2025. Initial investigations indicate that no leakage of sensitive customer data has been confirmed. The organization remains exposed to cyber attack threats.
5	Equipment Register Development	A system will be established to calculate asset registers, maintenance histories, update frequencies, and update costs, enabling efficient maintenance management.	Currently, equipment registers are not properly maintained, and records of update histories and maintenance plans are not systematized. K-GIS can only map straight pipework, making accurate location management of curved pipelines and similar challenging. Accurate grasping and updating of equipment information is a key issue.
6	Implementation of Automated Control Functions for Water Distribution Management via SCADA	Implement automated control functions for valve operations within the water distribution network, enabling remote operation from the central SCADA center to enhance the efficiency and sophistication of water distribution operations.	The water distribution system is currently only monitored at the central SCADA center; automatic control functions remain unimplemented. Valve operations within the water distribution network are performed manually by staff and lack centralized control capabilities.
7	Pattern Analysis and Forecasting of Water Demand and Available Supply Capacity	Pattern analysis and forecasting of water demand and available supply capacity using simulation software will enable the formulation of optimal water operation plans and stable water supply.	Monitoring is conducted at the central SCADA center, but control functions remain unimplemented. The challenge lies in optimizing water management plans by utilizing existing monitoring data, considering water demand forecasts and the overall balance of water intake and conveyance.
8	DX Technology-Based Measures Against NRW (Leak Detection Using Satellite Imagery x AI)	Satellite imagery and AI analysis can identify areas with potential leaks, enabling more efficient leak detection surveys.	The rate of NRW remains high, and continuous management across all areas has not been achieved even after DMA formation under the JICA project. Japanese-made leak detection equipment was trialed, but accuracy is compromised by underground utilities and noise interference. Implementing leak countermeasures through efficient leak detection surveys is necessary to reduce NRW.
9	DX Technology-Based NRW Mitigation (Water Pipe Deterioration Diagnosis Technology)	AI-based water pipe deterioration diagnosis technology to predict pipes requiring replacement, enabling preventive maintenance.	The NRW rate remains high, and even after the formation of DMAs through the JICA project, continuous management across all areas has not been achieved. Japanese-made leak detection equipment was trialed, but its accuracy has declined due to underground obstructions and noise. A shift is needed from reactive maintenance of water pipes to preventative maintenance to reduce NRW.

N o	Digital Solution Proposal	Solution Description	Current Issues to Be Addressed by the Solutions
10	KPI Management via an Integrated Management Dashboard	An integrated management dashboard covering existing systems will be created, enabling senior management and supervisors to efficiently manage KPIs and utilize the information for decision-making and information sharing. It is envisaged to provide functions for centralized management and analysis of water supply & distribution status, and billing collection & financial status.	While SCADA, Sajala, WMS, and other partial management dashboards are either implemented or planned, a fully integrated management dashboard remains unestablished.
11	Establishment of an Internal Knowledge Management System	Develop digital content for relevant training modules and operate this via internal intranet. Within the technical departments, creating digital content before experienced trainers retire is expected to contribute to a degree to continuous human resource development.	The retirement of experienced staff and personnel reductions due to operational efficiency improvements present challenges in transferring specialized expertise.
12	Introduction of Smart Meters (Commercial/Industrial Customers)	Wholesale commercial and industrial customers account for approximately 30% of the total customer base but generate around 70% of revenue. The replacement of meters with smart meters, which incurs costs for customers, is also expected to proceed relatively smoothly for business customers. This is anticipated to improve meter reading efficiency and is judged to offer high cost-effectiveness.	Meter reading operations still rely heavily on manual visual input. With anticipated expansion of water supply areas and increases in customer numbers, challenges include workforce reduction and the ageing of meter readers.
13	Introduction of Smart Meters (Households)	This is expected to improve the efficiency of meter reading operations for customers, who account for approximately 70% of the total. However, challenges remain regarding the cost of the meters borne by customers and social acceptance.	Meter reading operations still rely heavily on manual visual input. With anticipated expansion of water supply areas and growth in customer numbers, challenges include staff reductions and the ageing of meter readers.

Source: JST

(5) Digital Solution List Prioritization Process and Outcomes

1) Prioritization Process for Solution Proposals

2) Prioritization Results

Figure 2-10 Score distribution of solution proposals (BWSSB)

Table 2-35 Digital solution proposals: Scoring results (BWSSB)

Digital Solution Proposals		Prioritization													
No.	Digital Solution Proposal	① Impact				② Feasibility									Overall Evaluation (Out of 6 points)
		Service Level			Eval	Implementation Framework				O&M Mngt System			Compatib ility with Existing Systems	Eval	
		Water Supply	Custom er	Finan ce		Comms Env./Dat a Access	Perso nnel	Skills	Initial CapEx	Perso nnel	Skills	O & M budget			
1	Formulation and progress management of the overall DX master plan	3.0	3.0	2.0	2.7		2.0	2.0	3.0	2.0	2.0	3.0		2.3	5.0
2	Enhancement of Customer Portal and Online Services	1.0	2.0	1.0	1.3	3.0	2.0	2.0	1.0	1.0	2.0	1.0	2.0	1.8	3.1
3	Establishment of an integrated data platform	1.0	1.0	2.0	1.3	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.4	2.7
4	Strengthening cybersecurity and digital infrastructure	1.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	3.0	2.5	4.5
5	Equipment register maintenance	1.0	1.0	3.0	1.7	3.0	3.0	3.0	2.0	3.0	3.0	3.0	2.0	2.8	4.5
6	Implementation of automated control functions for water distribution management using SCADA	3.0	1.0	3.0	2.3	1.0	2.0	2.0	1.0	2.0	2.0	1.0	1.0	1.5	3.8
7	Pattern Analysis and Forecasting of Water Demand and Supply Capacity	3.0	2.0	2.0	2.3	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	4.4
8	DX Technology-Based NRW Measures (Leak Detection Using Satellite Imagery x AI)	2.0	2.0	3.0	2.3	3.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	2.4	4.7
9	Water Loss Prevention Measures Utilizing DX Technology (Water Pipe Deterioration Diagnosis Technology)	2.0	2.0	3.0	2.3	3.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	2.4	4.7
10	KPI management via an integrated management dashboard	3.0	2.0	2.0	2.3	2.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	2.4	4.7

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Digital Solution Proposals		Prioritization													
No.	Digital Solution Proposal	① Impact				② Feasibility									
		Service Level			Eval	Implementation Framework				O&M Mngt System			Compatib ility with Existing Systems	Eval	Overall Evaluation (Out of 6 points)
		Water Supply	Custom er	Finan ce		Comms Env./Dat a Access	Perso nnel	Skills	Initial CapEx	Perso nnel	Skills	O & M budget			
11	Establishment of an internal knowledge management system	1.0	1.0	3.0	1.7	3.0	2.0	3.0	2.0	2.0	2.0	3.0	2.0	2.4	4.1
12	Smart meter Installation (commercial/industrial customers)	2.0	2.0	3.0	2.3	2.0	3.0	2.0	2.0	3.0	2.0	2.0	2.0	2.3	4.6
13	Smart Meter Installation (Households)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	1.8	3.8

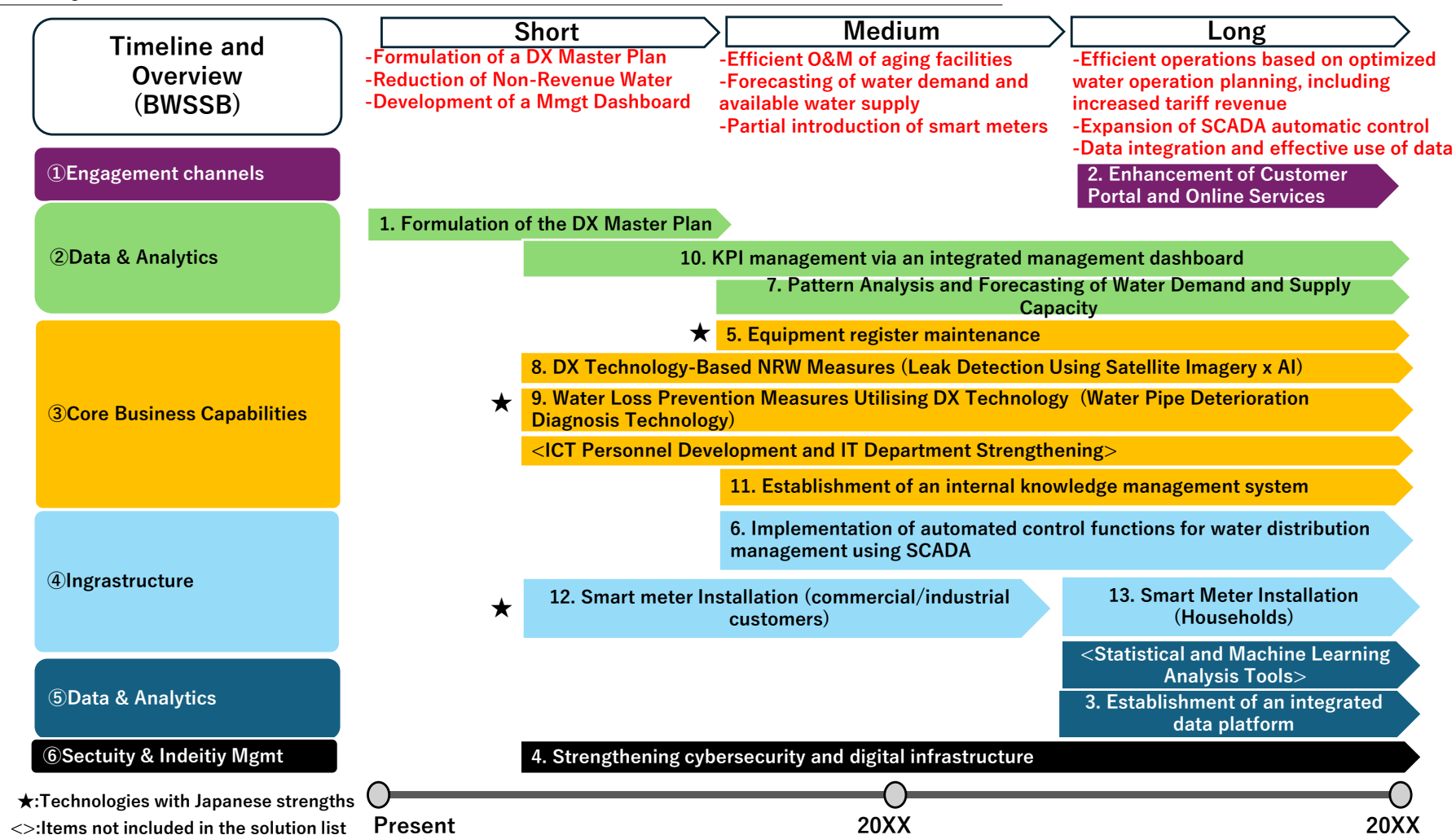
Source: JST

3) Results of Organizing Priority Digital Solutions

(6) Creation of a Roadmap

The BWSSB roadmap was developed following the same principles as the SRWSA roadmap. Figure 2-11 illustrates the BWSSB roadmap. For details on each digital solution, refer to Table 2-34.

Furthermore, similar to SRWSA, BWSSB has prioritized the early implementation of measures for "ICT personnel development and IT department strengthening" and "cybersecurity countermeasures" as short-term initiatives to effectively advance DX (BWSSB is partially implementing both measures).



Source: JST

Figure 2-11 BWSSB Roadmap

3. Summary of Findings

3.1. Proposed Updates to Reference Materials for Digital Utilization to Support the Development Stages of Water Utilities

3.1.1. Regarding the Structure of Operational Reference Materials

The current Operational Reference Materials subject to this survey is the material provided for training purposes in May 2025. In this survey, proposed improvement measures for the Operational Reference Materials are presented in Section 3.1.2, and the incorporation of these measures results in changes to the structure of the table of contents.

The current table of contents of the Operational Reference Materials, as well as the revised table of contents reflecting the proposed updates described in Section 3.1.2, are shown in Table 3-1 and Table 3-2, respectively. The sections highlighted in red indicate the main changes to chapter titles. It should be noted, however, that even in cases where chapter titles remain unchanged, the content of the slides has been revised in some instances. Details of these revisions are described in Section 3.1.2.

(Before revision)

Table 3-1 Reference Materials for Official Duties: Table of Contents Structure (Current)

Background, Purpose, and Objectives
Steps for Project Formation, Implementation/Supervision, and Evaluation with Digital Utilization in Mind
1. List of common challenges observed at each stage of water utility development
2. Water Utility Digitalization Level Assessment Tool
3. Examples and Application Methods for Water Utility Digital Architecture As-Is/To-Be
4. Data Acquisition and Digital Utilization Levels to Aim for at Each Development Stage by Management Element
5. JICA Water Support Theory of Change
6. List of Digital Solutions for Challenges
7. Example of Prioritization for Digital Solution Selection
8. Key Success Factors (KSF) for Proof of Concept Implementation
Appendix - Digital Solution Use Cases



(Revised)

Table 3-2 Reference Materials for Executive Use: Table of Contents Structure (Revised Proposal)

Background, Purpose, Objectives
Procedure for Project Formation with Digital Utilization in Mind: Project Formation
Procedures for Project Implementation/Supervision and Evaluation with Digital Utilization in Mind
1. Support Scheme Review Table
2. List of Common Challenges Observed at Each Development Stage of Water Utility Organizations

3. Digital Capability Map
4. Overview of Water Utility Digital Architecture by Challenge
5. Water Utility Digitalization Level Assessment Tool
6. Digital Solutions List
7. Target Data Acquisition and Digital Utilization Levels by Management Element and Development Stage
8. Example of Prioritizing Digital Solutions
9. Checkpoints for Project Formation and Implementation Supervision
10. Examples of Change Management Measures
11. Examples of RfP and Contract Documents (CWASA/ZAWA)
12. Examples of monitoring systems
13. Comparative study of development methodologies (Agile, Waterfall, etc.) and overview of each process procedure
14. Examples of regular surveys for reviewing solution adoption and deployment status, as well as issues and countermeasures
15. PoC review items (CWASA/ZAWA)
Appendix - Digital Solution Use Cases

3.1.2. Proposed revisions to Operational Reference Materials

Through this survey, the improvement proposals were prepared both by the Survey Team and by JICA in-house consultants separately. The points were shared and discussed at Working Group meetings held between November and December 2026, with the participation of JICA officials. During these meetings, views and opinions were exchanged on each set of proposed improvements.

The improvement points for the Operational Reference Materials that were finalized through these discussions are summarized in Table 3-3.

Table 3-3 List of improvements

No.	Item	Improvement Point	Slide Number*1
1	Background, Purpose, Table of Contents	Add wording to the 'Background and Purpose' section to convey that the importance of data collection and accumulation is recognized, not merely the selection of digital solutions.	P2
2	Project Formation, Implementation/Supervision, and Evaluation Steps	- The procedures for project formation are specified in greater detail. Specifically, as follows: ➤ Modifications and additions to the content within each phase of project formation (current state analysis, target setting, solution consideration, project scope consideration) (overview, specific tools, detailed materials)	P2

No.	Item	Improvement Point	Slide Number*1
ditto	Project Formation, Implementation/Supervision, and Evaluation Steps	Addition of a new information collection format to organize collected data during the aforementioned 'Current Situation Analysis' stage (specific details to be outlined later at 3.2)	p2
3	Project Implementation/Supervision and Evaluation Procedures	- Add explanations regarding procedures during the project implementation/supervision and evaluation stages ➢ Added overview, specific tools, and detailed materials	New
4	Exit points for each support scheme	- Added information anticipating the exit points for each support scheme (yen loans, technical cooperation, grant aid) ➢ Add prerequisites and points to note for each main support pattern ➢ Support Scheme Review Table (Points to Note for Grant Aid)	New
5	Theory of Change	- The "JICA Water Support Theory of Change" referenced in the reference materials for duties has been repositioned as a reference, with the location of the description changed ➢ "5. JICA Water Support Theory of Change" has been moved and renamed to "2. (Reference) JICA Water Support Theory of Change"	Location of publication changed
6	Digitalization Level Assessment Tool	- Clarified the expression as the use of the Digital Capability Map was not explicitly stated ➢ Changed the phrase "using the Digital Capability Assessment Tool" to "Digital Capability Map:"	P4
7	Digital Capability Assessment Tool	- Added the original Digital Capability Map as a new tool ➢ Added the Digital Capability Map, which was initially documented separately from the reference materials for executive use, as the Digital Capability Assessment Tool	New
8	Digitalization Level Assessment Tool	- Added the Digital Capability Map checklist (A3 table) ➢ This table may be utilized as supplementary material when necessary to verify the presence and utilization level of each component.	New
9	Solution Consideration	- Add the following to the solution prioritization step: ➢ "⑤ Discuss the prioritized digital solutions, incorporating the business entity's intentions. Based on the outcome, revise the scoring as necessary and finalize it."	P51
10	Solution List	"Technological innovation (e.g., generative AI) necessitates ongoing consideration of additional solutions" is stated.	P24
11	Target level of data acquisition and utilization	- Revised the results of the review concerning the required digital talent ➢ Changed from "Business Architect" to "DX Promotion Lead" ➢ Removed "Architecture formulation, etc." from the description of "Software Engineer"	P40-42
No specific information	No specific information	No specific information	No specific information

No.	Item	Improvement Point	Slide Number*1
mation			
12	PoC Overview	Add CWASA and ZAWA cases as PoC overview	New
13	Project Formation	- Added checkpoints to the 'Case Formation (Case Scope Review)' procedure - Document actions, checkpoints, and CWASA/ZAWA case studies during project scope review	New
14	Procurement	- Added checkpoints in the "Procurement" procedure - Document actions, checkpoints, and CWASA/ZAWA case studies during procurement - Checkpoints and CWASA/ZAWA case studies during RfP creation/issuance and contract execution	New
15	Solution Development and Implementation	Added checkpoints for the "Solution Development and Implementation" procedure	New
16	Solution Stabilization and Deployment	Added checkpoints to the "Solution Stabilization and Deployment" procedure	New
17	Checkpoints	- Added "Summary of Checkpoints" - Organize key learnings across each phase: project formation, implementation/supervision, and others	New
18	Change Management	- Added "Change Management Measures Examples" - Outline key points derived from CWASA/ZAWA case studies and other examples - Includes case study on internal demand survey in Palestine	New
19	RfP/Contract Document Examples	- Add "RfP/Contract Examples" - Attach CWASA/ZAWA examples	New
20	Monitoring System Example	- Added "Monitoring System Example" - Add CWASA/ZAWA case studies	New
21	Comparative Study of Development Methods	- Addition of "Comparative Analysis of Development Methods and Overview of Each Process Procedure" - Details the types of digital solution development methodologies and criteria for determining development approaches	New
22	Solution Adoption	- Added "Solution Adoption and Deployment Status" - Solution adoption. Includes sample questions and points to note for assessing deployment status	New
23	PoC Review	- Added "PoC Review Items" - Addition of CWASA/ZAWA case studies for results review, root cause analysis, and lessons learned	New
24	Quality Management	Add a checklist summarizing the perspective of JICA staff conducting quality management of development consultant outputs	Proposal

[Note] *1 – Page number of the latest version of the Operational Reference Material (May 2026 edition)

3.2. Evaluation tools

(1) Utilization of the Operational Reference Materials

While JICA Operational Reference Materials provide a useful framework for comprehensively organizing the management status and development stage of water utilities, the wide range of charts, tables, and evaluation items means that the specific procedures for organizing and analyzing each item are not always clearly indicated. Furthermore, while water consultants find content related to water technology and facility operations relatively easy to understand, items concerning digitalization, information systems, and data utilization present a relatively challenging aspect to grasp due to differences in specialization.

