

Cambodia

National Social Security Fund

Collaboration Program with
the Private Sector for Disseminating
Japanese Technology for Biometric Individual
Identification for Social Security System
in Kingdom of Cambodia
Final Report

April, 2017

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Hitachi, Ltd.

OS
JR
17-040

Cambodia

National Social Security Fund

**Collaboration Program with
the Private Sector for Disseminating
Japanese Technology for Biometric Individual
Identification for Social Security System
in Kingdom of Cambodia
Final Report**

April, 2017

**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)**

Hitachi, Ltd.

Table of contents

Map	1
Abbreviations	2
Chapter 1 Summary	5
1.1. Summary	5
1.2. Project overview image	9
Chapter 2 Background of the project	10
2.1. Background of the project	10
2.2. Disseminated technology and possibility of contributing to development issues	11
2.2.1. Details of disseminated technology	11
2.2.2. Possibility of Contribution to Development Issues	11
Chapter 3 Project overview	15
3.1. Objectives and goals of the project	15
3.1.1. Objectives of the project	15
3.1.2. Goals of the project (Contribution to development issues of the country, region, and city)	15
3.1.3. Goals of the project (Business side)	15
3.2. Contents of the project	16
3.2.1. Implementation schedule	16
3.2.2. Implementation structure	17
3.2.3. Contents of implementation	18
Chapter 4 Result of the project	21
4.1. Kick-off activities	21
4.1.1. Objectives of kick-off activities	21
4.1.2. Contents of the implementation	21
4.1.3. Details of the implementation	22
4.1.4. Implementation result	22
4.1.5. Work after the 1st local activity	23
4.2. The 1st verification activity	29
4.2.1. Objectives of the 1st verification activity	29
4.2.2. Contents of the implementation	29

4.2.3.	Details of the implementation	30
4.2.4.	Result of the implementation	31
4.3.	The 2nd verification activity	32
4.3.1.	Objectives of the 2nd verification activity	32
4.3.2.	Contents of the implementation	32
4.3.3.	Details of the implementation	33
4.3.4.	Result of the implementation	33
4.4.	Technical improvement of finger vein authentication	34
4.5.	Invitation to Japan	34
4.5.1.	Objectives of invitation program in Japan	34
4.5.2.	Invitees	34
4.5.3.	Curriculum and schedule	34
4.5.4.	Contents of the implementation	35
4.5.5.	Result of the implementation	37
4.6.	Report on verification results to NSSF	38
4.6.1.	Objectives of the verification result report to NSSF	38
4.6.2.	Contents of the implementation	38
4.6.3.	Details of the implementation	38
Chapter 5	Summary (Evaluation for the implementation result)	41
5.1.	Results of the project (Contribution to the target country, region, and city)	41
5.2.	Results (Business side) of the project, remaining problem and its solution policy	45
5.2.1.	Results of the project (Business side)	46
5.2.2.	Issues and solution policy	47
Chapter 6	Business development plan of this project	48
6.1.	Business objectives and goals	48
6.1.1.	Expected results through business (Contribution to target socio-economic development in the target country, region, and city)	48
6.1.2.	Outcome	48
6.2.	Business development plan	48
6.2.1.	Business overview	48
6.2.2.	Business target	53

6.2.3.	Business implementation structure	53
6.2.4.	Business deployment schedule	54
6.2.5.	Plan of investment and funding	55
6.2.6.	Status of competition	55
6.2.7.	Business development issues and solution policy	55
6.2.8.	Risks assumed in business development and its countermeasures	56
6.3.	Collaboration possibilities with ODA project	57
6.3.1.	Necessity of collaborative project	57
6.3.2.	Supposed business scheme	58
6.3.3.	Solid contents of collaborative project	58
Attachment	59
References	60

Map



<http://www.sekaichizu.jp/>

Abbreviations

Abbreviations	Official name
ASEAN	Association of Southeast Asian Nations
FAR	False Acceptance Rate
FRR	False Rejection Rate
FTER	Failure To Enroll Rate
ICT	Information Communication Technology
SDGs	Sustainable Development Goals
NSSF	National Social Security Fund
ODA	Official Development Assistance
PBI	Public Biometric Infrastructure
PIC	Personal Identity Check method
PKI	Public Key Infrastructure
UHC	Universal Health Coverage

Registered trademark

Windows is either a registered trademark or a trademark of Microsoft Corporation in the United States and/or other countries.

Windows Server is either a registered trademark or a trademark of Microsoft Corporation in the United States and/or other countries.

Microsoft and SQL Server are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Table of contents for Figure and Table

Figure 1.1-1 Image of system proposal phase for ASEAN	8
Figure 1.2-1 Image of project overview	9
Figure 2.2-1 Image of shortening processing time by combination of PIC and biometrics authentication	14
Figure 3.2-1 Implementation schedule of the project	16
Figure 3.2-2 Structure of the project.....	17
Figure 3.2-3 Concept image of the verification measures	18
Figure 4.1-1 Histogram of insured persons by age.....	25
Figure 4.1-2 Result of analysis on date of birth of insured persons.....	25
Figure 4.1-3 Analysis result of the birth place data of insured persons.....	27
Figure 4.2-1 Process to collect information of insured persons and their finger vein	31
Figure 4.6-1 Utilization of PIC for other public operation	39
Figure 5.1-1 Efficiency improvement by PIC	42
Figure 5.1-2 Proposed countermeasure for system improvement to register insured persons.....	43
Figure 5.1-3 Image of system improvement with finger vein	44
Figure 6.2-1 Image of Social Security ICT System.....	49
Figure 6.2-2 Image of National information management ICT system centered on Family Book.....	51
Figure 6.2-3 Effects of National information management on the overall administration	51
Figure 6.2-4 Image of system introduction phase in ASEAN	52
Figure 6.2-5 Business development system.....	53
Figure 6.3-1 Measures to enhance the insurance system in Cambodia.....	57
Figure 6.3-2 Measures for improving insurance administrative capacity and utility of ICT.....	57
Table 2.2-1 Details of Extraction of personal identity technology	11
Table 2.2-2 Details of finger vein authentication technology.....	11
Table 3.2-1 Information of counterpart organization	17
Table 3.2-2 Roles of stakeholders	17
Table 3.2-3 The specific contents (summary) of the project and their goals.....	19
Table 3.2-4 The equipment used in the project.....	20
Table 4.1-1 Contents of the kick-off activities	21
Table 4.1-2 Viewpoint of research for item of insured persons data.....	23
Table 4.1-3 Analysis result of ID numbers of insured persons.....	24
Table 4.1-4 Result of analysis on names of insured persons	24

Table 4.1-5 Result of analysis on erratic data of year of birth of insured persons.....	26
Table 4.1-6 Analysis result of the birth place data of insured persons	27
Table 4.1-7 Formulation of data specification key	28
Table 4.2-1 Implementation contents of the 1st verification	29
Table 4.2-2 The efficiency analysis result of selected data	31
Table 4.3-1 Implementation contents of the 2nd verification.....	32
Table 4.5-1 Curriculum and schedule of the invitation program.....	34
Table 4.6-1 Implementation contents of verification result report for NSSF	38
Table 5.1-1 Outcome (Accuracy and efficiency speed).....	41
Table 5.1-2 Desired values and achievements	41
Table 5.1-3 Overview of operation to register insured persons	42
Table 5.1-4 Results of the reinvestigation if insured persons information	43
Table 5.2-1 Overview of the implementation and achievement	45
Table 6.2-1 Target countries after Phase3	53
Table 6.2-2 Schedule for business development.....	54
Table 6.2-3 The investment amount and assumed sales amount after 2016.....	55
Table 6.2-4 Assumed risks and the countermeasures	56
Table 6.3-1 Issues in expanding the social security system in Cambodia	58

Chapter 1 Summary

1.1. Summary

- Background

Government of Cambodia has been planning the development of social security system with top national development strategy (Rectangular Strategy), aiming further economic growth, innovated by vigorous economic activities of workers. As a part of this, National Social Security Fund (hereinafter referred to as “NSSF”) carries out the operations of workers’ compensation and health insurance, and prepares pension scheme which starts in 2018.

As one of the problems of Cambodia, the system of national information management that secures uniqueness and accuracy is not being developed. NSSF is promoting the distribution of new workers’ compensation cards and allocating new IDs to insured persons at the timing of the start of the health insurance system, but duplication check to ensure uniqueness as originally planned is not done.