Furthermore, when water consultants actually seek to develop DX utilization projects, it was felt that the reference materials alone may not sufficiently provide the necessary information for accurately analyzing the target organization's current situation. For instance, it would be desirable to sufficiently grasp and organize entity-specific management challenges, existing measures and strategies, the status of support from development donors, and the actual state of digitalization before proceeding to consider digital architecture and solutions. However, the current reference materials alone lack practical tools for systematically organizing and grasping such information. This raises concerns that analysis results may remain abstract or generalized, and that the information collected by consultants may lack consistency. Particularly when considering and prioritizing digital solutions, more concrete and systematic information organization is considered essential to link and organize the business entity's management challenges with its current digital status.

(2) Proposed Information Collection Format

1) Overview and Structure of the Information Collection Format

2) How to Use the Information Collection Format

(3) Other Observations

1) Proposed Improvements to Digital Architecture in JICA Operational Reference Materials

2) Recognition of challenges from the perspective of complementing water consultants' expertise

3) Recognition of Challenges Regarding the Positioning and Utilization of the Digital Capability Map

4) Approach to Digital Solution Consideration

5) Cost Estimation of Digital Solutions

3.3. Opinion Exchange Meeting

In May 2025, JICA organized the “Training Program on Promoting Digital Transformation (DX) for Water Utilities.” An opinion exchange meeting was subsequently held with water-sector consultants who participated in the training, with the objective of sharing key considerations and lessons learned from this survey regarding the examination of DX initiatives.

An overview of the opinion exchange meeting is presented in Table 3-6.

Table 3-6 Outline of Opinion Exchange Meeting

Meeting type	Online
Date/Time	17 th Feb. 2026, 10:00-12:00
Participants	Water-sector consultants (who participated in JICA’s DX utilization training in May 2025), JICA staff, and the survey team Total 35 persons
Topics	1. JICA Water Resource Group: DX Strategy and Initiatives (JICA) 2. Report on Survey Results (JICA Survey Team) 3. Study Session on Promoting DX in Water Utilities (JICA DXLab In-house consultant) 4. Question and Answer

The contents of the presentations delivered at the briefing session and the participants’ responses are described below.

3.3.1. Reporting Content

At the meeting, presentations were delivered focusing on the basic policy of the survey, the DX assessment methodology, overall findings, and proposed improvements and future applications. The main contents of the presentation are outlined below.

(1) Basic Policy of the Survey

Under the basic policy of the survey, the proposals presented in the work plan prior to the commencement of the survey were introduced. The policy consisted of three overarching directions:

- (i) improvement of the operational reference materials to effectively contribute to project formulation incorporating a DX perspective;
- (ii) enhancement of the reference materials to make them more practical and user-oriented; and
- (iii) improvement of overall operational efficiency throughout the survey.

In addition, seven specific guiding principles underpinning these three directions were explained. For further details, refer to “1.2. Basic Policy of the Survey.”

(2) DX Assessment Methodology

This section explained the practical methodology applied in the survey for examining DX, including information collection, formulation of the digital architecture, the solution selection process, and the assessment results. Specifically, the presentation covered the desktop survey conducted prior to the field visit, pre-survey information collection through questionnaires, assessment of the digitalization level, development of the digital architecture (As-Is and To-Be) following the field survey, scoring, and solution selection. For further details, refer to “2.2. Assessment Results of Water Utility Operations and Digital Utilization in the Target Utilities.”

(3) Overall Findings of the Survey

In the overall summary, the reactions of the target utilities, BWSSB and SRWSA, were presented, along with points that were difficult to explain and key considerations during discussions with the counterparts. In particular, the presentation highlighted the following aspects:

- (i) the wide range of evaluation axes (classifications and tiers);
- (ii) cost estimation;
- (iii) digital architecture; and
- (iv) key points in the scoring methodology

(4) Proposed Improvements and Future Application

This section presented key proposed improvements and observations regarding how to refer to and utilize the operational reference materials.

With regard to proposed improvements, the following points were highlighted:

- (i) the need for practical tools to systematically organize information;
- (ii) development of standardized information collection formats;
- (iii) clarification of the level of detail required for collected data;
- (iv) accumulation and addition of digital architecture case examples for more advanced development stages; and
- (v) the need to further accumulate knowledge and expertise related to DX.

Among these, particular emphasis was placed on the development of an information collection format to systematically organize information on water utility operations and digital utilization during the survey. Regarding future applications, the presentation addressed:

- (i) utilization of the Digital Capability Map; and
- (ii) approaches to examining digital solutions.

Both points were key insights gained through the survey and represent aspects that consultants may often overlook during project formulation.

3.3.2. Response from Participants

The main questions, responses, and comments raised during the opinion exchange meeting are summarized in the table below.

Table 3-7 Main Q&A and Comments in the Opinion Exchange Meeting

Topic	Contents
Digital Solution List	- A question was raised regarding how to interpret the Digital Solutions List provided in the Appendix of the operational reference materials. It was explained that the solutions presented in the document are intended solely as illustrative examples of specific tools for reference purposes, and that they are not necessarily meant to be selected exclusively from that list. - As a supplementary comment, it was noted that, with ongoing technological innovation, new solutions beyond those listed in the Appendix are expected to emerge in the future. As knowledge and experience regarding such solutions accumulate, the range of options available for consideration is likely to expand.
Reference Information on the Costs of Digital Solutions	- It was pointed out that, when explaining proposed solutions to senior management, presenting cost estimates is crucial, and an inquiry was made regarding reference information on costs. In response, the survey team noted that, for example, CWASA has formulated an IT strategy in which solution costs are included in the roadmap. In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has published the “Digital Transformation (DX) Technology Catalog for Water Supply and Sewerage,” which includes cost information. It was suggested that providing an indicative cost range based on such references would be a practical approach. - Ministry of Land, Infrastructure, Transport and Tourism (MLIT), “Digital Transformation (DX) Technology Catalog for Water Supply and Sewerage” (October 2025) https://www.mlit.go.jp/mizukokudo/watersupply_sewerage/jyouge_dx/index.html
Approaches for Regions Lacking Reliable Vendors	A comment was made regarding the difficulty of introducing DX in countries where reliable vendors are not available. In such cases, it was suggested that scalable free software solutions—such as those for meter reading and billing—could be beneficial. The importance of conducting prior market assessments and the potential use of open-source solutions were identified as areas for further consideration.

Topic	Contents
Approach to System Installation and Integration	• A discussion was held on whether to introduce a large-scale integrated system. Referring to a case from another project, it was noted that there is a risk that interfaces may fail to connect properly when integrating existing systems with new ones. It was suggested that, for utilities where digital systems are not yet widely implemented, the option of introducing a large-scale integrated system in one go should also be considered. • JICA commented that while the introduction and integration of a large-scale system represents an ideal scenario, it is important to consider whether capable local vendors are available, as well as the risks of vendor lock-in and system upgrades. In many cases, a lightweight and flexible modular approach may be more practical. • It was also explained that system introduction and integration should be considered based on the utility's management challenges and needs. The stance is to introduce solutions that address bottlenecks and are aligned with the utility's level of capacity and maturity.
Cost-Benefit of Digital Solution	• When introducing digital solutions, it is desirable to demonstrate their cost-effectiveness. For example, this could include estimating the extent to which personnel costs can be reduced through implementation, and how long it would take to recover the initial investment and ongoing operation and maintenance costs. • It was suggested that using tools such as Excel to estimate cost-effectiveness could be one possible approach. It was also noted that such information could be useful when engaging in discussions with the utility's management.
Approach to utilities with low levels of digitalization	• It was commented that, for utilities with a low level of digitalization, advancing digitalization rapidly should be approached with caution. For example, if even basic record-keeping practices are not in place, it may be important to begin by establishing the habit of maintaining records on paper. This point was also emphasized during the presentation and was particularly noteworthy.

Appendix

Appendix 1	Information Collection Format
Appendix 2	Supplementary Material (Digital Capability Map Checklist)
Appendix 3	Bibliography
Appendix 4	List of Materials Collected
Appendix 5	List of Interviewees
Appendix 6	Field Survey Schedule and Interview Records
Appendix 7	Photo Pictures
Appendix 8	Questionnaire Responses (SRWSA and BWSSB)

Appendix 1: Information Collection Format



Enhancement of DX Utilization for Water Utility

Information Collection Format

Japan International Cooperation Agency (JICA)

February 2026

Contents

- 0. Explanation
- 1. KPIシート (Development Stage Evaluation)
- 2. Analysis for Current Situation and Challenges (Water Service Management)
- 3. Analysis for Current Situation and Challenges (Digitalization)
- 4. Work Process
- 5. List of Existing System
- 6. List of Existing Data
- 7. <Correspondence Table>

Explanation

Sheet name	Explanation of Workflow	Usage method
1. KPI Sheet (Development Stage Evaluation)	1. Enter KPI values for the past three years in cells I26 to K37 of the “(2) KPI Input Sheet.” - In accordance with “(1) Utility Development Stage Assessment – Benchmark,” the development stage level for each indicator will be automatically displayed. 2. In Column L of the “(2) KPI Input Sheet,” indicate the trend of each KPI value using arrows in order to grasp trends. 3. In Column P of the “(2) KPI Input Sheet,” enter the source/reference of each KPI value. 4. In Column Q of the “(2) KPI Input Sheet,” conduct a brief analysis of performance and trends based on the KPI values.	- Based on the KPI analysis, obtain an overview of operational performance and areas of concern, and use the results as basic information for current status analysis. - Utilize the results when referring to the Operational Reference Document, including the “List of Common Issues Observed by Development Stage” and the “Target Data Acquisition and Digital Utilization Levels by Development Stage.”
2. Situation Analysis and Challenges (Water Service Management)	1. Enter information on existing management plans and strategies (title and year of formulation), as well as an overview of development donor support, in the upper left and upper right sections, respectively. 2. In Column F, organize the current status and challenges of utility operations based on information obtained from interviews, existing plans and strategies, and development donor information. 3. In Column G, summarize priority measures and strategies. 4. In Column H, indicate the source/reference for the information entered in Item 3.	- Identify areas that the utility should address and areas where growth should be prioritized, based on information on the utility’s challenges and existing measures and strategies. - Utilize this information when examining and prioritizing digital solutions.
3. Situation Analysis and Challenges (Digitalization)	1. In Column E, organize the current status and challenges related to digital system utilization based on information obtained from interviews and existing plans and strategies. 2. In Column F, indicate which of the six perspectives of the digitalization level assessment each item corresponds to. - While a dropdown list is provided for selecting one option, multiple selections are acceptable if applicable. 3. In Column G, enter the evaluation score based on the four-level digitalization assessment scale.	- Understand challenges related to digitalization and existing measures and strategies, and use the information as a basis for conducting the digitalization level assessment. - Organize information by management aspect (major and sub-categories) and align it with the six perspectives of the digitalization level assessment.
4. Work Process	1. In cells E5 to E7, describe work activities and challenges identified through interviews and other sources. 2. From Column 12 onward, enter information on systems and data used in daily operations. - Ensure consistency of IDs with Sheets 5, 6, and 7. 4. Describe business processes separately for system-based processing and manual processing. - System-based processing should primarily reflect the processes organized in Item 2.	- Further examine and organize business processes in which issues have been identified through the current status and challenge analysis. - Rather than preparing this for all business processes, it is assumed that it will be prepared only for those processes identified as having issues.
5. System List	For the items shown in Row 3, organize relevant information based on interviews and existing plans.	- Compile a list of implemented systems and utilize it to assess the current status of digitalization. - If a system inventory can be prepared in advance through questionnaires prior to the field survey, smoother surveys and interviews can be conducted.
6. Data List	For the items shown in Row 3, organize relevant information based on interviews and existing plans.	- Compile a list of collected data and utilize it to assess the current status of digitalization.
7. Correspondence Table	For the items shown in Row 3, organize relevant information based on interviews and existing plans.	- Clarify the relationships between systems and data for the purpose of developing a digital architecture.

1. KPI Sheet (Dev. Stage Evaluation)

(1) Dev. Stage Evaluation of Utility Benchmark

Category	Growth Spiral	KPI No.*1	KPIs	Benchmark for Dev. Stage Evaluation			
				1	2	3	4
Service Level	1. Improvement of Service & Investment	5	Continuity of Service (Hrs/day)	Less than 12h/d	12-24h/d	24h/d	—
		6	Quality of water supplied (Compliance rate: %)	(Untreated/turbid. Water)	WQ compliance rate less than	(WQ compliance rate (80%-90%))	(Compliance rate 90% or more)
Service Scale	2. Increase of Customer-Base and Satisfaction	10	Service coverage / Water coverage (%)	(Below 50%)	(50-80%)	(80% or more)	(95% or more)
Viability	3. Increase of Revenue Collection	15	Collection ratio (%)	(60% or less)	(60-85%)	More than 85%	(98-100%)
		16	Non-revenue water ratio(%)	(40% or more)	(25-40%)	Less than 25%	(10- 25%)
		17	Metering ratio (%)	(80% or less)	(80-95%)	(Aim for 100% (95-99%))	(99-100%)
Profitability	4. Improvement of Management	22	EBITDA margin (%)	(Negative)	(0%-30%)	Aim for 30% or more	—
		25	Operating Profit Margin(%)	(Negative)	(Less than 10%)	(Aim for 10% or more)	—
Financial Soundness		26	Equity ratio (%)	—	(Less than 40%)	(Aim for 40% or more)	—
		27	Fixed long term conformity rate (%)	—	(Above 110%)	Aim for less 110%	—
		28	O&M cost coverage ratio (%)*2	(Less than 100)	(100-130)	(Above 130)	—
Human Resource		35	Number of staff per 1,000 connections*2	(11 or more)	(6.5-11)	(4.0-6.5)	(Less than 4.0)

Source: "JICA Data Collection Survey on Guidance for Cluster Strategy for Supporting for Utility Growth", "Monitoring indicators for JICA cluster project strategy for supporting for utility growth"

[Note]

Overall --- The benchmark values are the threshold values used by JICA for monitoring the Cluster Strategy of ‘Support for the Growth of Water Utilities’ and serve as indicative values for progressing to a higher development stage.

The benchmark values shown in parentheses are not the thresholds used for the aforementioned monitoring; However, they are presented as reference values indicative of the respective development stage.

*1 --- The KPI numbers follow those used in the above-mentioned survey. While the KPI sheet includes a total of 35 indicators, this sheet extracts 12 indicators from among them for the purpose of assessing development stages.

*2 --- This indicator is proposed by the Survey Team and is not included in the 26 indicators currently used by JICA (as of February 2026) for monitoring the Cluster Strategy of “Support for the Growth of Water Utilities.”

(2) KPI Entry Table

Category	Growth Spiral	KPI No.	KPIs	KPI value			Benchmark for Dev. Stage Evaluation			Trend	Source	KPI Analysis for Dev. Stage
				202X	202X	202X	202X	202X	202X			
Service Level	1. Improvement of Service & Investment	5	Continuity of Service (Hrs/day)				NA	NA	NA			
		6	Quality of water supplied (Compliance rate: %)				NA	NA	NA			
Service Scale	2. Increase of Customer-Base and Satisfaction	10	Service coverage / Water coverage (%)				NA	NA	NA			
Viability	3. Increase of Revenue Collection	15	Collection ratio (%)				NA	NA	NA			
		16	Non-revenue water ratio(%)				NA	NA	NA			
		17	Metering ratio (%)				NA	NA	NA			
Profitability	4. Improvement of Management	22	EBITDA margin (%)				NA	NA	NA			
		25	Operating Profit Margin(%)				NA	NA	NA			
Financial Soundness		26	Equity ratio (%)				NA	NA	NA			
		27	Fixed long term conformity rate (%)				NA	NA	NA			
		28	O&M cost coverage ratio (%) ^{*1}				NA	NA	NA			
Human Resource		35	Number of staff per 1,000 connections ^{*1}				NA	NA	NA			

*1 --- This indicator is proposed by the Survey Team and is not included in the 26 indicators currently used by JICA (as of February 2026) for monitoring the Cluster Strategy of “Support for the Growth of Water Utilities.

※Indicate the three-year trend using arrows in the above box.

↗
→
↘

2. Situation Analysis and Challenges (Water Service Management)

Current Business Plan and Strategy		Support by Development Partners
Title/ FY		Donors/ Out;ine
1		JICA: xxx project
2		•
3		•
4		xxx :

Management Area				Challenges and Plan		
Categorir	Sub-category		Check items	Situation & Challenge on Water Service Management	Priotized Policy and Strategy (approx. 5 years)	Source
Capital investm ent strategy	1a	Project planning	Securing water sources Implementation of water demand forecasting Facility development and expansion planning			
	1b	Asset Management, Facility Design, Lifecycle	Facility and equipment renewal and rehabilitation planning			
	1c	Project information management Progress	Management and recording of asset information Facility and equipment renewal and rehabilitation planning 進捗管理			
	1d	Project Implementation and Management	Procurement Management Inventory issuance management of facilities and materials			
O&M	2a	Asset Management, Facility Design, Lifecycle Management	Operational status of intake, treatment, and transmission/distribution Status of water supply hours, volume, and pressure Water quality management status Staff knowledge and skills			
	2b	Maintennce (incd. NRW reduction)	Facility maintenance status Leakage control measures and activities O&M planning and implementation Preventive maintenance Staff knowledge and skills			
Custiner Service	3a	Reading	Status of meter reading (manual operations) Accuracy and efficiency of meter reading			
	3b	Billing and collction/ Tarigg Setting	Billing and collection status Tariff levels and tariff revision			
	3c	Customer Information	Recording and updating of customer information Accuracy of customer information			
	3d	Outstanding Arrears Collection	Management of outstanding receivables Measures and activities for arrears collection			
	3e	Customer Service	Customer response Complaint reception and handling Customer satisfaction surveys			
Support system	4a	Finance	Operating balance Cash flow Debt and subsidies			
	4b	Personnel Management/ HRM	Organizational and staffing structure Human resource development framework and plans Personnel management			
	4c	Supply Chain Man.	Procurement Logistics Inventory management			
	4d	Information Management & Digilization	IT strategy Level of digital infrastructure and security Digital human resources			
	4e	Other/ Enf man	Water source protection Relevant laws and regulations			
Others	5a	Policy/ Law/ Regulation agency	Supervisory authorities Relevant legal and institutional frameworks Regulatory bodies (water resources management, tariff regulation)			

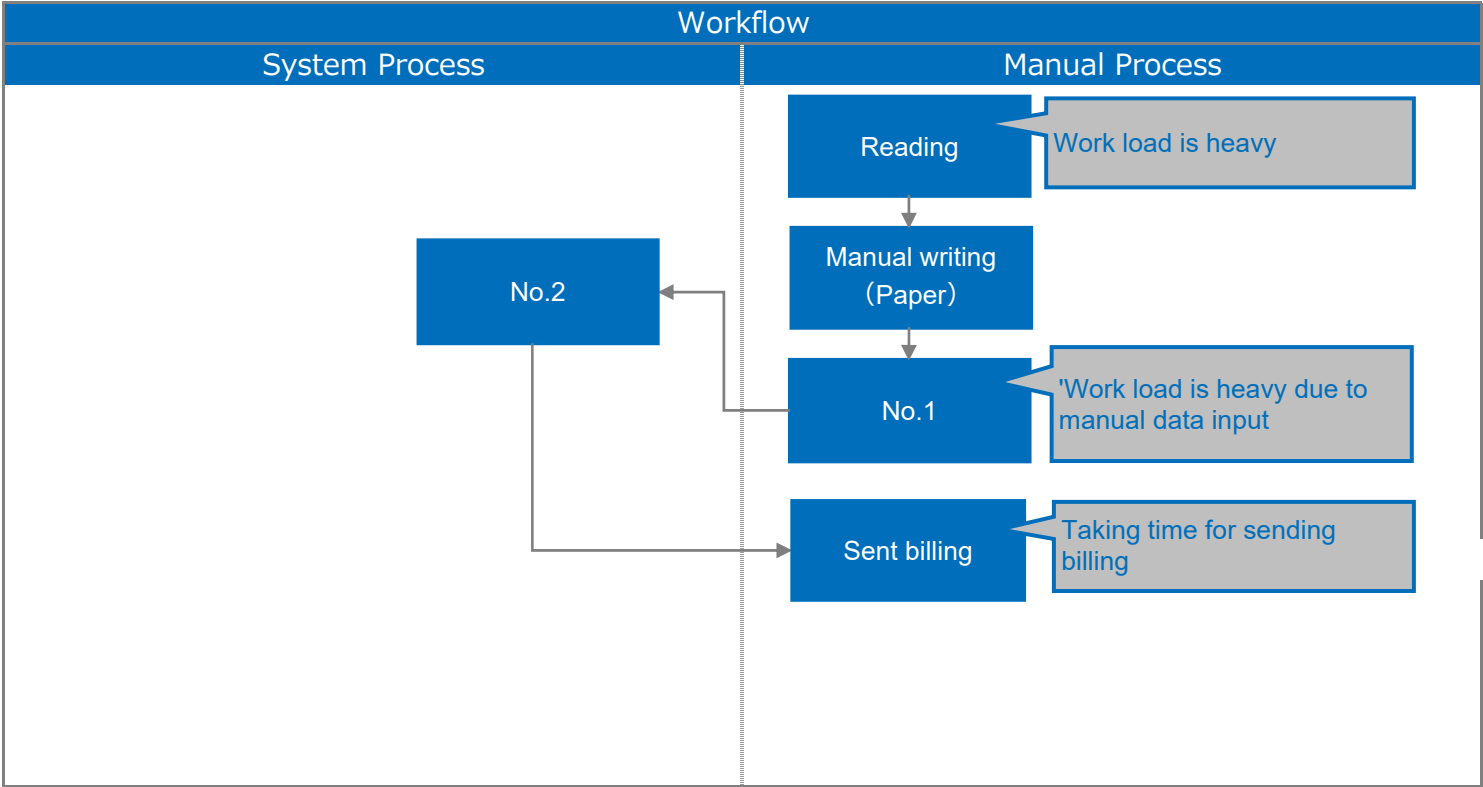
3. Situation Analysis and Challenges (Digitalization)

Management Area			Current Situation and Challenge for Digitalization	Digital Level Evaluation	
Category	Sub-category			Parameter	Level
Capital investment strategy	1a	Project planning			
	1b	Asset Management, Facility Design, Lifecycle Management			
	1c	Project information management Progress monitoring			
	1d	Project Implementation and Management			
O&M	2a	Asset Management, Facility Design, Lifecycle Management			
	2b	Maintennce (incd. NRW reduction)			
Custiner Service	3a	Reading			
	3b	Billing and collction/ Tarigg Setting			
	3c	Customer Information			
	3d	Outstanding Arrears Collection			
	3e	Customer Service			
Support system	4a	Finance			
	4b	Personnel Management/ HRM			
	4c	Supply Chain Man.			
	4d	Information Management & Digilization			
	4e	Other/ Enf man			
Others	5a	Policy/ Law/ Regulation agency			

4. Work Process

Process for		
Outline	Main Wotrck Item	- Field staff visually check meters at each household - Upon returning to the office, meter readings are recorded on paper forms by han - Data entry staff input the handwritten data into the system - After charges are calculated by the system, bills are issued and sent to customers
	Section/ Number of Persons	〇〇Dept./ Sec., 〇〇 persons
	Challenges	- Meter readings verified on site are first recorded on paper and then manually entered into the system. → Under the current staffing structure, this labor-intensive, manual meter reading approach will become increasingly difficult to sustain as the water supply service area expands.

System & Data							
No.	Input		Process		Output		Subsequent process
	DATA_ID	Data	SYS_ID	Current System	DATA_ID	Data	
1	-	Paper	SYS_04	SUMS	DATA_04	Reading	Billing
2	DATA_04	Meter reading	SYS_04	SUMS	DATA_05	Billing	Collection



5. System List

[illegible]

6. Data List

[illegible]

7. Correspondence Table

[illegible]

Appendix 2: Supplementary Material (Digital Capability Map Checklist)

Digital Capability Map Checklist

			Level 1	Level 2	Level 3	Level 4	Level 5	Exist/ Non-exist	Level of capability/ utilization
①Engagement Channels	Customer Touch Points		Physical Mail	Email					
				SMS/Whatsapp					
				Call center & IVR	Customer Servicing portal				
					Customer Mobile App				
					Messaging Services (WhatsApp, Viber)				
	Work Force Touch Points (MI, MOD, Contractors, Etc.)				Kiosk				
						AI enabled Chatbot			
					Work Force Portal				
					Employee Mobile App				
					Intranet				
	External / 3 rd party Intergrations				Meter reading app				
					Management Dashboards				
					POS Devices				
					NRW Dashboard				
						Mobile device mgmt. Early Warning Systems			
Engagement Channel Functions				Payment Gateway			Social Media Intergation		
							Weather services		
							Banking Services		
							Space agencies		
							Government agencies		
			Document Mgmt.	Customer Portal Mgmt. Employee Portal Mgmt.					
					Customer Relationship Mgmt.(CRM) Customer Communication Mgmt. Employee Relationship Mgmt.				
						Partner Mgmt.			
②Data & Analytics	Data Platform		Data Ingestion			ETL/ELT			
						Data Replication			
						Event Messaging			
						Batch			
						Change Data Capture			
			Data Storage			Data Streaming			
						Raw Data			
						Relational Database			
						Cached/Fast Access Data			
						Staging Data			
	Business Intelligence &Reporting			ODS					
				Enterprise Data Warehouse					
				Specialized Data Marts					
				Archiving					
				Unstructured Data		External Data			
	Analytics			MIS Reports					
				Regulatory Reports					
				Operational Reports					
				Adhoc Reports					
	Advance Analytics				Data Visualization				
						Self-service Analysis			
						Data Discovery & Search			
						Analytics Sandbox			
				Descriptive & diagnostics analytics					
					Predictive, Prescriptive analytics				
					GIS, Geo Spatial Analytics				
Data Management & Governance		Master Data Mgmt			Orchestration & Scheduling				
					Customer Master				
					GIS Master				
		Data Quality & Manage ment			Asset Master				
					Reference Data				
					Data Catalogue				
		Data Governa nce			Data Lineage				
			Data Quality Management						
AI Platform & Operations				Data Stewardship					
				Data Policies					
		AI platform				AI / ML Models			
						AI agent			
						Prompt Ops			
		AI Ops				ResponsibleAI Govenance			
						AI Guardrails			
External AI Services				LLMs					
				AI / ML Services					

		Level 1	Level 2	Level 3	Level 4	Level 5	Exist/ Non-exist	Level of capability/ utilization
③Core Business Capabilities	Productions & Distribution			SCADA systems				
				Production mgmt. systems				
				Water qullity monitoring systems				
					Automated Dosing Systems			
					Variable frequency drives(VFDs)			
	Metering operations		Billing & Arrears		Programmable logic controllers(PLCs)			
					Hydraulic modeling systems			
					Remote terminal units			
	Asset Management			Payments				
				DMA mgmt				
				Revenue mgmt				
				Asset Data Mgmt				
	Inventory Management			Asset Register Mgmt.				
				Asset Design & Build				
				Asset Monitoring				
				Asset Maintenance	GIS Management			
				Inventory Mgmt.				
	Field Force Mgmt		Meter Reading & Inspection					
			New Connections					
			Servicing & complaints					
				Maintenance				
				Surveying				
				Work Flow Management				
				Work Resource Planning				
				Work Scheduling				
	Enterprise Resource Planning			Customer Orders Managements				
				Beat Plannning				
				SOP				
				Training Manuals				
	Task Manage ment			Field Force Support				
				Knowledge Base				
				Human Resources				
				Finance				
				Supply Chain And Procurement				
				Vendor, Contractor & Partner Mgmt.				
				LCPM system				
				Administrator & Office Mgmt.				
	Service Delivery & Planning			Real estate mgmt.				
				Governance, Risk & compliance mgmt				
④Infrastructure	Digital Infrastructure		Network and Comms					
			IT facility mgmt.					
			Backup & Archival					
			Sensors and IoT Gateway					
				Cloud Management				
	Physical Infrastructure			Fault & Performance Monitoring				
				Logging				
					IT device mgmt.			
					Smart Meters			
		Chemical Building						
		Clarifier						
		Receiving Wells						
		Drainage Tank						
		Coagulation and Flocculation Tank						
		Clear Well Tank + Booster Pumps						
		Reservoir						
		Deep Tube Wells						
		Elevated Tanks						
		Dewatering facility						
⑤Intergation & Data Exchange				Boosting Stations				
				Pipelines				
				Valves				
				File Transfer Services				
				Scheduling & Workflow Mgmt				
				API Orchestration				
⑥Security & Identity Mgmt.				Pub Sub Mgmt				
				Internal Gateway				
				Adapter & Connectors				
				Encryption & Masking				
					External Gateway			
				Authentication				
				Identity Mgmt.				
				Authorization & Access Controls				
				Single Sign-on				
				Cyber Security Governance				

Appendix 3: Bibliography

Appendix-3 Bibliography

No.	Document Title	Type
BWSSB		
1	BWSSB, "Blueprint for the future (Vision)"	electronic data
3	JICA "Preparation Survey on Water and Sewerage Facility Development in Bengalore City (Phase3) Final Report Summary"	electronic data
4	JICA "Completion Report on the Demonstration Project for the Dissemination of a Leakage Detection System Using Automatic Leak Noise Detectors in India"	electronic data
5	BWSSB, "IT Initiative" ppt	electronic data
6	Deccan Herald Article, "BWSSB to replace 40-yr-old pipelines to bring down water leakages" https://www.deccanherald.com/india/karnataka/bengaluru/bwssb-to-replace-40-yr-old-pipelines-to-bring-down-water-leakages-3683320	electronic data
2	Deccan Herald Article, "BWSSB to replace 40-yr-old pipelines to bring down water leakages" https://www.deccanherald.com/india/karnataka/bengaluru/bwssb-to-replace-40-yr-old-pipelines-to-bring-down-water-leakages-3683320	electronic data
7	IWA, "Building Bengaluru's water future: identifying challenges and a strategic blueprint for sustainable management" https://iwaponline.com/wp/article/27/9/1036/109218/Building-Bengaluru-s-water-future-identifying	electronic data
SRWSA		
1	SRWSA, "Business Plan 2022-2026"	electronic data
2	JICA "SRWSA-Presentation 16 Feb 2024"	electronic data
3	JICA "Pre-Project Evaluation Sheet for SR Smart City ph1&ph2"	electronic data
4	JICA "Preparatory Survey on Siem Reap Water Supply Development in Cambodia"	electronic data
5	JICA "Report on Support for Small- and Mid-Enterprise - Geo-Craft Co., Ltd.-"	electronic data
6	MISTI, "Water Supply Data -Public Water Utility-"	electronic data

Appendix 4: List of Materials Collected

資料 4 収集資料リスト

No.	Document Title	Type
BWSSB		
1	Annaul Accounts 2020-21.pdf	electronic data
2	Annual Accounts 2019-20.pdf	electronic data
3	Annual Accounts 2021-22.pdf	electronic data
4	Annual Accounts 2022-23.pdf	electronic data
5	BWSSB Sajala User Manual SRS.doc	electronic data
6	JalaSnehi_SRS_Document.pdf	electronic data
7	Kaveri On Wheels Srs.docx	electronic data
8	Noc app flow chart.pdf	electronic data
9	IT initiative-02.08.2025-ATI-new.pptx	electronic data
10	BWSSB Best Practices_25.07.25 2.docx	electronic data
11	Tender_Specifications_Full_Smart_IoT_Borewell_Controller_Final.docx	electronic data
SRWSA		
1	Business_Plan_2022-2026_detail.docx	electronic data
2	Business_Plan_2022-2026_outline.docx	electronic data
3	ផែនការអាជីវកម្មឆ្នាំ២០២២-២០២៦.pdf	electronic data
4	SRWSA's Annual Report 2022.pdf	electronic data
5	SRWSA's Annual Report 2023.pdf	electronic data
6	SRWSA's Annual Report 2024.pdf	electronic data
7	SRWSA's Annual Report 2024_en.docx	electronic data
8	Audit report - internal control 2024.pdf	electronic data
9	Audit report 2022.pdf	electronic data
10	Audit report 2023.pdf	electronic data
11	Audit report 2024.pdf	electronic data
12	Aqua Crew Operation Manual (v2.0) (AQUA Crew)EN.pdf	electronic data
13	Screenshots of Main Screen(WTP1, WTP2, WPT3)	electronic data
14	SCADA System Overview.docx	electronic data
15	Screenshots of Aqua Crew Main Screen_Mapping system.png	electronic data
16	Screenshots of SUMS - DYnamics_NAV2015 Main Screen_Accounting system_Billing system_Stock Asset Mgt.png	electronic data
17	SRWSA Org. Chart_En.pdf	electronic data
18	SRWSA Org. chart_kh.pdf	electronic data
19	WTP3 flow chart.pdf	electronic data
20	WTP3 Drawings (As_built).pdf	electronic data

Appendix 5: List of Interviewees

資料 5 面会者リスト

Ctry.	Org	Dept.	Name
Bengaluru (India)			
	BWSSB	Chief Engineer, Design Section	Mr. Sanath Kumar
		Additional Chief Engineer, MIS & IT	Mr. V.B. Maheswarappa
		Executive Engineer, Design Section	Mr. Chandrasekhar
		Assistant Executive Engineer, MIS	Ms. Lakshmi
		IT Department	Ms. Kavita
		Technical Assistant	Ms. Ashwini
		Executive Engineer, IT Section – Billing & GIS	Ms. Shilpa V.
		Chief Engineer, Project Department	Mr. K.N. Rajiv
		Executive Engineer, IT Section	Ms. Laxmi
		Accounts Section	Mr. Prakash
		Executive Engineer, UFW-II Department	Ms. Nalini
		Additional Chief Engineer, UFW-II Department	Mr. Purushothama BG
	NJS Engineers India Pvt. Ltd.	Director	Mr. Pradipto Sarkar
		Senior Vice President	Mr. Nizamuddin Ahmed
		PMC Representative	Mr. Salauddin
	Chavare Engineering Pvt. Ltd.	GM Automation (System Integrator)	Mr. Sachin Jawale
Seam Reap (Cambodia)			
	MISTI	Under Secretary of State, Ministry Executive	H.E. Khut Vuthiarith
		Office Chief, Office of Technique and Project Management	Mr. Phea Sinat
		Office Chief, Office of Planning and Data Management	Mr. Kong Sovan
		Office Chief, Office of Data Management	Mr. Ly Chansothea
	SRWSA	Director General, Executive Management	H.E. Chan Sengla
		Deputy Director General, Executive Management	Mr. Yay Monirath
		Deputy Director General, Executive Management	Mr. Kot Nimol
		Deputy Director General, Executive Management	Mr. Sok Hout
		Director, Project Management Department	Mr. Pheng Bunhor
		Deputy Director, Project Management Department	Mr. Luon Soknoun
		IT Manager, IT Section (under HR/Admin)	Mr. Somphos Vichhai Chhon
		SCADA Operator, Distribution Department	Mr. Meng Hengkim Lin
		Vice Chief of Office, Distribution Network Management	Mr. Kheav Kimleng
		Deputy Director, Distribution Department	Mr. Horm Sophany
		Accounting Officer, Accounting Department	Ms. Thap Seila
		Chief Accountant, Accounting Department	Ms. Meas Vichana
		Deputy of Commercial Office, Commercial Department	Mr. Sam Senghan
		Water Quality Technician, Water Quality Laboratory	Ms. Seang Ravy
	JICA Cambodia Office	Senior Staff, Country Office	Mr. Munakata Atsushi
		Staff, Country Office	Mr. Seng An Youk

Appendix 6: Field Survey Schedule and Interview Records

資料 6 現地調査行程

1) First site visit (Bengeluru and Siem Reap)