Determination of benefit qualifications and payment amounts may not be executed correctly based on the contribution history over a long period of time since insurance information without uniqueness does not correctly correlate the contribution history. With the rapid economic development in Cambodia, the number of companies and insured persons are increasing, so it is necessary to realize a mechanism to identify individuals and appropriately manage insured person information as soon as possible.

- Disseminated technology of the project

The target disseminated technology by the project is an individual identification technology combining the following 2 technologies.

[Technology1: Extracting identical person candidates accurately in a short time]

It is a technology that can immediately and accurately extract attribute information such as name and birth date when one person's information is registered as a plurality of different data. In Japan, it is necessary to analyze kanji, hiragana, katakana, alphabet, halfwidth /fullwidth forms, and similar letters, etc., so the name identification technology is better than in other countries. This technology also includes a database technology to identify enormous amounts of data.

[Technology 2: Biometric technology]

It is a technology to identify individuals by utilizing biological information on physical features such as fingerprints, veins, irises. Since biological information is unique to each person and never changes over its lifetime, it is possible to identify individuals reliably, and the impersonation risk is low.

In countries where the citizen information is not uniquely managed, it can be utilized as a technology to reliably identify a person. The verification in the project uses finger vein authentication developed by Hitachi and is superior to other biometrics authentication in terms of high authentication accuracy (FRR: 0.01%, FAR: 0.0001%, FTER: 0.03% or less), difficulty of counterfeiting, difficulty of change due to abrasion, etc., it is superior to other biometrics authentication. In addition, because finger veins can be read only living human who has blood flow, it is suitable for the social security field that mainly provides benefits to survivors.

- Objectives and goals of the project

(1) Objectives

Through this project, utility of disseminated technology will be verified and understanding of NSSF for this technology will be deepened. Furthermore, we will increase the motivation to introduce Social Security ICT System based on this technology.

(2) Goals

We quantify the problem of securing uniqueness in assigning new IDs to insured persons by NSSF as a requirement and demonstrate that this technology satisfies the requirements in verifications in line with actual operation.

- Implementation contents

In local activities, we first analyze current insured person information and carry out the localization of PIC technology based on Khmer characters, according to the analysis results. Then, we verify the utility of this technology in line with actual operation. Finally, in order to have the NSSF considered the introduction of this technology, we will report on the results of the verification and propose improvement of the ICT system based on the verification result.

During the invitation program in Japan, we introduce specialized technologies of finger vein authentication technology, inspection case examples of social security system, and hold session on Cambodia Social Security System, to deepen the understanding of NSSF for Hitachi's technology which support social security scheme in Japan and its quality.

- Results and achievements of the project

PIC technology satisfied the quantified requirements and showed that it is useful for new ID assignments of insured. And through the report of the verification results, the NSSF understood this technology and the necessity of Social Security ICT System which is based on this technology. Moreover, as we had the comments that the customer would like us to propose this technology to National ID management operated by the Ministry of Home Affairs, we believe that we have achieved the Objectives and goals of this project.

- Business development prospect at the present stage

The reasons to promote the PIC based on the technology and Social Security ICT System for Cambodia are as bellow. We also plan to promote them for emerging countries such as Myanmar or Laos according to the same reasons.

- The system and technology for the data check of ICT system is not developed enough
- On the other hand, to solve the duplicated registration is strongly desired
- The construction of new Social Security ICT System to start pension scheme is necessary

- Judgmental criteria of business development

We judged developing business is effective because above these assumed reasons are confirmed through the verifications. Also PIC technology was evaluated positively and NSSF began to find some donors in order to introduce Social Security ICT System utilized this technology.

Also in Myanmar and Laos, we understand that duplicate registration of insured is an important issue based on the survey results of both countries. In addition, since the method of inputting letters by combining vowels and consonants is similar to that of Cambodia, localization of PIC technology is expected to be possible. In this project, it was judged that it is possible to develop business because the technology and Social Security ICT System is certainly valid in Cambodia.

- Policy/countermeasures and remaining issues towards business development

Since fingerprint authentication has already been introduced to many countries as a biometrics authentication technology, the policy to propose finger vein authentication will be different from that of fingerprint authentication according to its characteristics and application scenes to selectively coexist with each other.

- Plan for future business development

We will propose the introduction of ICT system in stages according to target country's budget and business need. In the countries where insured cannot be managed accurately, we will first propose introduction of PIC technology and implement accurate management of insured information.