Date	Time	Meeting Topic / Department
23-Jul-25	14:40-15:40	Kick-Off (Cross-departmental)
25-Jul-25	11:00-12:30	Billing System and GIS (IT Section)
25-Jul-25	12:40-14:15	BWSSB's initiatives related to digitalization
25-Jul-25	15:15-16:00	IoT Borewell Monitoring and Kaveri on Wheels (Design Section)
25-Jul-25	16:05-16:30	Current Digitalization Status of BWSSB
26-Jul-25	09:30-14:30	WTPs (Site visit)
28-Jul-25	10:30-12:00	CP-24 Centralized SCADA Integration (PMC Interview)
28-Jul-25	11:50-13:15	MIS, Kaveri on Wheels, GIS and Digital Services (IT Section)
28-Jul-25	13:15-14:45	Financial Systems, WMS, HRMS, ERP (Accounts Section)
28-Jul-25	16:30-17:00	Bulk Flow Meters and NRW Monitoring (UFW-II Department)
29-Jul-25	11:00-13:00	CP-24 Central SCADA System Overview (Central SCADA Centre)
29-Jul-25	13:00-14:00	Detailed SCADA Operations and Visualization (Central SCADA Room)
29-Jul-25	15:45-16:30	NRW Reduction and Digital Monitoring Strategy (UFW-II Department)
30-Jul-25	-	Transfer from India to Cambodia
31-Jul-25	07:50-08:15	SRWSA Kickoff Meeting
31-Jul-25	08:30-09:20	AQUA Crew and IT Section
31-Jul-25	09:20-10:20	Commercial Department
31-Jul-25	10:35-11:30	Accounting Department
31-Jul-25	11:35-12:00	Complaint Management and Others
31-Jul-25	14:30-15:40	Kickoff with MISTI
31-Jul-25	16:15-17:10	SCADA Room at WTP3
1-Aug-25	08:30-10:00	MISTI
1-Aug-25	10:40-11:00	Distribution Department
1-Aug-25	11:30-12:00	Leak Detection Section
1-Aug-25	14:30-15:30	Project Planning & Management Dept.
1-Aug-25	16:10-17:00	SCADA Room at WTP1 & WTP2
4-Aug-25	09:00-10:00	Head of Accounting Department
4-Aug-25	10:00-11:00	Head of Commercial Department
4-Aug-25	11:10-12:00	Accounting Department
4-Aug-25	14:30-	Site Visit - Pipe Construction & Avenza Use (App.)
5-Aug-25	08:30-10:10	AQUA Crew
5-Aug-25	10:10-11:00	Water Supply Dept. (O&M)
5-Aug-25	11:10-11:40	Stock Yard Status
6-Aug-25	14:30-16:00	WTP Monitoring & Site Visit
6-Aug-25	09:40-10:10	Accounting Department
6-Aug-25	11:10-12:10	Meeting - Kitakyushu Water Service (KWS)
6-Aug-25	15:30-16:00	Findings Explanation to SRWSA Management

2) Second site visit (Bengeluru and Siem Reap)

Date	Time	Meeting / Session
27-Oct-25	10:45-11:25	IT section
27-Oct-25	11:30-12:05	IT section
27-Oct-25	12:20-13:10	2nd Meeting: Explanation of 1st Survey Results & Q&A
27-Oct-25	13:20-15:05	IT section
27-Oct-25	15:10-16:00	Accounts Section
28-Oct-25	11:30-12:30	Monitoring Section
28-Oct-25	13:00-13:20	IT section
29-Oct-25	-	Transfer from India to Cambodia
30-Oct-25	09:00-11:30	2nd Meeting: Explanation of 1st Survey Results & Q&A
31-Oct-25	10:00-11:00	Follow-up Discussion with Project Management Director
31-Oct-25	14:30-16:00	Technical Discussion on Proposed Solutions (SCADA & WTPs)
3-Nov-25	8:30-12:00	Wrap-up meeting for the 2nd site visit

Appendix 6-1: First Field Survey (SRWSA)

1. Meeting Minutes -SRWSA Kickoff meeting

The yellow-colored areas are those where the content could not be fully confirmed.

Date: 07:50-08:15 on July 31, 2025

Location: 3th floor at SRWSA Office

Attendees: JICA Consulting Team

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Piseth (Cambodia)
 - Cambodia side
 - MISTI: 1.
 - 1. H.E. Khut Vuthiarith, Under Secretary of State, 2.
 - Mr. Phea Sinat, Office Chief of Technique and Project Management, 3.
 - 3. Mr. Kong Sovan, Office Chief of Planning and Data Management
 - SRWSA
 - 1. H.E. Chan Sengla, Director General
 - Mr. Yay Monirath, Deputy Director General
 - Mr. Kot Nimol, Deputy Director General
 - Mr. Sok Hout, Deputy Director General 5.
 - Mr. Pheng Bunhor, Director of Project Management Department
 - JICA Cambodia office: Mr. Munakata Atsushi, Mr. Seng An Youk
-
- Mr. Ohno explained the project outline, schedule, and requested items.
 - He confirmed that the SRWSA would be adjusted according to the schedule of the survey team.
 - **The President?** Some SRWSA staff members, including the President, are participating in workshops in other regions, so they are unable to participate in the discussions, but they will make adjustments accordingly.

2. Meeting Minutes (Observation) -AQUA crew and IT section

Date: 08:30-09:20 on July 31, 2025

Location: 2nd floor at SRWSA Office

Attendees: JICA Consulting Team

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Piseth (Cambodia)
- SRWSA: Mr. Bunhor (Director of the Project Management Department), Mr. Luon Soknoun (Deputy of the Project Management Department), Mr. Somphos Vichhai Chhon (IT manager under the Human Resources Department) 1.

1. PCs in AQUA Crew and their usage

- A total of three PCs are available for AQUA Crew use.
 - Two are used by the IT section.
 - One is located on the first floor near the payment counter and is used for new customers who wish to connect. Customers and SRWSA can mutually check the status of the pipe network around their homes. 2.
-

2. information and functions included in the Aqua Crew

- Registration Information:
 - Includes pipe networks, meters, valves, and customer information (water meter locations, contract PDFs, photos, etc.) outside of the water treatment plant.
 - No information on water treatment plants.
 - Input/output function:
 - Various information can be input and output in CSV format.
 - Customer payment status is reflected by manually importing CSV files.
 - Pipe network information is manually updated as needed. 3.
-

3. pipe network calculation and technical requirements

- Pipe network calculations such as flow rate and water pressure for each pipe are available.
 - We understood that water pressure per customer point cannot be checked.
 - Pipe network calculations require a ".inp" format file.
 - A paid service from Geographic is required to create an up-to-date version of this file.
 - The ".inp" file can be exported to Sharp format.
 - In the future, SRWSA intends to make it possible to create the file on its own. 4.
-

Cooperation with other departments

- The O&M department provides maintenance management information such as repairs, leaks, etc. to the ICT section, and the ICT section manually reflects the information in AQUA Crew.
 - No integration with other systems (SUMS) at this time.
 - Inquired with Geographic about the possibility of integration with the SUMS system used by the Accounting section. No response yet.
 - Even if integration is possible, it is expected to be done for a fee.
-

5. other

- All work in the Administration department is done manually.

3. Meeting Minutes (Observation) -Commercial Department

Date: 09:20-10:20 on July 31, 2025

Location: 2nd floor at SRWSA Office

Attendees: JICA Consulting Team

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Piseth (Cambodia)
- SRWSA: Mr. Bunhor (Director of Project Management Department), XXX (Comercial Dep.), XXX (Project Management Department)

1.Synergistic Utilities Management System (SUMS) Overview and Operation Status

- SRWSA has implemented a Synergistic Utilities Management System (SUMS) to manage customer information, billing, and payment data. Customer information is manually entered and updated and used to calculate monthly meter readings and billing amounts; the system supports output in CSV format, but is not linked to AQUA Crew.
- The system is currently maintained by a Malaysian vendor and online support is provided in case of technical problems.
- The basic fee for SUMS is approximately US\$5,000 per year, with fees increasing by 10% each year. Additional modules such as HR, payroll, and customer connectivity will incur additional costs, increasing the annual total to approximately US\$10,000. These modules have been approved by the Board of Directors and a Malaysian vendor will visit SRWSA in 2025 to upgrade the system.

2. meter reading and data entry process

- The meter reading process is manual. The meter reader records the readings on paper at the site and then returns to the office to manually enter the data into the system. Bills are then issued and delivered to the customer's mailbox again.
- Meter readings for the past and current month are recorded monthly, and the amount used is calculated.
- Data is entered into Excel and then uploaded into the system.
- The current process is time-consuming and relies on manual labor, making accuracy and modernization a challenge.

3. constraints on modernization

- Entities recognize that current manual processes are outdated and should be replaced with digital tools such as handheld terminals and mobile apps.
- However, cost is a major obstacle:
 - The cost per handy terminal is around 6,000-7,000 RIR?

- In addition, additional costs are incurred for software apps and compatibility with smartphones.
 - Currently, there are 9 meter readers, and a large investment would be required to deploy terminals to all of them.
-

4. future possibilities

- Handheld terminals that can print invoices locally are considered promising for improving efficiency and reducing response time.
 - The post-COVID financial situation makes it difficult to invest in new technology.
 - The introduction of digital applications is being considered, but implementation has been postponed due to budget constraints.
-

5. fee structure and revenue collection

- Rates vary depending on the type of customer (e.g., commercial customers such as hotels).
 - Means of collection:
 - Cash payment at the counter
 - Bank transfer via mobile app
 - Billing and collection operations are overseen by the Commercial Dep. and involve three departments: Billing Billing (revenue), House connection Household connection, and Customer service Customer service
-

6. billing system and hardware

- The current SUMS system has been in place for over 10 years. It took several minutes to even open billing data.
 - Updates are planned along with new PC hardware. 7.
-

7. licensing and access restrictions

- Simultaneous use of the system is restricted as follows
 - The number of simultaneous users is limited to four (due to licensing restrictions).
 - Since additional licenses are expensive, priority access is given primarily to financial personnel.
 - Depending on the financial situation, the need for expanded access in the future may be considered.
-

8. tax classification and billing structure

- Customers are classified for taxing and billing purposes as follows
 - General residential

- Commercial
 - Public housing
 - Public Institutions
 - The billing system provides a monthly breakdown by service and customer category.
-

9. revenue collection performance

- Revenue collection rates are reported to be very high, over 99%.
 - If a customer fails to pay within 15 days, water service is suspended until payment is received.
 - Strict policies are in place to ensure on-time payment.
 - Customers are notified prior to shutdown.
 - Staff manages approximately 27,000 customers, of which 23,000 are active.
 - Inactive connections are often associated with vacant apartments, etc.
-

10. geographic service area and metering challenges

- The service area includes not only the central city, but also suburban areas about 40 km away.
 - The revenue department has one headquarters office, but meter readers may be affiliated with the commercial department.
 - A separate customer service office handles meter malfunctions and relocations.
-

14. system speed and SUMS updates

- Staff is hopeful that the SUMS update will improve system processing speed and performance.
 - Frequent slowdowns and technical limitations were cited as operational challenges.
-

15. smart meters and pilot projects

- Smart meters for customers are not currently installed.
 - Pilot installations are being considered but have not yet been implemented.
 - Procurement and inter-departmental coordination are identified as challenges.
-

16. handling customer complaints

- Responsibility for handling customer complaints is the responsibility of the Commercial Dep.
- There is an "Information Center" on the first floor of the main building, next to the counter, where customers can file complaints in person.
- Common complaints include the following
 - Undelivered or lost bills
 - Leaking pipes due to road construction
 - Meter malfunctions, etc.

17. recording of complaints and response time

- Complaints are manually logged, compiled in Excel, and shared monthly with the management group on Telegram. The report includes the type of complaint and the status of the response, which is used by the management group to expedite response and interdepartmental coordination.
- Members of the management group include the office director, deputy director, directors of each department, security personnel, and the administrative department (Admin. Dep.). Minor complaints are generally resolved within 5 days to 1 week, and meter relocation and water leakage are handled on the same day whenever possible. In particular, requests for meter relocation are often resolved within 3 days.

Customer Satisfaction and Feedback

- Customer satisfaction is considered high and is evaluated based on feedback from the field.
- In a FS survey conducted by a third-party organization (AFB), customer evaluations were generally favorable.
- However, there is no internal mechanism to systematically measure customer satisfaction.
- The approximate level of satisfaction is estimated based on the number and types of complaints received at the Information Center.

22. main issues identified

- High licensing costs limit system user access
- Meter reading, billing, and complaint handling are all done manually, which is inefficient.
- Budget constraints prevent the installation of equipment such as smart meters and additional SMUS modules
- PCs are outdated and slow, which hinders business operations.
- Lack of real-time linkage between meter reading, billing, and customer information
- Roles of each department are fragmented and lack automation

4. Meeting Minutes (Observation) -Accounting Department

Date: 10:35-11:30 on July 31, 2025

Location: 3rd floor at SRWSA Office (different building)

Attendees: JICA Consulting Team

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Piseth (Cambodia)
- SRWSA: Mr. Bunhor (Director of Project Management Department), Ms. Thap Seila, accounting officer

1. inventory management system (SUMS)

- The system records inventory movements including
 - Opening balances
 - Inflow / stock in
 - Outflow / stock out
 - Ending balance
- Inventory records are supported by the following detailed documentation
 - Purchasing documents
 - Delivery receipts signed by both supplier and purchaser
 - Supplementary documents submitted by the requesting department
- Items such as machinery and equipment and water purification related materials are also recorded in the system.
- Each asset is assigned a control number. 2.

2. asset request and approval workflow

- Each department submits a formal application for the use of materials and assets.
- Applications are approved by the Director General.
- After approval, the transaction is entered into the system.
 - Example: if 5 items are dispatched, the system records 5 dispatches and adjusts the balance.
- A record of outgoing and incoming shipments is maintained.
- All transactions have a written record and are signed and printed for audit and reference.

3. asset classification

- When each department requests an item, it determines whether the item is classified as
 - Assets (e.g., machinery)
 - Consumable inventory
- This classification determines how the item will be handled in the system.

Part 2: Depreciation and Financial Reporting 4.

Calculating Depreciation

- Once an asset is entered into the system, annual depreciation is automatically calculated.
- Depreciation is generated and reported monthly.
 - Example: In June, some assets depreciated over 4,000 units.
- The system can output a detailed report showing the monthly depreciation and the value of the asset after renewal.

5. financial reporting process

- Each month, the finance team prepares a profit and loss statement that summarizes the following
 - Asset value
 - Operating expenses
 - The information is integrated with information from each department to produce a report for the entire organization.
 - The income statement is a simplified format that provides a high level of visibility into the financial status.
 - The organization-wide report reflects the activities of all departments.
-

Part 3: Financial Challenges and System Updates

6. post-COVID financial status and the Charigar project

- SRWSA continues to have financial deficits after 2020 due to COVID-19.
- The start of the WTP3 water treatment plant project will result in a significant increase in the following
 - Depreciation and amortization
 - Power costs (due to 10 km pumping from the lake)
 - Chemical costs (due to the poor quality of the lake water compared to conventional groundwater)
- 6. water rate increases were not sufficient to offset the increased costs

7. gap between production capacity and demand

- Total production capacity of 3 water treatment plants: 90,000 m³/day
- Current usage: ~30,000 m³/day (about 1/3 of capacity)
- Preparatory study for WTP3 was conducted in 2010 and contracted in 2012. Corona has reduced the volume of demand in the Commercial sector. Initially, full operation was expected by 2030, but it is difficult to see demand growing to that level.
- Full operation is expected to be reached around 2042.
- Currently, pipe network expansion is underway to increase the utilization rate of the water treatment plant as much as possible.

8. pipe network expansion plan

- Main objectives of pipe network expansion

- Utilization of unused capacity of water purification plants
- Supply to new residential and industrial areas
- Improve financial sustainability through increased water sales
- **Project 1: 400 km network expansion**
 - Implementation period: 2024-2027 (initially 2024-2026)
 - Financed by government loan
 - Aimed at distributing water to newly developed areas and expanding customer base (Priority will be given to areas with high demand for water supply.)
- **Project 2 (AFD support): 200 km network expansion**
 - Scheduled implementation: 2027-2029
 - Currently in planning stage
- **Expansion to be funded by SRWSA's internal budget:**
 - Continuous small-scale expansion of 10-20 km per year Purpose of expansion

5. Meeting Minutes (Observation) -Complain management and others

Date: 11:35-12:00 on July 31, 2025

Location: 1st floor at SRWSA Office

Attendees: JICA Consulting Team

- JICA Consulting Team: Ohno, Ogata, Ohara, and Mr. Piseth (Cambodia)
- SRWSA: Mr. Bunhor (Director of Project Management Department), Ms. XXX (Customer section)

1. reporting categories and customer registration

- The meeting began with a discussion on the reporting structure of water utility operations:
 - A total of 28 complaint categories are managed.
 - Reports are categorized into two types
 - Direct reports at the customer desk at the headquarters:
 - The most common inquiry is "lost invoice", followed by "payment after new connection" and "water disconnection during repair work".
 - Hotline (telephone inquiries):
 - The most common inquiry is about "lost invoice".
 - 30% of customers make payments over the counter and 70% make payments through the mobile app.
 - Customers can view their water bills by entering their ID on a designated mobile app.
 - The app links billing information to the customer's bank account and displays the amount due in real time.
-

2. complaint response process

- When a customer files a complaint (inquiry):
 - Staff first handwrites a record of the complaint.
 - Depending on the nature of the complaint, it is forwarded to the appropriate department.
 - All complaints are recorded in an Excel spreadsheet.
 - For each complaint, a manual check is made to see if it has been resolved.
 - For technical issues and repair complaints:
 - Information is shared with the repair team via group communication tools.
 - When repairs are completed, feedback and completion reports are returned to the Customer section by the responsible team.
-

3. water source and access issues

- The water intake point is located approximately 10 kilometers from a nearby lake.
- During the rainy season, access is severely restricted due to flooding:

- The access road is submerged, making vehicular access impossible.
 - Especially in September, when the water level is high, it can only be reached by boat.
- These seasonal conditions present a major logistical challenge for maintenance operations.

6. Meeting Minutes (Observation)-Kickoff with MISTI

Date: 14:30-15:40 on July 31, 2025

Location: 3rd floor at SRWSA Office

Attendees: SRWSA

SRWSA: 1.

1. H.E. Chan Sengla, Director General

Mr. Yay Monirath, Deputy Director General

Mr. Kot Nimol, Deputy Director General

Mr. Sok Hout, Deputy Director General

Mr. Pheng Bunhor, Director of the Project Management Department

MISTI: 1.

H.E. Khut Vuthiarith, Under Secretary of State

Mr. Phea Sinat, Office Chief of Technique and Project Management

Mr. Kong Sovan, Office Chief of Planning and Data Management

JICA Cambodia office: 1.