Furthermore, we propose a Social Security ICT platform based on databases that constitute this technology to countries where there is no know-how on long-term insurance information management such as pensions and have issues and concerns in the management of Social Security in the future. The Social Security ICT platform can flexibly extend the business functions according to the scheme and expansion of the target enterprise.

By introducing the ICT system in stages as described above, it is possible to small-start and gradually expands the Social Security ICT System which becomes more complicated year after year due to economic growth and demographic changes. In addition, by collaborating with users and local business partners to introduce the ICT system, we cultivate local human resources necessary for maintaining and managing the system.

In line with the above flow, we will propose a series of tasks from construction of Social Security ICT system and maintenance of system operation. The detailed phase of the proposed system is shown below.

Phase1: It will be a model case to demonstrate PIC functions in Cambodia and lead to subsequent technology dissemination.

Phase2: We will introduce the technology demonstrated in Phase 1 to the Government of Cambodia.

Phase3: Propose ICT system that supports social security system with database built at Phase 2 as the core and receive order (including orders for donor support). Continuously, we aim for proposal and ordering in countries with features similar to Cambodia such as Myanmar and Laos.

Phase4: We will expand this technology to other important administrative systems such as civil identification, etc.

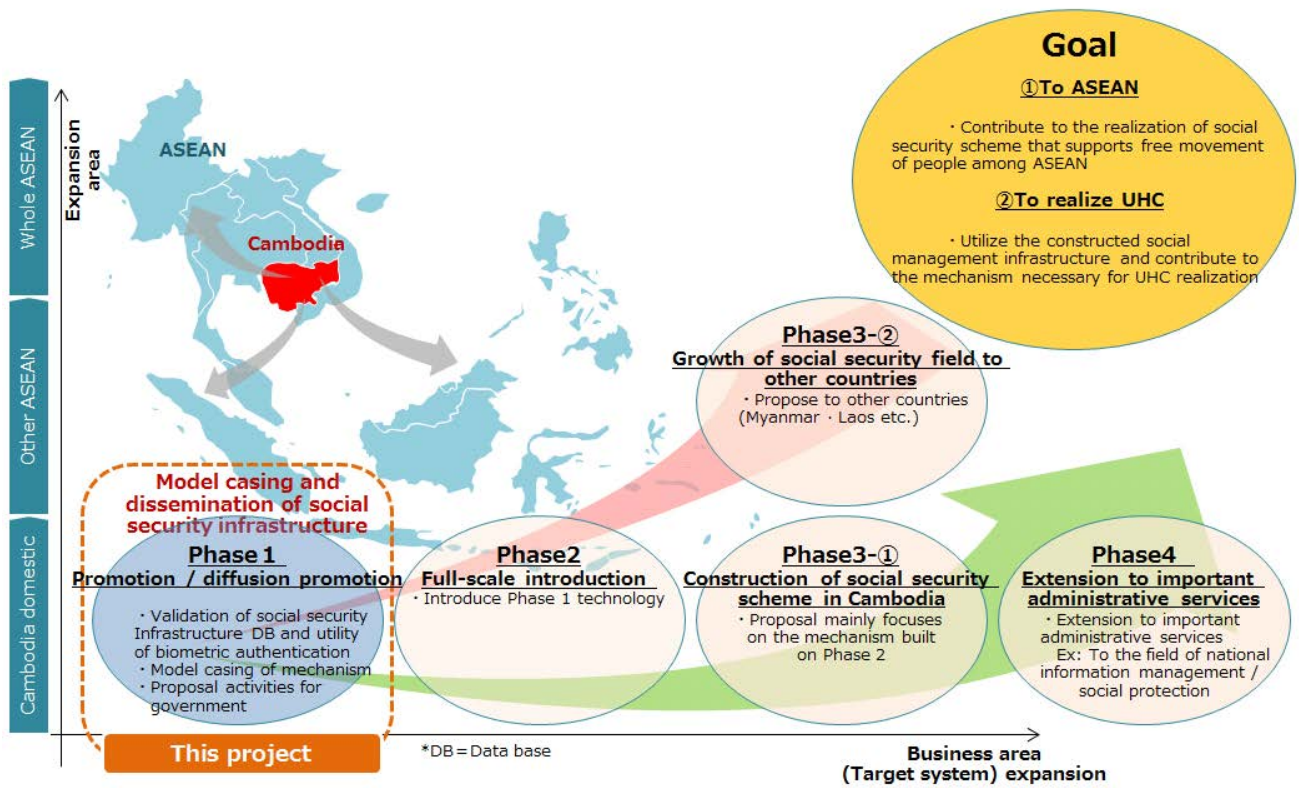


Figure 1.1-1 Image of system proposal phase for ASEAN

- Possibility of collaboration with ODA project

Implementation of a stepwise ICT system, effective system development, construction of a system operation structure in cooperation with other Ministries and Agencies, and implementation of Social Security ICT System through collaboration with local partners as ODA collaboration project can be promoted more concretely.

JICA recognizes that Cambodia is advancing efforts toward the realization of UHC, including assistance centered on the maternal and child health field, which is the priority issue of SDGs. The dissemination target technology and Social security system of this project not only supports the accurate and stable management of personal information and operation of Social Security but also helps to manage accurate information to promote UHC.

1.2. Project overview image

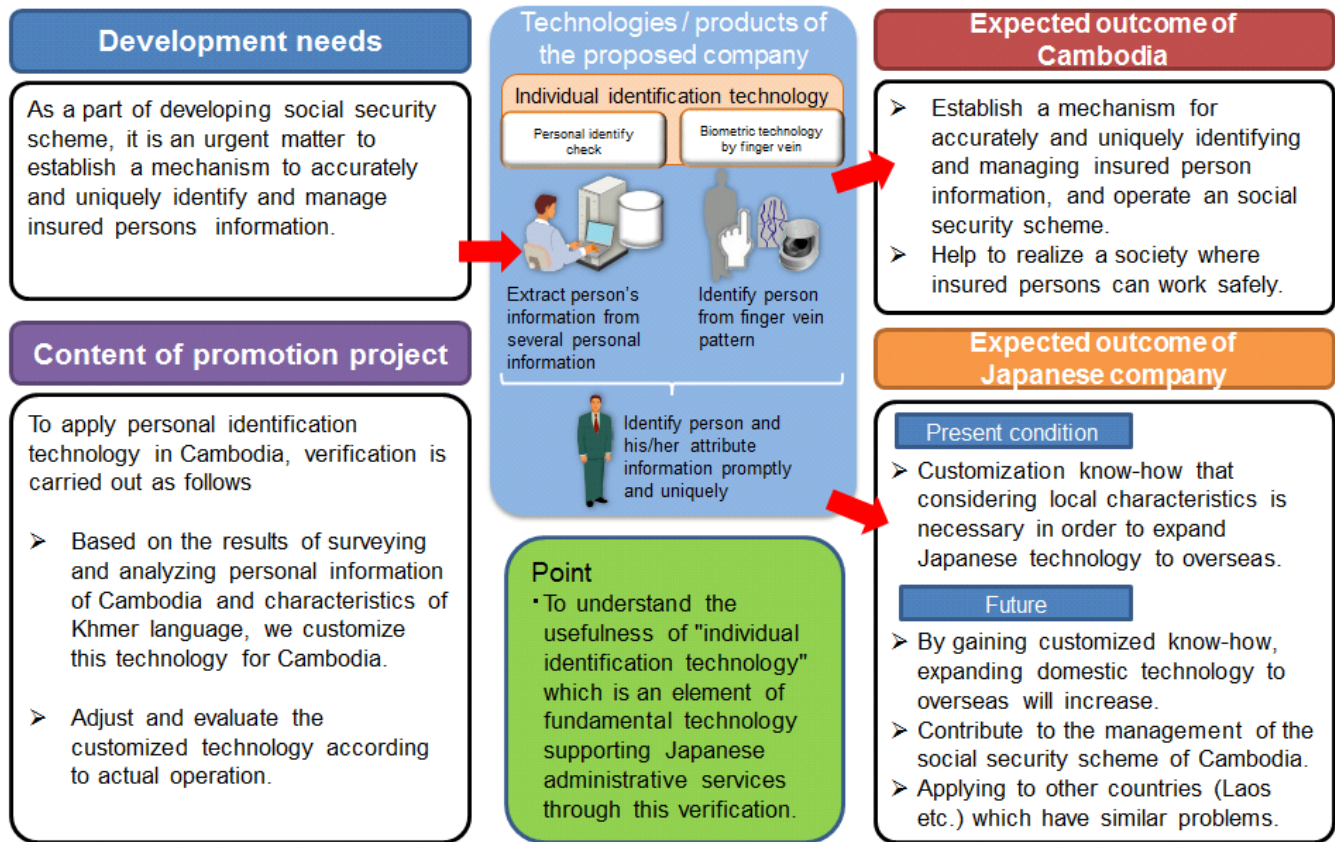


Figure 1.2-1 Image of project overview

Chapter 2 Background of the project

2.1. Background of the project

Hitachi set a globalization strategy in the medium-term management plan, it has positioned as a priority market for ASEAN. We have made proposal activities to ASEAN countries by making full use of long term experience of ICT in social security field centered on pension in Japan. First of all we approach to Cambodia where plans to introduce pension scheme soon, and then we aim to expand to other ASEAN member countries.

(1) Political / Economic overview of target development country, region, and city

Government of Cambodia has been planning the development of social security system with top national development strategy (Rectangular Strategy), aiming further economic growth, innovated by vigorous economic activities. As a part of this, NSSF carries out the operations of workers' compensation and health insurance, and prepares pension scheme which starts in 2018.

(2) Development issues faced by target development country, region, and city

Cambodia has a mechanism of civil identification, but it can not be performed accurately so the can not manage the citizen uniquely. Consequently, it became a problem to promote the development of the social security scheme. For more accurate management of the social security scheme, NSSF has introduced a new ID and started insured persons registration, but the duplication check of the insured persons can not be carried out as scheduled. There is the risk that the insured persons information and the contribution history can not be linked and correct payment can not be performed. In Cambodia, with the rapid economic development, the number of enterprises and the number of insured persons are expected to continue to increase, it is necessary to resolve this issue immediately.

NSSF has constructed ICT systems and databases in line with the constant of the social security scheme. So it is expected that the burden of maintenance will increase since the ICT system is not systematically constructed. In addition, the information of citizens will be decentralized and it will be an obstacle to accurately managing records for long term.

2.2. Disseminated technology and possibility of contributing to development issues