Mr. Munakata Atsushi

Mr. Seng An Youk

JICA Expert Team and National Assistant: 1.

Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

Opening Remarks

Mr. Kut Boutiarit, Undersecretary, MISTI

- **Mr. Kut Boutiarit expressed his appreciation for JICA's long-term support to Cambodia's water supply sector, especially the grant assistance for the Siem Reap Water Supply Project in 2006 and the scholarship support for capacity building of SRWSA staff.**
- **He noted that JICA plays an important role not only in physical infrastructure but also in human resource development.**
- **He stressed the importance of integrating SCADA and other smart systems across different projects.**
- **Referring to his experience in visiting Japan in 1995, he expressed his deep respect for JICA's**

support over the years.

- **Noting that** many existing systems **are only utilizing about 10% of their original capacity**, he stated that integrating systems could greatly improve overall effectiveness.
-

3. main points of discussion

3.1 System Integration and Digital Transformation (DX)

- Undersecretary Boutiarit emphasized the following
 - The importance of designing systems that match the capabilities of staff (especially to be able to analyze and operate on data).
 - The goal is to improve operational efficiency and fiscal sustainability.
 - Digital government and technology-based services need to be prioritized.
 - The JICA-supported integrated management and monitoring system of PPWSA (Phnom Penh Water Supply Authority) was cited as a good example.
 - Systems operated by private operators should also be able to be expanded by public agencies in the future.
 - He emphasized that JICA's support is valuable in "teaching people how to fish" rather than "giving them fish."

3.2 Business-Oriented Management

- Undersecretary Boutiarit stated that
 - Water services should be viewed as a business and should be profitable. Profit is essential for reinvestment and business sustainability.
 - Increased efficiency, use of data, and rapid response are priorities.
 - Real-time data such as telemetering systems, flow rates, and water pressure are essential.
 - It must be accompanied by not only the installation of the system but also the training of human resources capable of utilizing it.
-

4. comments from JICA and the expert team

Mr. Atsuo Ohno (JICA expert team)

- Reaffirmed that MISTI's policy and the direction of the JICA expert team are in agreement.
- He reiterated the importance of human resource development, not tools.
- He confirmed that field surveys are being conducted in Cambodia and India to assess the digital maturity level of each country and to prepare DX architecture proposals.

Mr. Atsushi Munakata (JICA Cambodia Office)

- expressed JICA's sincere commitment to continue its cooperative relationship with MISTI and SRWSA.
- He stated that DX and human resource development will play an important role in future

cooperation.

5. technical capacity and challenges

SRWSA Representative

- Explained the limitations of the current technical staff:
 - For example, the AQUA Crew system is operated by only three trained personnel.
 - More personnel are needed to fully utilize the digital system.
- He emphasized that sustainable staffing is essential for the continuous operation of the digital system.

JICA Expert Team (Mr. Ohno and Mr. Pisses)

- confirmed that the project team plans to assess current capacity and infrastructure.
- Through the study, the team will determine if SRWSA can properly operate the smart meter and telemetering system.
- Based on the survey results, the team will consider appropriate support measures for integration and capacity support.

6. Question and Answer Session

6.1 Smart Meter Pilot Project and its Feasibility

- Referring to the term "pilot project," Undersecretary Boutiarit asked whether JICA's implementation support would include the actual installation of smart meters.
- In addition, he mentioned the "Phnom Penh ICT-based Smart Water Management System" being implemented by K-water (Korea Water Resources Corporation) from 2025 to 2027, with Greentech Inc. as a partner. ***
- JICA Cambodia Office (Mr. Seng Ang Yuk) responded as follows:
 - If SRWSA already has smart meters, the support may include the provision of technical training by the JICA expert team.
 - If smart meters have not yet been installed, the location and quantity required for installation may be considered.
 - Based on the results of the survey, future support details will be considered.

6.2 Consistency of technology and staff responsiveness

- Undersecretary Butiarit pointed out:
 - Technology must be aligned with staff competencies, especially in data analysis and system control.
 - Capacity building is not optional, but essential.
- JICA expert team view:
 - Without skilled personnel, the tool will not be effective.
 - Capacity building is a core element of this project.

7. future dx strategies and priorities

7.1 Focus on Business Model

- **Undersecretary Butiarit commented:**
 - **Water utilities need to operate as businesses in a sustainable manner.**
 - **Especially in PPPs (public-private partnerships), profits will be the source of reinvestment and debt repayment.**
 - **Operational improvements and the introduction of digital tools need to result in clear efficiency gains.**
-

10. final findings

- **Both parties shared their perceptions on the following points**
 - **The alignment of digital tools with the competencies of operational personnel is crucial.**
 - **That SRWSA has shown a positive attitude toward new technologies and human resource development.**
 - **The importance of future discussions and technical collaboration.**
- **Future steps:**
 - **The JICA expert team will complete the digital maturity assessment and system architecture proposal.**
 - **SRWSA will review the proposed framework presented by the study team in October 2025.**

***Installing smart meters in pilot areas in Phon Pnem (Korea)

https://www.kwater.or.kr/eng/busi/overseas/overseas17Page.do?s_mid=2263

https://construction-property.com/korea-to-support-cambodia-equip-the-smart-water-management-technology-in-phnom-penh/?utm_source=chatgpt.com

https://greentechinc.co.kr/en/sub3-tab6/?utm_source=chatgpt.com

https://www.khmertimeskh.com/501122332/cambodia-south-korean-firm-discuss-smart-water-technology-cooperation/?utm_source=chatgpt.com

7. Meeting Minutes (Observation) -SCADA Room at WTP3

Date: 16:15-17:10 on July 31, 2025

Location: WTP3

Attendees: 1.

SCADA System and Water Treatment Plant Operation

- **Water Intake Facility (Intake)**
 - There are two pipelines, but only one is currently in use.
 - Currently **only 15% of the** intake capacity is in use, and the following issues arise due to low flow and velocity:
 - Sedimentation is likely to occur.
 - Fish carcasses in the pipes cause odors, which affect the raw water.
 - As a result, the water purification process is time-consuming.
 - Intake **is manually operated by a local operator who operates the switch (not remotely controlled by SCADA)**. After that, automatic control by VFD.
- **Flocculation and sedimentation treatment**
 - No sensors are installed for Flocculation and Sedimentation.
- **Filtration system**
 - Of the total of 6 filters, only 3 are currently in use.
 - The operation of the other three filters is switched alternately on a monthly basis.
- **Water pumps**
 - There are five pumps for transporting water from the water purification pond, but currently only one is in use.
- **SCADA System**
 - Equipment in the water purification plant can be monitored and controlled by the SCADA system.
 - The system is operated by comparing water quality sensor data with the results of analysis at the water quality laboratory.
 - The status of WTP1 and WTP2 can also be monitored in real time from WTP3. **What items? Not controllable?**
- **Chlorine and Lime injection**
 - As designed, Chlorine and Lime injection rates are manually adjusted.
- **Water Distribution Zones and Non-Revenue Water Management**
 - There are a total of 7 water distribution zones, with Inlet Bulk Meter at the entrance of each zone.
 - Water pressure and flow rate for each Bulk Meter can be monitored in real time on the

SCADA system.

- Difference between inlet (supply) and outlet (usage) can be calculated by comparing with the water meter usage for each house. Manual operation. Currently, smart meters have not been installed and fully automatic monitoring is not possible. 2.
-

2. operation of water quality testing laboratory

- **Inspection frequency and items**
 - Water quality inspections are conducted every 2 hours (8 items).
 - Water is sampled at designated points in the water treatment plant and compared with sensor data.
 - Algae are inspected about 3 times a month.
 - Detailed inspections are conducted on 18 items on a monthly basis.
 - E.coli is also inspected in the Biological Room.
- **Records and Data Management**
 - Inspection results are handwritten on a designated form.
 - The data is then organized and saved in Excel.
 - The data is managed as one file per year.
 - The system is not linked to any other system.
- **Issues in the dry season**
 - Turbidity tends to increase during the dry season.
 - The design value is 500 NTU, but it can reach nearly 700 NTU, and in 2024, it exceeded 1,000 NTU on some days.
 - The increase in turbidity is directly related to the increase in the cost of water treatment.

8. Meeting Minutes (Observation) -MISTI

Date: 08:30-10:00 on Aug 1, 2025

Location: : 3rd floor at SRWSA Office

Attendees: : MISTI: : 3rd floor at SRWSA Office

MISTI: 1.

1. H.E. Khut Vuthiarith, Under Secretary of State

Mr. Phea Sinat, Office Chief of Technique and Project Management

Mr. Kong Sovan, Office Chief of Planning and Data Management

SRWSA

Mr. Pheng Bunhor, Director of the Project Management Department

JICA Cambodia office: 1.

Mr. Munakata Atsushi

Mr. Seng An Youk

JICA Expert Team and National Assistant: 1.

Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

1. MISTI's Efforts in Digital Transformation (DX)

- MISTI explained that while they recognize the importance of DX in the water supply sector, they do not currently have a department dedicated to DX or IT.
- All data from public water utilities is managed by a single team within MISTI, and there is no dedicated DX team.
- MISTI is currently in the process of starting to develop a DX strategy to improve operations, mainly for public water utilities.
- DX promotion requires cooperation with external donors such as JICA and ADB, and collaboration with the private sector is not envisioned at this time due to challenges of regulatory compliance and lack of capacity.
- Establishment of sustainable and quality water supply is a key issue for MISTI, and currently DX implementation is not progressing due to lack of budget.

2. KPI and monitoring system

- Mr. Ohno asked whether there are any KPIs (Key Performance Indicators) related to DX and the possibility of developing them.
- Director Futuaris responded that KPIs for general water utilities exist, but KPIs specific to DX have not yet been established.
- There are quarterly board meetings with 11 public water utilities, during which KPI data is collected.
- All KPI data is centrally managed by MISTI and is usually consolidated in June.
- JICA expressed its willingness to discuss future KPI formulation with MISTI and consider supporting the establishment of DX-related KPIs.

3. comparison of public and private water utilities and challenges

- According to MISTI, cooperation with public water utilities is relatively smooth and institutionally organized, but cooperation with private entities is fraught with difficulties.
- There are approximately 450 private water utilities in Cambodia.
- About 90% of private operators are not able to ensure water quality that complies with national standards.
- Many private companies prioritize profit and have inadequate service quality and responsibility systems.
- Some private operators may temporarily meet standards, but fail to ensure continuous water quality.
- MISTI is in the process of developing a legal and institutional framework to classify and regulate private operators in a phased manner through a licensing system.
- The states, in cooperation with MISTI, are also in the process of strengthening their systems for supervising local private operators.
- It is MISTI's policy to prohibit unauthorized operators from operating under its authority.
- MISTI is currently collecting and organizing detailed information on private water utilities and plans to develop appropriate regulatory approaches based on this information.

4. regulatory policy and strategic vision

- MISTI's long-term goal is to establish institutional controls over both public and private entities to ensure sustainable service delivery.
 - Public entities are seen as role models for private entities and are expected to continue to serve as model cases.
 - Publicly-owned entities are required to submit master plans and service expansion schedules in line with the SDGs (Sustainable Development Goals).
 - MISTI aims to expand publicly owned service coverage to 60-70%.
 - It was emphasized that achieving the water-related targets of the SDGs is not a small-scale effort that can be completed within five years, but a medium- to long-term challenge.
-

5. expectations for Japanese companies

- **Mr. Ogata (TEC) asked about expectations for Japanese companies in Cambodia's water supply sector.**
- **Mr. Htuari expressed his high evaluation of Japanese companies' technical capabilities, efficiency, and quality control.**
- **SOMA Construction & Development Co., Ltd. was introduced as a good example of a joint project with the government on water supply .**
- **What is expected of Japanese companies?**
 - **Introduction of energy-saving technology**
 - **High-performance equipment and systems**
 - **Highly transparent business operations**
 - **Provide sustainable solutions from a long-term perspective**
- **Some European (especially French) companies have already developed joint ventures, and Japanese companies were also considered to have high potential for participation.**
- **Marubeni's plan to expand coverage to 3,000 points nationwide by 2035 (deployment by six private operators) was also introduced.**
- **JICA, for its part, indicated that it intends to position the efforts of public entities as a role model for private entities. 6.**

6. History of SRWSA (Siem Reap Water Supply Authority)

- **A feasibility study (FS) was conducted in 2010 and a re-FS in 2011, covering the following four water sources**
 - 1. Siem Reap River**
 - 2. Groundwater**
 - 3. Balay Reservoir**
 - 4. Tonle Sap Lake (final selection)**
- **With JICA support, an 8,000 m³/day water treatment plant and a 40 km water distribution network were established in 2006.**
- **By 2019, the supply capacity will be expanded to 15,000 m³/day.**
- **In the past, water supply reached only a limited area along Route 6, but service is now being expanded to the west side of the city.**
- **However, households generally use water storage tanks, and the mismatch between intermittent water supply and demand remains an issue. 7.**

7. current status and future demand outlook

- **When the operation of a water treatment plant reaches 80%, it is considered to be practically operating at full capacity of the facility.**
- **Water demand by 2030 is expected to exceed the current supply capacity.**

- Water use by hotels and commercial facilities is high and already exceeds historical projections.
- Network expansion to urban and surrounding areas is urgently needed.
- JICA's Master Plan, developed in 2011, was based on the demand at that time, but needs to be updated to accommodate the current urbanization and tourism development.

8. investment needs and plans

- It is estimated that approximately US\$15 million in investment is needed to expand the water supply network.
- Further construction of water treatment plants and extension of distribution pipes will be required to meet the increasing demand and stable supply.
- In order to reduce dependence on Tonle Sap Lake, development of new water sources is also being considered.

9. MISTI's Final Opinion and Strategic Direction

- Secretary Htuaris stressed that achieving the water sector of the SDGs (Sustainable Development Goals) will be difficult in the short term and is not a small task that can be completed within 5 years.
- SRWSA (Siem Reap Water Supply Authority) has made significant progress so far in improving intermittent supply and expanding its network, but more work is needed to ensure reliable service throughout the region.
- MISTI aims to achieve responsible water services within a national strategy that integrates both private and public entities.
- Ensuring water quality by private entities is a particularly urgent issue, and it was noted that while some providers temporarily meet standards, approximately 90% of all providers do not meet standards on a permanent basis.

10. strengthening regulation and governance of private water utilities

- MISTI has the legal authority to issue licenses to and regulate private operators.
- It is in the process of classifying, monitoring, and gradually strengthening regulations for approximately 450 private entities in Cambodia.
- Many private entities lack the technical skills, knowledge, and sense of responsibility to reach standards on their own.
- MISTI intends to provide training and support to private entities to strengthen their capacity in a phased manner while strengthening regulations.
- Each state government, in cooperation with MISTI, will be responsible for supervising local private entities.
- Coordination with private operators remains difficult due to the scale, decentralization, and lack of a monitoring system.

11. water demand forecasting and system efficiency

- The current water treatment plant is **already operating at 80%**, which is effectively considered full

capacity.

- There is a gap between actual production and measured data, highlighting the inadequacy of water supply efficiency and analytical capacity.
- Households use rooftop water storage tanks, and the mismatch with intermittent supply makes it difficult to coordinate supply and demand.
- There are peaks in the early morning and evening hours of the day, and a decrease in water pressure during these hours is clearly observed.
- The survey and master plan conducted by JICA from 2008-2013 remains valid, but needs to be reviewed as the recent expansion of urban development and tourism has resulted in consumption exceeding projections.

12. cooperation and future collaboration with Japan

- MISTI expressed its deep appreciation for JICA's support over the years. In particular, cooperation in infrastructure development and human resource development was highly appreciated.
- MISTI hopes to continue cooperation in the following areas
 - Expansion of water supply infrastructure
 - DX implementation and modernization of IT systems
 - Training for public and private entities
 - Introduction of advanced technology by Japanese companies
- The Cambodian government welcomes responsible foreign investment in the water supply sector, and Japanese companies are expected to be long-term and reliable partners.

9. Meeting Minutes (Observation) -Distribution Dep.

Date: 10:40-11:00 on Aug1, 2025

Location: 3rd floor at SRWSA Office

Attendees: SRWSA

SRWSA: 1.

1. Mr. Meng Hengkim Lin, SCADA operator

Mr. Luon Soknoun, Deputy of the Project Management Department

Mr. Kheav Kimleng, Voice Chief of Office (Distribution Network Management) 4.

Mr. Pheng Bunhor, Director of the Project Management Department 5.

Mr. KOT Nimol, Deputy Director of the General

Mr. HORM Sophany, Deputy Director of the Department.

JICA Expert Team and National Assistant: 1.

Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

Definition and Current Status of Non-Revenue Water (NRW)

- **Definition of NRW:**
Water produced - Water sold (water billed)" = Non-Revenue Water (NRW)
- **There is no automated calculation system, and everything is handled manually.**
- **The only digital system is SCADA, and there is no DX (Digital Transformation) related implementation. 2.**

Organizational Structure and Main Tasks

- **The NRW division belongs to the Water Supply Bureau, which is the largest in the organization.**
- **Seven main operations:**
 - 1. Water production and supply (also covers water treatment plants)**
 - 2. Operation and maintenance (O&M) of water treatment plants**
 - 3. Maintenance of the water distribution network**
 - 4. NRW reduction activities**
 - 5. Mechanical management**
 - 6. Piping installation**
 - 7. Regional office operations, including**
 - Water treatment plants (3 locations)**

- Mechanical and electrical offices (including repairs)
 - Piping installation offices
 - Water Distribution Office (including leak detection and maintenance)
 - Mechanical Installation Office
 - Detailed organization chart will be provided separately. 3.
-

3. efforts to reduce NRW

Network development and maintenance

- Almost all water distribution pipes were installed within the past 20 years, although some are more than 30 years old.
- Pipe installation is done according to Standard Operating Procedures (SOPs).
- When a leak is reported, response begins within one hour.

Leak Detection Team

- 16-member team (8 maintenance personnel + 8 leak detection personnel)
- Daily leak detection. Equipment used:
 - Hearing sticks (used at night)
 - Underground leak detector
 - Visual inspection
- After responding to a leak, a leak report is sent to the GIS staff, and the leak location is recorded on a GIS map.
- Communication is by telephone and telegram.
- The water distribution office is located in the main building.
- About 40 leaks are detected each month.

Pressure Management

- Pressure is maintained at approximately 3 bar.
 - Manual valve operation for repairs.
 - The pressure of the water distribution pumps can be adjusted in the SCADA room, but the valves are operated manually.
 - Opening and closing of Valves in the field is only possible for new connections or repairs.
-

4. SCADA and current monitoring system

- SCADA is in operation at the following
 - Water Treatment Plant (WTP): monitoring pressure and flow rate
 - Water distribution zone entrances: flow meters at each of the 7 zone entrances
- Two outlet meters at WTP1, one at WTP2, and one at WTP3
- Monitoring within the water distribution network is not yet implemented. A site visit is required.

- SCADA has not yet been linked to GIS or AQUA Crew
-

5. use of GIS and AQUA Crew

- Record and share leak locations and repair information on GIS.
 - Using AQUA Crew and Avenza, the following functions are also available on smartphones:
 - Display of piping diagrams
 - Visualization of repair points and valve locations
 - Utilized to plan and coordinate field work.
-

7. meter management and illegal connection measures

- Customer meters: 27,000
 - Meter renewal cycle: 8-10 years
 - Meters with an error of 3% or more are replaced. Average of 20 meters renewed per month (5 this month).
 - Check items:
 - Differences between actual measurements and records
 - Meter failure or backflow
 - Signs of illegal connections, etc.
-

8. water distribution zone configuration and valve operation

- The seven water distribution zones are hydraulically independent.
 - There are valves at the boundaries between zones (normally closed).
 - Valves are opened and zones connected only in case of emergency.
 - Water flow and pressure management is mainly manual operation.
 - As the SRWSA water distribution area has expanded, there are plans to distribute water outside of the existing zones.
-

9. reduction of illegal connections and countermeasures

- Seven years ago, there were many illegal connections.
 - Main measures:
 - Replacement of PVC pipes (less than 1 bar) with PE pipes (3 bar)
 - Increased penalties
 - Immediate disconnection of illegal connections
 - Regular patrols and detection
-

10. Meeting Minutes (Observation)-Leak detection section.

Date: 11:30-12:00 on Aug1, 2025

Location: SRWSA Office

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor, Director of the Project

1 Mr. Pheng Bunhor, Director of the Project Management Department

Mr. Kheav Kimleng (Leak detection section)

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

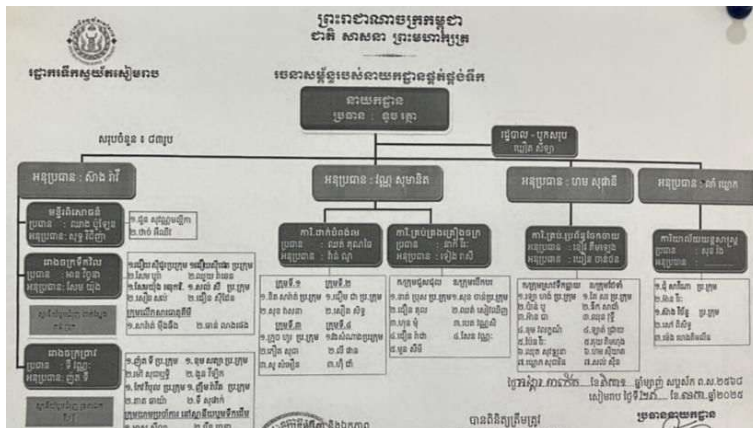
Mr. Srorn Piseth

1. overview of the water supply system

- The local water supply system was first established in 1930 with the support of the French government.
- Full-scale expansion began around 2004, and especially since 2017, rapid progress has been made with the support of JICA and ADB.
- Currently, about 99% of the pipes are about 20 years old, and projects to expand the network are ongoing.

Organizational Structure and Related Departments

- Water supply Dep. is organized as follows (see photo):
 - Production
 - Pipe installation
 - Distribution and network management
 - Mechanical



- The Water Supply Dep. is divided into 16 groups, each with 2 team leaders. They monitor, repair, and install new pipes. 3.

3. leak detection policy

- The main target of leakage investigation is the water distribution main
- Correlative leak detectors are installed inside valves or on walls, etc., and are operated at night (midnight to 7:00 a.m.) to detect leaks while ambient noise is low.
- Based on an annual plan, all water distribution pipe networks are inspected once a year.
- In addition to this periodic inspection, surveys are also conducted as needed.

4. prioritization based on data

- Prioritization of detection areas is based on the following information
 - Monitoring data from the SCADA system
 - Minimum Night Flow (MNF) analysis
 - Age of piping installed
 - As-built drawings and repair history
- Identification of areas at high risk of leakage based on MNF anomalies; leaks from PVC pipes and water pipes are common.
- Prior to field survey, target areas are selected in the office and routes are clarified before dispatching to the site.

5. capacity building and external support

- Skills related to leakage survey were acquired through the following JICA support and other sources:
 - 2015: JICA technical cooperation project (provision of detection equipment and database construction)
 - 2023: Participation in training in Nagoya (practical training on non-revenue water control and acoustic leak detection methods)
- These collaborations have strengthened the technical skills of the field staff and are the foundation

of the current survey system.

6. maintenance and warehouse operations

- Multiple warehouses are operated to store the following equipment and parts
 - Leak detectors
 - Water meter and fitting parts
 - Emergency repair parts
- Approximately 40 units of spare equipment are always available, and the company maintains a system that can be used on weekends (Saturdays and Sundays).
- The company maintains a maintenance system capable of handling both periodic inspections and emergency repairs.

7. old infrastructure and stockpiling facilities

- Some old infrastructure and equipment from the 1930s and 1960s have been preserved, and traces of the early French-style water supply system still remain.
- Some of the old equipment is stored in a warehouse as backup and technical documentation, but is not used in the current system.

11. Meeting Minutes (Observation) - Project Planning and Management Department

Date: 14:30-15:30 on Aug1, 2025

Location: SRWSA Office

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

JICA Expert Team and National Assistant: 1.

1. Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

Water Supply System Expansion Project

a. WTP (Phase 1, 2 and 3) and Water Distribution Pipe Network Expansion (JICA Financed)

- The project to expand the water purification plant (already constructed and in operation) and water distribution pipelines is ongoing.
- An additional 20 km of water pipeline will be constructed using the balance of the existing JICA loan.
- Construction has already begun, with 9-10 km completed by the contractor.
- Overall completion is scheduled for early next year.

b. 400km water pipeline expansion project (Cambodian government funded)

- Funding by the Government of Cambodia: US\$23 million.
- Description: Installation of 400km of water pipeline around the SRWSA service area.
- Period: Originally planned for 2024-2026, but delayed. The new period is September 2024-2027.
- Priority is based on population density, starting with areas with the highest number of users.

c. AFD (French Development Agency) funded expansion project (2027-2029)

- Description: Installation of 200 km of water distribution pipes.
- Budget: €30 million (€25 million loan + €5 million EU grant).
- 25,000 household connection components (meters, etc.) for poor households will also be provided.
- Feasibility study (FS) completed.
- Hydraulic analysis is ongoing.
- AFD is responsible for the following FS components
 - Socio-economic survey: complete
 - Financial Study: Completed
 - Technical and environmental study: consultant selection in progress
 - The FS will be funded by an AFD grant of 23,000 EUR and an additional 200,000 EUR.

d. Master Plan and New JICA Projects (2025-2040)

- A new JICA mission is scheduled to visit in November to develop a master plan for 2025-2040.
 - Study details:
 - Comprehensive master plan development
 - Implementation of FS on priority projects in the plan
 - Study on water source reliability, population coverage, and fund consistency
-

2. water purification plant (WTP) capacity

- Current water treatment plant capacity: 90,000 m³/day
 - Current production: approx. 30,000 m³/day
 - Expansion will focus on expanding the water distribution network to utilize unused capacity and attract new customers
-

3. smart meters and NRW (non-revenue water) management

a. Introduction of smart meters

- Mechanical (conventional) meters are currently in use.
- Smart meters are recognized as effective for leak detection and NRW monitoring.
- According to examples from other countries, each unit costs about US\$100 (Ohno pointed out).
- However, financial constraints make immediate introduction difficult.

b. NRW monitoring (current method)

- An integrated digital NRW monitoring system has not yet been introduced.
 - Currently, flow rates are measured by mechanical meters at the following locations
 - Water intake points
 - Each zone
 - Customer meters
 - Leakage is calculated manually by comparing the total inflow to the zone with the total customer usage.
-

4. loan repayment and financial challenges

- SRWSA has received loans from ADB, JICA, and AFD.
 - Principal repayment officially begins in 2022.
 - Due to financial constraints, a 3-year repayment moratorium is requested.
 - With the government's permission, the start of repayment was postponed to 2028.
 - Financial situation remains difficult, making new investments in smart meters, etc. difficult.
-

5. connection costs and equipment procurement

- **New connection costs for customers: approx. 595,000 Riel (approx. US\$150)**
 - **This includes**
 - **Water meter (approx. 140,000 Riel / US\$35-75, made in Malaysia)**
 - **Piping, fittings, and installation costs**
 - **Free connection and material costs for poor households through AFD and other donor programs.**
 - **25,000 connections planned through AFD subsidies.**
-

6. digitalization and IT system

a. Current IT structure

- **IT department will be newly established in 2022 or 2023.**
- **Deployment:**
 - **2 IT staff under HR/Administration**
 - **2 GIS staff under the project planning department**
 - **Total of 4 people working on digitalization promotion**
- **The GIS team will utilize Aqua Crew and will also receive training in Japan (2 GIS staff + 1 IT staff requested, of which only 2 accepted).**

b. System usage and challenges

- **Aqua Crew is used for GIS mapping and data analysis, including pipe networks and customer locations.**
- **Data is manually entered and utilized by planners.**
- **Digital system integration is limited; SCADA and automatic meter reading have not yet been implemented.**
- **SARMIS (asset ledger management information system) is a unified national platform:**
 - **Mandatory asset registration for buildings, infrastructure, water and power facilities, furniture, etc.**
 - **No integration with SRWSA's internal system.**
 - **System access is restricted and server management is by the central government.**
 - **Obligation to comply according to guidelines from the Ministry of Economy and Finance.**

7.

7. organization and management structure

- **HR/Administrative Department**
 - **Responsible for human resource management of IT and administrative staff**
 - **Manages the assignment of personnel in charge of digitalization**
- **Project Management Department**
 - **Responsible for GIS-based planning, Aqua Crew operations, and data analysis**

8. socioeconomic and transfer-related issues

a. Customer connectivity and billing

- SRWSA reports that:
 - Total connections: 27,000
 - Actual billable (active) connections: 23,000
 - Approximately 4,000 are unbilled (inactive or informal connections)
- Some households use shallow wells due to misunderstanding that "water is free" or to avoid paying the fee.
- Awareness-raising and publicity activities are needed to promote formal connection (Mr. Bunhor).

b. Shallow well use and health risks

- Despite health risks, shallow wells continue to be used in some areas because they are free.
- SRWSA aims to raise awareness about water contamination risks.

c. Resettlement Projects

- Government-initiated resettlement affects the client base.
- Relocation from high-density areas to new settlements is underway.
- Demand for water service in new settlements is unclear.
- SRWSA working with government agencies to address asset registration and future service delivery.

9. digitalization vision and future strategies

- Digitalization is identified as a priority in terms of
 - Leak detection (however, currently, many pipes are damaged due to road construction. Leakage is not due to aging)
 - Non-revenue water (NRW) reduction
 - Billing and customer management
- SRWSA hopes to implement smart meters and integrated monitoring dashboards in the future.
- Financial constraints and lack of IT human resources are the main bottlenecks.
- Possible donor support and pilot implementation from Japan and other donors are being considered.

10. funding and budget status

- SRWSA confirmed that all ongoing projects (JICA piping, government funded 400km, AFD expansion) have been budgeted.
- Future pipeline expansions will also be internally funded.
- SRWSA is aiming for all residents to have access to water supply by 2030, but this is expected to be difficult to achieve.

12. Meeting Minutes (Observation) -SCADA Room at WTP1 and 2

Date: 16:10-17:00 on Aug1, 2025

Location: SCADA Room at WTP 1 and 2

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

2 Mr. XXX, young person who always explains details to us

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu 4.

Mr. Srorn Piseth

1. Facility Overview

- There are two water treatment plants in this facility:
 - WTP 1: Constructed in 2006 (groundwater source)
 - WTP 2: Constructed in 2019 (surface water source) 2.

2. pumping equipment and control system

- WTP 1 has eight deep well pumps that can be remotely controlled through SCADA.
 - Each pump has an individual control panel and is connected through a PLC system.
 - LED indicators on the panel: red (running), green (standby), and yellow (alarm).
- Eight additional pumps installed by SRWSA are not connected to SCADA and require manual operation on-site; SCADA also does not show the eight additional pumps.
- Some older pumps have remote control failures and require troubleshooting. 3.

3. water intake and filtration system configuration

- Water from all pumps is delivered to a common receiving well through two intake pipes equipped with flow meters.
- Water is sent to an existing coagulation and filtration unit (3 ponds).
- Water is sent to a newly constructed filtration unit installed by SRWSA on its own (2 ponds).
- The treatment capacity of the facility was initially 8,000 m³/day and was increased to 15,000 in 2013-2015. 4.

4. filtration system and control

- There are currently 5 sand filtration ponds, but only the initial pond is shown on SCADA (the additional 2 ponds are not shown).

- Backwashing is automatically performed every 24 hours by PLC timer control, but remote control is not possible.

- The filtration system can be switched manually/automatically on site, but requires a worker's presence for adjustment.

5. dosing system

- Lime and chlorine dosing system:
 - Status can be checked on SCADA screen.
 - Remote operation is not possible. Manual operation on site is required.
 - Start/stop of dosing pumps is manual.

6. functions and limitations of SCADA

- SCADA is mainly used for the following
 - Status and alarm monitoring.
 - Visualization of flow, pressure, water level, and tank status.
- Many alarms and events are record only and cannot be controlled via SCADA.

7. water distribution and pressure management

- Water distribution pumps:
 - Operates with simple manual start/stop operation; no VFD (variable frequency drive) installed.
 - Automatic adjustment of pressure and flow rate is not possible.
- Due to the old equipment, this water treatment plant is currently used primarily for "water production" only and not for "water distribution". The purified water is sent to the water treatment pond at WTP2 and distributed from WTP2.
- WTP1 has only one PLC.

8. issues related to operation of two water treatment plants

- The operation of two water treatment plants within the same water distribution system poses the following issues
 - Different pump capacities and pressure requirements for each water treatment plant (e.g., 4.5 bar for one and less for the other).
 - It is difficult to control pressure at both water treatment plants at the same time, which may lead to system instability.
- Current operational policy:
 - One water treatment plant is operated at a fixed pressure with manual settings.
 - The other is dynamically adjusted according to the flow rate.
 - Due to the difference in sensors, valves, and pump outputs, it is our opinion that both water treatment plants should be operated with independent control systems.

9. SCADA server-client configuration and limitations

- **SCADA is a server-client system:**
 - The main server is in operation.
 - The client terminal is out of order and simultaneous operation by multiple users is not possible.
- **Countermeasures:**
 - Workers access SCADA using Microsoft Remote Desktop.
 - However, only one user can operate the system, and other users are disconnected upon connection.
 - This method is inefficient and unsuitable for emergency response.
- Control is performed by only one central PLC, which is connected to the remote I/O unit via optical fiber.
- It is possible to monitor WTP2 from WTP1, but it is not possible to monitor the status of WTP1 from WTP2.

10. water quality monitoring and sensor status

- **Monitors key water quality parameters:**
 - pH, temperature, electrical conductivity, dissolved oxygen, etc.
 - Some sensors are normal, but others are malfunctioning or uncalibrated.
- Limited ability to automatically alert when water quality standards are exceeded.

11. water distribution pumps and frequency control (WTP2)

- There are four water distribution pumps in WTP2.
 - Currently only one unit is in operation (remote startup, but frequency is manually adjusted).
- WTP3 has introduced automatic control with VFD, but WTP2 sets the frequency manually.
- WTP2's SCADA can view trend displays, curves, and alarm history, but **operation is still manual**.

12.

12. challenges with SCADA software and vendor support

- The biggest concern is lack of vendor support after implementation:
 - SCADA vendors (**Singapore**, France (WTP2), Japan (WTP1)) withdrew after installation, no maintenance contracts.
 - Users have no access to software update files, technical documentation, or licenses.
- SCADA reporting system (**e.g., Raypod**) stopped functioning because monthly update files were not received and applied.
 - Update files are shared only with the system integrator.
 - Without updates, false alarms and malfunctions occurred.
 - Currently not in use.
- **Difficult to contact vendor:**
 - Dispatching a vendor's technician to Cambodia would require overseas travel expenses,

which would be more expensive than the cost of the software.

- No local technical support system exists.

13. views of the survey team

- The following measures are needed
 - Establishment of a local agency or a support system through a long-term contract.
 - Training for users for alarm handling and maintenance.
 - Upgrade to SCADA with multi-user support and local control.
- On-site operations are fragmented and manual due to lack of tools, automation, and support systems compared to WTP3.

13. Meeting Minutes (Observation) -Head of Accounting Dep.

Date: 9:00-10:00 on Aug4, 2025

Location: meeting room on the 3rd floor at SRWSA

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

Ms. Meas Vichana, Chief of the Accountant

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

Outline of Business Plan

- The current business plan covers the period from 2022 to 2026.
- SRWSA is currently developing a new business plan for 2026-2030, which will include the following
 - Investment Plan
 - Business plans for each department (including administration) 2.

2. enhancement of the SUMS system (digitalization progress)

- Three new functions will be added to the current SUMS (management system):
 - Payroll
 - Customer Service
 - House Connection
- Background:
 - Since 2007, all HR-related tasks (staff profiles, payroll, performance evaluations) have been managed in Excel.
 - A new system module was approved by the Board and Director this year.
- Implementation Plan:
 - A Malaysian company (with a local agency in Cambodia) assisted in the implementation.
 - Local staff will begin preparations in August 2025.
 - Implementation period: 6 months
 - Scheduled start of operation: January 2026
- Current understanding:

- Ms. XXX is not familiar with the detailed functions of the new system.
- Similar modules have been implemented in other provinces, mainly accounting systems, but HR systems are not yet commonly implemented.
- PPWSA (Phnom Penh Water Supply Authority) used to use all modules of SUMS (it is unclear if they are still in use); SRWSA has the same system and configuration, but currently uses only some modules.

3. issues in human resource management

- **Recruitment:**
 - Difficulty in finding qualified applicants that meet SRWSA's requirements.
 - Transfers between departments, e.g., from accounting to administration, are common.
 - Graduates of business universities are multidisciplinary and can work in multiple departments.
 - MISIT (Ministry of Industry, Science, Technology, and Innovation) directs the Water Authority not to easily hire new employees, and SRWSA also utilizes internal transfers.
- **Selection Process:**
 - Until last year, no formal hiring process existed.
 - Beginning this year, a selection process was implemented at the direction of the Chairman.

4. current salary payment process

- **Monthly payroll:**
 - Paid via bank transfer on the 28th or 29th of each month.
 - Paid twice a month (mid-month and end of month), in accordance with government regulations.
- **Workflow:**
 - HR (human resources) department performs payroll calculation.
 - The accounting department checks the details.
 - What is included in the salary?
 - Base salary (based on work performance)
 - Overtime allowance (calculated based on applications from each department)
 - Incentives based on performance
 - Currently, all calculations are performed in Excel.
 - Expected improvements: The system is expected to make payroll processing much simpler and more efficient.

5. staffing and planning

- **Current staffing: considered adequate.**
- **Future staffing plan: Will be adjusted as the number of clients increases. No specific plans. If the number of customers increases , the number of meter readers will be increased accordingly.**
 - **Example: Currently there are 9 meter readers.**
 - **Originally there were 10, but one was promoted to an office position, so now there are 9.**
 - **The company would like to hire one more person to handle the increase in the number of customers in the future.**

14. Meeting Minutes (Observation) -250804_Head of Commercial Dep

Date: 10:00-11:00 on Aug 4, 2025

Location: meeting room on the 3rd floor at SRWSA

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

2 Mr. Sam Senghan, Deputy of the Commercial Office

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

Organizational Structure and Main Responsibilities

- **House Connection Section**
 - **Receives new connection requests from customers.**
 - **Prepare documents related to new connections.**
 - **Customer Service Section**
 - **Checks the accuracy of customers' water meters.**
 - **Relocation of meters in response to customer requests (e.g., road construction).**
 - **Collection of delinquent bills.**
 - **Discontinues water supply if payment is more than 15 days late.**
 - **Revenue Office**
 - **Meter reading, data entry, billing, and delivery.**
 - **Currently employs 9 meter readers; one has been promoted to office chief.**
 - **One person has been promoted to office chief and one additional person will be hired in the future (a total of 10 people are expected to be adequate).**
 - **Due to government policy, staffing cannot be increased.**
 - **Staff reductions can be considered through the introduction of equipment and technology.**
- 2.**

2) Operational status of meter reading operations

- **Number of customers served per meter reader: 2,000-3,000.**
- **Average number of meter readings per day: approximately 120.**
- **Operates on Saturdays and Sundays as needed.**

- It is difficult to handle more than 3,000 readings per person.
- Work schedule:
 - Morning: Meter reading, recording, and billing.
 - Afternoon: Deliver bills to locations where meter readings were taken in the morning.
- PPWSA uses equipment that can issue bills on the spot, but SRWSA has not yet installed such equipment. 3.

3. water meter accuracy verification and replacement standards

- Use test kits for accuracy verification as needed.
- If the meter is within the allowable error of 3%, it continues to be used.
- If it exceeds the standard, replace the meter.

Meter diameter Inspection frequency

15 mm Every 10 years

25-40mm Every 5 years

100mm every 2 years

- Brand used:
 - *Kent* (US\$35, made in Malaysia) - mostly used, high quality.
 - *Aichi Tokei* (US\$20, made in Vietnam) - small number, used since 3 years ago.

4. challenges in the commercial sector

- Pipeline expansion and bill delivery:
 - Expansion of the pipeline network makes invoice delivery time consuming. Expansion to more distant locations.
 - In 2023, 23 communes in and outside of Siem Reap province were added to the target area by MISTT's direction.
 - Of these, 11 communes are in the SRWSA service area.
 - The national policy is to achieve 100% dissemination of safe water. Water pipelines are not yet in place in some areas.
 - Some areas have poor groundwater quality and wish to be connected to SRWSA.
 - Priority will be given to densely populated areas.
- Risk of pipe breakage due to future land development (e.g., embankments).
- Low water usage among connected households:
 - In some cases, residents are using borehole water from shallow wells or other sources and do not wish to be connected to the water system. Water quality is not very good in some places.

- Hotels and guesthouses also tend to have their own groundwater facilities and do not connect to the water supply.
 - **Stagnant revenues:**
 - The number of commercial connections is decreasing due to the slowdown in the tourism industry, affecting revenues.
 - Some customers have delayed payments, but not many.
 - Sometimes due to leaks or from low-income households, the company receives negotiations to reduce the amount of bills.
 - In 2010, there was a case of 3-6 months in arrears and the water supply was suspended.
 - Some residents believe that "water is free" and have low awareness regarding water supply.
 - Awareness-raising activities are underway within the Department.
-

5. rate system and billing policy

- **Rate revision:**
 - The last revision was in 2017.
 - By law, rates can be revised every 5 years.
 - Due to increased debt, SRWSA wishes to revise.
 - After consultation among relevant departments, such as Finance and Commerce, a proposal will be made to MISTL.
- **Billing criteria:**
 - If monthly usage is less than 1 m³, no invoice is issued but maintenance fee is payable.
 - Since 2017, invoices are issued for usage of 3 m³ or more.
 - Since 2014, invoices are issued only to "active customers".

15. Meeting Minutes (Observation) – Accounting Dep.

Date: 11:10-12:00 on Aug 4, 2025

Location: Accounting Dep. on the 2nd floor at SRWSA

Attendees: SRWSA

SRWSA: (name and address)

1 Mr. Pheng Bunhor, Director of the Project Management Department

2 Mr. Sam Senghan, Deputy of the Commercial Office

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

1. new connections and client classification

- **New connection:**
 - New connections are made by the Revenue Office based on customer applications.
- **Current active connections: 27,225 total**
 - **Domestic: 23,863 connections**
 - **Commercial (including industrial): 3,200 connections**
 - **Commercial and industrial use will be categorized separately in the future.**
 - **Public Institutions: 162**

Trends toward digitalization of meter reading

- **Pilot project at PPWSA (Phnom Penh Water Supply Authority) (as explained to Mr. XXX by a SUMS representative):**
 - Customer's water meter is scanned with a smart phone and the read data is transferred to the SUMS system.
 - The SMUS representative called this system "AI meter reader".
 - However, the technology is likely to be OCR (Optical Character Recognition) rather than AI.
 - Details of the technology and its actual use need to be confirmed.
 - Currently in pilot phase, PPWSA plans to share results and progress with SRWSA.
 - It has not yet been confirmed whether the pilot phase has been completed.
- **SRWSA Interest:**
 - If the operation of this system is confirmed to be effective, SRWSA would like to implement

it.

- The objective is to save time and improve the efficiency of meter reading operations. 3.
-

3) Concerns about maintaining the operation of the system in the future

- Concerns of the survey team (Obara):
 - Concerns about whether the current analog method (manual meter reading and O&M) can be continued in the future as the number of customers increases and the service area expands.
 - As the coverage area expands, the workload will increase, and the current system may not be able to handle the increased workload.

16. Memo of site visit (Observation) -Construction site of pipes (Azenza)

Date: Aug 4, 2025

A free application called Avenza Maps has been downloaded to the cell phones of the staff of the NRW Office, Customer office, and House connection office.

Download Excel data from AQUA crew.

→Read the Excel data in QGIS.

→Export as KML data from QGIS

Download KML data at →Avenza

Cannot export KML data directly from AQUA Crew. Cannot export ".prj files" with coordinate data. SRWSA has developed its own way to do this. One staff member complained that AQUA Crew was difficult to use.

One staff member complained that AQUA Crew was difficult to use. Then, import it into Avenza Maps.

Then, the KML data can be viewed from Avenza Maps. Notes, points, etc. can be added, but in order to reflect them in AQUA crew, it is necessary to manually update AQUA crew after returning to the office (by asking the staff member who uses AQUA crew).

There is a concern about security because there is a free application.

KML data downloaded by each individual may not be the same (because they download at different times). The data is not loaded on the cloud.

Because the data is heavy, only the necessary zone data is downloaded. When other zone data is needed, delete it and download new KML data.

17. Meeting Minutes -AQUA Crew

Date: 8:30-10:10 on Aug 5, 2025

Location: AQUA Crew room on the 2nd floor at SRWSA

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

2 Mr. Luon Soknoun, Deputy of the Project Management Department

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

For details on how to view the AQUA Crew data in Avenza, please refer to "250804_1430_Site visite (2 bulk meters and 2 pipe construction sites)".

CSV files exported from AQUA Crew must be manually formatted (sorted, collated, etc.) in order to be read by SMUS. The exported CSV data cannot be imported by SMUS as-is.

Every six months, the CSV data, which includes water usage, customer information, etc., is reflected in SMUS.

AQUA Crew reflects the pipe network data, customer information, and leak locations at this time. Master Data.

SRWSA also needs to request Geocraft to perform pipe network analysis with different water supplies (in data acquisition).

Therefore, SRWSA uses QGIS for pipe network analysis and studies based on new piping data, etc.

It is conducting its own demand forecasting, pipe network analysis in EPANET, etc. Although this is a draft version, future demand forecasts are being conducted. They would like to consult with experts on the details in the master plan PJ scheduled in the future.

If there are any leakage points on site, staff will respond. The information on the leakage points will be compiled into a report. The local project office will receive the report and update the data in the AQUA Crew.

SMUS outputs the asset data in Excel. This is double-checked with the AQUA Crew asset data.

SRWSA talked to Geocraft about system integration with SUMS.

Geocraft informed us that they need to match the AQUA Crew data format.

They have contacted SUMS but have not yet received a response.

SRWSA staff is aware that we need to meet with SUMS and Geocraft to finalize the details. However, they understand that there will be costs associated with this.

The survey team: Customer data in SUMS is reflected in AQUA Crew once every six months, albeit manually (by hand). Also, today's discussion focused on data format rather than system integration.

18. Meeting Minutes (Observation) - Water supply Dep. (O&M procedure)

Date: 10:10-11:00 on Aug 5, 2025

Location: AQUA Crew room on the 2nd floor at SRWSA

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

2 Mr. Kimleng (Senior local mercenary, studied in China, coding, python, etc.) He is a senior of local charterer, knows China study, coding, python, etc. He is the person who is thinking how to bring AQUA Crew to Avenza and is familiar with QGIS, EPANET, and pipe network analysis. He also knows how to do leakage surveys. He has been in Japan for about a month for JICA training and hopes to obtain a PHD.)

JICA Expert Team and National Assistant: 1.

1. Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

SOPs are in place and maintenance is being conducted in accordance with these SOPs.

Leakage points are also managed in Excel. The staff enters the information in Excel, and when Kimleng checks it, it is colored yellow.

The vertical axis is the name of the road, and whether there is a leak or not is recorded as a maintenance record.

In addition to leaks, the company also records in Excel the cleaning records (Flashout) in the water pipes.

A maintenance schedule is also prepared.

The areas where valve covers need to be raised due to road construction, development, etc. are also recorded.

Valve opening and closing records are also recorded. Although the system is not operated in principle, Valve is opened and closed for maintenance purposes such as repairs.

Forms for checking the accuracy of customer meters are also maintained.

Maintenance records are in Excel files only.

For preventive maintenance, all water distribution pipes are checked and all valves are checked once a year.

In addition, WTP3 sends a daily photo of the water distribution volume for each Bulk meter (meters located at the entrance of each zone) for confirmation of water distribution volume. Telegrams are used. It is then entered into Excel.

In addition, once a month, the Excel data on water distribution volume is shared in an Excel file.

MISTI has instructed each water utility to make a demand forecast for the period 2026-2030.

SRWSA is also conducting its own demand forecasting and pipe network analysis using QGIS based on this.

Kimleng has independently learned Visual studio Code and is utilizing it in Excel.

19. Meeting Minutes (Observation) - Stock yard Status (Accounting Dep.)

Date: 11:10-11:40 on Aug 5, 2025

Location: Stock yard at 1st floor at SRWSA

Attendees: (in alphabetical order)

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

2 Mr. Kimleng Accounting Dep. man (also interviewed last week)

JICA Expert Team and National Assistant: 1.

1. Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

The new stock yard has just been constructed on the site of WTP1 and 2. Shelves have been set up for the installation of equipment and materials.

From now on, almost all of the materials and equipment will be transported to the new stock yard.

The current stock yard will be used only for customer meters and materials needed to connect customer meters. (For customer service, it is about a 30-minute drive to WTP 1 and 2).

When customer meters are taken out of the Stock yard, they will be handwritten in a notebook. Then we will compile it into an Excel file.

(The following must be verified).

All materials and equipment are first managed as "Stock in" at SUMS.

When you want to use them, you need to apply for stock out, and only after approval, you can take them out from the stock yard.

Stock in: Need equipment and materials → Application for purchase (paper) → Approval (paper) → Purchase → Arrival (entered in SMUS as Stock in?) Stock in: Need to use the equipment→Apply for stock out (paper)

Stock out: Use the equipment→Apply for stock out (paper) →Approve (paper) →Use (send out), also written in SUMS

20. Meeting Minutes (Observation) -WTP Monitoring and site visit

Date: 14:30-16:00 on Aug 6, 2025

Location: WTP3 SCADA Room

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

2 Mr. Meng Hengkim Lin, SCADA operator (Distribution department)

3 Ms. Seang Ravy (water quality test)

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

I can monitor the status of WTP2 from WTP1, but not from WTP2.

Because we are using remote desktop, we can monitor WTP2 from WTP1. This is not SCADA.

Items that can be monitored and controlled from WTP1

WTP1 (partial control)

WTP2 (monitoring)

WTP outlets (Flow, Mpa for 2 meters)

The 8 additional Intake units are manual switches only.

Can be monitored and controlled from WTP2. n

WTP2 (almost everything can be operated remotely)

WTP2 outlets (Flow, Mpa for one meter)

Water intake pumps are located on site.

Can be monitored and controlled from WTP3 also n

WTP3 (almost everything can be operated remotely)

Outlets of WTP1,2,3

Inlets in Zone 2 to 7

On/Off of water intake pumps located 10 km away can be remotely controlled.

Status other than WTP1,2 outlets cannot be monitored.

There are no current problems with sedimentation from intake pipes or odors from fish carcasses; what MISTI described is a past situation. Currently, only one of the two pipes is used, so they are not experiencing such problems.

WTP3 is currently operating from 6:00 AM to about 4:00 PM. The operating efficiency based on operating hours is about 42%.

Current water purification capacity is 11,000-12,000 m³/day.

The initial design calls for 24-hour operation.

No water is currently distributed to Zone 7.

21. Meeting Minutes (Observation)-Accounting Dep.

Date: 9:40-10:10 on Aug 6, 2025

Location: AQUA Crew room on the 2nd floor at SRWSA

Attendees: SRWSA

SRWSA: 1 Mr. Pheng Bunhor

1 Mr. Pheng Bunhor, Director of the Project Management Department

1 Ms. XXX, Accounting Dep.

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

Functions of SUMS currently used by WSA

Financial Management

- General lodger
- Receivable
- Fixed asset
- Inventory
- Payables

Water Billing

3 functions to be added in January next year

- Payroll
- Human Resources
- House connection



22. Meeting Minutes -KWS Mr. Kiyama

Date: 11:10-12:10 on Aug 5, 2025

Location: 3rd floor at SRWSA

Attendees: Mr. Kiyama

SRWSA: 1 Mr. Pheng Bunhor, Director of the Project Management Department

1 Mr. Pheng Bunhor, Director of the Project Management Department

Kitakyushu Water Service (KWS)

Kitakyushu Water Service (KWS)

JICA Expert Team and National Assistant: 1.

1 Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

Outline of the Ministry of Foreign Affairs Free of Charge Project (Target: PPWSA)

- **Project name:** Integrated Platform Development Project (free of charge by the Ministry of Foreign Affairs)
- **Period:** XXX - 2027 (to be completed in 2027)
- **Objective/Function:**
 - **Centralization of data and real-time monitoring**
 - **Extraction and visualization of necessary indicators and data (including Dashboard function)**
 - **Monitoring of water treatment plant electricity consumption**
 - **Demonstration test of valve control**
- **Target systems:**
 - **SUMS:** In use by PPWSA and SRWSA; based on Windows Dynamics. The MOFA free PJ will extend PPWSA's SUMS functionality.
 - **Challenges:** High license fee (PPWSA will pay a total of 2.3M USD per year in the future when using the functions to be added this time).
 - **GIS software:** PPWSA has been using KIS for many years; API is not yet open, which hinders integration; migration to AQUA Crew has not progressed. Mr. Kinoshita is aware that KIS will not bother to create an API for this project.
- **Expected Benefits:**

- Visualization of planning, inventory management, incident response, etc. ? ? ? ?
- Potential to be a model for a digital integrated infrastructure for national water utilities, including SRWSA. 2.

2. current status of PPWSA and DX initiatives

- **System integration: Linking SUMS and water meter data to automatically calculate non-revenue water ratio (see below).**
- **Smart meter testing:**
 - Testing underway with multiple manufacturers (e.g., E-Water).
 - Bluetooth-reading type (meters can take measurements when a meter reader approaches); piloting with some customers.
 - Challenges exist in terms of cost and dissemination (for reference, smart meters are not widely used in Japan due to inexpensive labor costs for meter readers).
- **Water quality monitoring and DMA integration (Korea-supported PJ):**
 - 184 DMAs targeted. Integration of more than 200 devices including water quality meters.
 - The objective is not just meter installation, but integrated management on a parcel-by-parcel basis.
- **Complaint handling:**
 - Received by phone and telegram
- **Leakage management application:**
 - SenseWater (made by Yokogawa) is used: get customer data from SUMS, get DMA data from SenceWater, sort by DMA, and calculate yield for each DMA. Frequent NRW can be ascertained.
 - High failure rate of DMA meters is an issue.
- **Future Plans:**
 - Plans to move to data analysis using machine learning in the development of the Nilot Water Treatment Plant.
 - Aim to enhance decision making through data visualization.

3. status and challenges of SRWSA

- **Background of SUMS implementation: Requested by MISITI; MISITI also wanted to understand SRWSA's electricity usage.**
- **Challenges:**
 - **Lack of technical capacity:** absence of a technical middleman, limited understanding of calculations and analysis (e.g., "magic" understanding of some technical details was observed)
 - **Demand variability:** delayed recovery of hotel demand after Corona; large differences in water demand by zone; lack of technical expertise; lack of understanding of the technical

aspects of the project; lack of technical expertise to understand the technical aspects of the project.

- **Master Plan:**
 - **First edition: 1995**
 - **Kiyama** conducted field survey in **2010** to forecast demand; **NJS conducted facility planning (not master plan)**
- **Future Outlook:**
 - **Based on the results of this study, a new master plan preparation PJ is scheduled to start in 2026**

4. aqua crew and GIS

- **Development Background:**
 - **Jointly developed by Kitakyushu City and GeoCraft.**
 - **Water distribution management system from the 1990s was integrated with GIS.**
- **Features:**
 - **Advantage: UI/functions** specialized for waterworks.
 - **On the other hand, there are limitations in applicability to other fields.**
- **Utilization for SRWSA:**
 - **Effective for inventory management and visualization of accident response.**
 - **In the next two years, we will proceed with the installation of applications and specification development.**

Part 2: Smart Meter Installation Status and Issues (PPWSA)

- **Status of Smart Meter Deployment**
 - **PPWSA is currently testing several smart meter devices.**
 - **Example of a developer: eWater (Cambodian IT company)**
 - **Introduced a model that can be read by meter readers via Bluetooth.**
 - **In some cases, meter reader access is difficult due to the location of meter installation on the premises.**
 - **Smartphone-readable meters have practical issues such as counters being dirty and unreadable.**
 - **Price of smart meters: expensive at approximately 250 USD/unit.**
- **Factors preventing widespread use**
 - **One of the reasons why meters are not widely used in Japan is the low labor cost of meter readers.**
 - **(e.g., in Kitakyushu City, the cost is 20 yen per meter reading.**

- May be suitable for apartment complexes, but difficult to introduce to individual residences.
 - **Current Response Policy**
 - PPWSA installed the system for some customers as a pilot project.
 - Customers are charged normal meter rates, and cost sharing for smart meter renewal has not yet been determined.
 - Due to many technical and operational issues, the next phase of deployment has not yet been reached.
-

5. digital architecture concept and JICA's involvement

- **Involvement of Mr. Kiyama**
 - At the request of JICA, Mr. Kiyama prepared the "Digital Architecture Proposal for Integrated Platform" as part of the Ministry of Foreign Affairs' grant project.
 - Although he was not present at the actual meeting, he recognizes the importance of sharing the draft.
 - **Mr. Kiyama's view**
 - The significance of "digital architecture" is difficult to convey at the field level.
 - Those in charge (water treatment plants/water distribution network/inventory management, etc.) understand the benefits of management on the same platform.
 - Example: Visualization of inventory and accident information in AQUA Crew → Contributes to future business planning and more efficient response to accidents.
 - **Proposed elements in the JICA project**
 - Promote application installation, specification development, and visualization (to be realized in the next 2 years)
 - The integrated application is expected to enable the use of other peripheral applications.
 - However, another issue is that Windows Dynamics-based SUMS is very expensive.
-

6. additional background and expertise of Mr. Kiyama

- **Mr. Kiyama has been engaged in overseas operations since 2003.**
- **He has also experienced DX projects in Japan for about 7 years.**
- **He was involved in the development of Aqua Crew from the early stages and is familiar with its affinity with field operations.**
- **He was also involved in the Siem Reap water source survey (around 2010) and has experience providing survey data to NJS.**

23. Meeting Minutes (Observation) -Findings explanation

Date: 15:30-16:00 on Aug 6, 2025

Location: 3rd floor at SRWSA

Attendees: (1)

SRWSA: 1.

1. H.E. Chan Sengla, Director General

Mr. Yay Monirath, Deputy Director General

Mr. Kot Nimol, Deputy Director General

Mr. Sok Hout, Deputy Director General

Mr. Pheng Bunhor, Director of the Project Management Department

JICA Expert Team and National Assistant: 1.

Mr. Atsuo Ohno

Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Srorn Piseth

1. overview

- **Explanation of the current situation by Mr. Ohno (visualization on a paper mache + sticky notes) and policy comments from the upper management 2.**

Main comments from Director General

- 1. Importance of step-by-step promotion:**
 - **Step-by-step is important to introduce digital tools. You can't just jump up and down.**
- 2. Emphasis on human resources and organization:**
 - **In parallel with the introduction of digital technology, it is essential to strengthen the capacity of staff (training and retention support).**
- 3. Benchmarking and compatibility:**
 - **Based on the comparison with PPWSA, we would like you to propose solutions necessary for SRWSA.**
 - **We would like to see realistic steps to reach the goal of getting as close to PPWSA as possible.**

Appendix 6-2: Second Field Survey (SRWSA)

Main Points of Discussions

Date: October 30, 2025

Time: 9:00 - 11:30

Venue: SRWSA Meeting room

Attendees: MISTI

MISTI: H.E.KHUT Vuthiarith - Under Secretary of State

H.E.KHUT Vuthiarith - Under Secretary of State

Mr.Phea Sinat - Chief of Technical Office

Mr.Ly Chansothea - Chief of Data Management Office

SRWSA: H.E. Chan Sengler

Mr. H.E. Chan Sengla - Director General

Mr. SEAK Pengkeang - Deputy Director General

Mr. Pheng Bunhor - Director of the Project Management Department

JICA: Mr. Youk Seng An An

Mr. Youk Seng An

JICA Expert Team: Mr. Atsuo Ohno

Mr. Atsuo Ohno - Team Leader

Mr. Koichi Ogata

Mr. Ohara Yu

Main Points of Discussion 1.

Explanation of Analysis Results Based on the First Survey

The Team Leader, Mr. Ohno, provided an explanation based on the handout materials (A4 x 2 sets). 2.

Questions and Answers

H.E. KHUT Vuthiarith: Expressed appreciation for the DX-related

Expressed appreciation for the DX-related survey.

(1) H.E. Chan Sengla: The reported results accurately reflect the current situation.

As discussed in today's agenda, smart meters are expensive; therefore, it would be more practical to develop a DX-related survey. As discussed in today's agenda, smart meters are expensive; therefore, it would be more

practical to introduce a system capable of reading existing meters. SRWSA agrees with the current proposal and also recognizes that staff development is crucial when implementing DX.

(2) Mr. SEAK Pengkeang: I appreciated for the survey team to summarize.

I appreciated for the survey team to summarize the findings and the results appropriately. In addition, as we are currently developing the SRWSA Master Plan, how will it align with the DX? Among the 14 proposed potential solutions, is there any specific order for implementing the solutions?

The specific order for the implementation of solutions has not yet been considered, While, a simplified roadmap will be included in the final report, so it would be an additional information. Regarding the second question, the survey team is not to be a position to mention about the on-going Master Plan clearly, while the survey team heard that the Master Plan has not yet been considered. Please note, however, that the SRWSA Master Plan will not be a comprehensive master plan, but will include the DX survey results including the solutions. Please note, however, that the SRWSA Master Plan will not be the DX master plan.

(3) Mr. Ly Chansothea: Human resource development is essential for implementing DX.

We would like to understand what types of facilities/equipment are required for each proposed solution, what benefits can be expected. In Cambodia, smart meters are perceived as expensive as the In Cambodia, smart meters are perceived as expensive as the survey report also mentioned, and water utilities prioritize pipeline expansion to increase water supply coverage. We are concerned that DX implementation may increase operational costs, especially given the current difficulty of revising water tariffs.

→ We are concerned that DX implementation may increase operational costs, especially given the current difficulty of revising water tariffs.

Because we have only limited cost information on the potential solutions at present, the cost evaluation in our score sheet would be very rough. It is important not merely to introduce DX technologies, but to apply them in ways that address operational challenges of SRWSA. It is important not merely to introduce DX technologies, but to apply them in ways that address the operational challenges of SRWSA.

(4) Mr. Phea Sinat: I concur with the survey results.

The key challenge for introducing DX facilities lies in addressing financial constraints. The key challenge for introducing DX facilities lies in addressing financial constraints. When implementing DX facilities through future JICA projects, please ensure that daily operations are not overly affected, and consider human resource development alongside equipment installation. .

→ Mr. Atsuo Ohno: For now, SRWSA basically should not be a target to progress.

For now, SRWSA basically should aim to advance by one level. If aiming higher, the proposed solutions would be different from the ones proposed this time and would need to be revised accordingly. If aiming higher, the proposed solutions would be different from the ones proposed this time and would need to be revised accordingly.

(5) H.E. KHUT Vuthiarith: Thank you for your valuable comments.

The evaluation by the Survey Team has helped us reaffirm SRWSA's current situation. MISTI will consider to include digital transformation as a component in the national strategy and closely continue MISTI will consider to include digital transformation as a component in the national strategy and closely continue monitoring the rapid progress of digital technologies.

Since my tenure as Director General of SRWSA, I have recognized the importance of system integration during my training in Japan. I observed that PPWSA had already automated meter reading.

Currently, SRWSA's water supply coverage has not yet reached 50%, and issues such as customers not willing to connect to pipelines some time. As the result, it may cause in low revenue, making it difficult to adopt new technologies due to cost concerns.

When we look at an overall status of water service both by public and private sectors in Cambodia, the main challenges are to improve water quality and water While, MISTI will consider to adopt a new technology in water sector.

In addition, MISTI request for JICA to consider a cooperation in implementing pilot projects at Cambodia. SRWSA is also conducting training with surrounding water utilities, and by positioning This survey will serve as a foundation for future discussions.

(6) Mr. Koichi Ogata:

In the first survey, we identified challenges such as the existence of multiple unlinked GIS systems and the need to expand When developing the DX Strategic Master Plan, we intend to consider whether and how to integrate and link future systems. When developing the DX Strategic Master Plan, we intend to consider whether and how to integrate and link future systems.

The plan will also address implementation and maintenance costs, human resource development, and organizational structure. The plan will also address implementation and maintenance costs, human resource development, and organizational structure.

(7) Mr. Ly Chansothea: We understand that system integration will require coordination.

We understand that system integration will require coordination with existing system vendors. The Microsoft Dynamics license currently used in the SUMS system for SRWSA is set to expire, and this should be taken

into consideration. We should also review examples from other projects regarding system integration approaches.

→ The Microsoft Dynamics license currently used in the SUMS system for SRWSA is set to expire, and this should be taken into consideration.

For instance, the JICA project in India, the integration of some SCADA systems has carried out by ensuring compatibility of the Thus, it could be an important point on how to verify and ensure the compatibility between the existing system and the Thus, it could be an important point on how to verify and ensure the compatibility between the existing system and the new system.

(8) Mr. Atsuo Ohno: Thank you for your valuable comments.

We plan to prepare the final report that will be shared by JICA.

The finalized minutes of this meeting will be sent by the Survey Team to Mr. Pheng Bunhor and subsequently reviewed and confirmed by MISTI.

Meeting Minutes _ Exchange of opinions with Mr. Bunhor (additional questions)

Date: 10:00-11:00 on Oct 31, 2025

Location: Meeting room on the 3rd floor at SRWSA

Attendees: SRWSA: Mr. Bunho

SRWSA: 1.

Mr. Buhor

JICA Expert Team and National Assistant: 1.

Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Khan Srun

<Additional questions about the digital capability map

Check if they use E-Mail, SMS, Telegram, etc. (communication with customers) -> mainly telegram, mobile (customers)

1 bank 1 app.(in charge of social dep.), 9 partner banks (online payment possible). 8 can pay via app. The remaining one is still in preparation.

Water purification and distribution volumes are monitored. There is no centralized water treatment plant monitoring; WTP1 and WTP2, as well as WTP3, are being monitored separately. Is there a plan to install flow meters in the distribution pipe network in the future, or is there a policy to automate the distribution pipe network? →At this time, there are no flow meters installed in the water distribution pipes. Only piping installation. (Flow meters are not required for water supply pipes (65-225 mm diameter)). In the Bacon area, 20 km extension has been done, but no flow meter has been installed. 7Zones (8 f flow meters. 8th is a flow meter to the airport).

The fixed asset ledger is being recorded in the SUMS system. CAD is used in construction design.

There is a regular maintenance plan. There is no medium- to long-term repair and renewal plan for the future according to the degree of deterioration. →The annual plan includes a repair plan, and the system information is stored in Aquacew. The system information is included in Aquacew. When it is time for renewal, Aquacew is used to draw out the renewal period and include it in the annual plan. Aquacew only manages the piping and flow meters (you can buy a license to use the asset management features; SUMS also has asset management (financial) features). SUMS also has an asset management (financial) function). At present, maintenance records are paper-based.

How to create a renewal plan for facilities and equipment: Example of an annual plan. A form that describes the renewal cost for the next year. It is not in the form of an individual facility renewal plan. For budget application, a renewal plan for the next year is created. Do you repair equipment after it breaks down? → If it looks like it is going to break, the operator makes a decision and applies for repair. It is not done after breakage. The senior manager of the water treatment plant makes a list of equipment that needs to be renewed. After that, staff members hold a meeting. The staff then meets and decides which items need to be renewed. During the meeting, priorities are decided based on the budget. The urgency level is determined based on the explanation of the person who proposed the idea. Next year, the budget will be in deficit due to Interest expense, depreciation, etc. In the group: Priority will be given to improving the efficiency of the current way of doing things rather than to making it more sophisticated.

The training will be conducted in Siem Reap Province and Oud Minh Choi Province, where private waterworks companies will come and receive training on leakage prevention. Piping, leakage prevention, etc.

SUMS maintenance costs are about 5,000USD per year. It is affecting the organization's budgeting process. The extended functionality is not yet available. When it becomes available, it will go up 10% per year. Next year it will be 5500. we are not sure how much the amount will be. we plan to be able to use it around February 2026 (initially).

Almost 100 data is stored on servers; there is also a SUMS server.

→ WTP3 servers are stored in the cloud in Singapore (Wester Mall). Buy the 1300USD package. When that capacity runs out, you buy another one. Only the flowmeter data is stored in the Singapore cloud at first; SCADA needs to store the flowmeter data in the cloud once in order to retrieve the data.

There is no system to request something between departments, but rather groups are created in Telegram and messages are exchanged within the groups. Telegram groups for the entire organization. There is also a department director group. Telegram is almost 100% as a communication channel.

Requests are made by the governor of the province, and the details are decided by the director group.

The IT department lacks technical skills and is not able to respond to cyber security issues. There have been no cyber security incidents to date. There have been some cases of hijacking of staff telegrams, but there have been no cyber-attacks on SUMS or other systems.

Above

Meeting Minutes _Exchange of opinions on solutions

Date: 14:30-16:00 on Oct 31, 2025

Location: SCADA room at WTP3

Attendees: SRWSA

SRWSA: 1.

1. Mr. Meng Hengkim Lin, SCADA operator (Distribution department)

Ms. Seang Ravy (water quality test)

JICA Expert Team and National Assistant: 1.

1. Mr. Atsuo Ohno

2. Mr. Koichi Ogata

3. Mr. Ohara Yu

Mr. Khan Srun

1. Opinions on solutions (SCADA updates for WTP1,2 (Solution 12) and SCADA integration with WTP3 (Solution 5))

- We believe that updating WTP1 and central monitoring with WTP3 are high priorities. We believe that updating the current system with WTP1 should come first.
- Each WTP has a different operation method. It is desirable to monitor WTP1 and WTP2 from WTP3. However, remote control would be difficult in reality, since operation is performed at each treatment plant. Operation should be performed at each of them.
- (Kohara question) Are there any difficulties in remote control with regard to the operation of each WTP?
- (Female) It would be better if WTP3 could be remotely controlled. The number of staff can be reduced. However, some parts of WTP1 are operated manually. It is questionable whether all operations can be remotely controlled. Also, WTP3, which will be the central monitoring base, may be difficult to remotely control due to communication problems with WTP1 and WTP2.
- After WTP1 was in operation, when SCADA matched the current facility, it could be operated from the SCADA screen.
- Around 10 years after installation, the WTP1 intake pumps have been struck by lightning twice; the first time was successfully handled, but the second and subsequent times have not. I don't think lightning rods were installed near the water intake facility. We contacted manufacturers in Cambodia. We also contacted a Japanese construction company, which visited Cambodia twice, and stayed for about two days to try to solve the problem, but we were unable to find the cause of the problem.
- It would be good to introduce a system for monitoring water quality on a regular basis. Currently, water quality is analyzed at (1) raw water intake, (2) water purification before distribution from the WTP, and (3) flow meters in each zone. It would be good to be able to monitor water quality in real time at each of these locations. 2.

Water pressure and residual chlorine concentration

- The area to the north of Zone 5 is relatively high in elevation and has higher water pressure than Zones 4 and 6, which are located to the south. The difference is about 0.04 Mpa. If the water distribution area is expanded in the future, it will be necessary to increase the water distribution pressure of the pumps from the water purification plant. If the water distribution pressure is increased, leakage from pipes near the water purification plant and other problems may occur.
- Once the water pressure near the SRWSA building is adjusted, the water pressure in other zones will be easier to manage. The water pressure in the center of town is 3 bar.
- All WTPs are served by the same distribution pipe network. There are flow meters and valves for zone closures at all zone inflows (connection points).
- No distribution ponds exist in the water distribution area.
- (In the future, the pressure problem could be solved by establishing a distribution pond and supplying water from the pond to the suburbs. This is one of the items to be considered in the water supply master plan. A water distribution pond is also useful from the perspective of maintaining residual chlorine levels.
- Currently, the residual chlorine concentration in residences is around 0.3ppm (government standard: 0.1-1.0ppm).

3. unit cost of water purification

- The water source of WTP1 is a well, which requires fewer chemicals for water purification treatment, resulting in the lowest annual unit cost for water purification.
- The water source of WTP2 is West Balai (reservoir), and the unit cost of water purification is higher than that of WTP1. The water quality of West Balai remains almost the same throughout the year.
- The source of WTP3 is Tonle Sap Lake, so the water quality (turbidity) varies greatly between the wet and dry seasons. In the rainy season, the amount of electricity and the unit cost of water purification are the same as WTP2, but in the dry season, the cost of chemicals and electricity is higher due to the higher turbidity. On average, WTP3 has the highest unit cost for water purification.
- The unit cost of water purification for the three treatment plants combined is approximately 1000 Riel/m³. Since household water consumption of 0-3 m³ is 900 Riel, the unit cost of water purification is in the red for households with small water consumption.
- Since usage fees vary by category, such as offices, factories, etc., the overall situation is that the recovery of fees exceeds the cost of water purification.

4. Water Supply Charges

- The current water rates in Siem Reap are the same as those used when WTP1 was constructed and have not been changed since then; the rate structure does not take into account the maintenance and management costs of WTP2 and 3. MISTI approval is required for rate revisions, but a previous application was denied.

- SRWSA's residential water rates are the highest among publicly owned water utilities; PPWSA charges approximately 700 Riel for 0-3 m3 of domestic water consumption.

5. Other

- Electricity cost in WTP2 is higher than in WTP1. It is necessary to confirm the basis of the calculation, but WTP1 sends the purified water once to the WTP2 water purification pond, and WTP2 distributes the water to the distribution network in batches. It is necessary to confirm how the calculations are made for this area.
- The operating efficiency of the water distribution pump at WTP3 is only about 60%, which means that high-efficiency operation has not been achieved. As a result, they consume a lot of electricity, causing high electricity bills.
- PPWSA has installed Green General's solar panels at the water treatment plant. The solar panels are maintained by Green General, and PPWSA purchases the electricity generated. The purchase price is lower than the market price.

Above.