2.2.1. Details of disseminated technology

A mechanism of “PIC technology” to uniquely identify and manage each citizen by Hitachi’s “identity applicant extraction technology” of name identifies and "finger vein authentication technology" of biometrics authentication technology is to be adopted as the technology to be popularized. Details of both technologies are shown below.

(1) Extraction of personal identity technology

Table 2.2-1 shows f Extraction of personal identity technology.

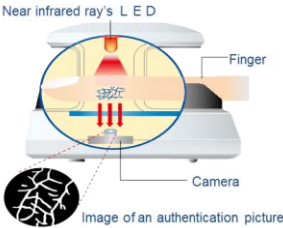
Table 2.2-1 Details of Extraction of personal identity technology

No.	Items	Details
1	Technology/ Product image	Originally, it is a technology to extract information that seems to be the same person candidate when there are several duplicate information of individuals that need to be managed uniquely. In Japan, it is utilized to merge bank user name, etc. It consists of a database technology that realizes matching processing of similar information and personal information management for permanently and uniquely, processing with high degree of merge accuracy and high speed. In the project, Hitachi developed technologies to adjust the Japanese technology to the culture and language of Cambodia, carry out localization, extract the same person to identify.
2	Features (Strengths, weaknesses)	<ul style="list-style-type: none"> • It is possible to extract identical person candidates from the existing insured person database and to realize accurate and high speed processing related to personal information. • Considering errors in registration of information such as names and addresses, even if there are some registration mistakes, they can be extracted as identical person candidate. (It is possible to extract mistakes in registration of names, addresses, etc.) • In consideration of language characteristics, accuracy and performance can be improved.
3	Sales result in domestic and overseas	<ul style="list-style-type: none"> • Name identify in linking resident card code and social security member information : About 110 million people • Name identify for social security generating number: About 33 million • Name identify for Social security member information and form record etc. : About 50million

(2) Biometrics authentication technology (Finger vein authentication technology)

Table 2.2-2 shows finger vein authentication technology.

Table 2.2-2 Details of finger vein authentication technology

No.	Items	Details
1	Technology/ Product image	 <p>It is the technology to identify individuals by utilizing biological information on physical features such as fingerprints, veins, irises. Since biological information is unique to each person and never changes over its lifetime, it is possible to reliably identify individuals, and the risk of impersonation is low. It is widely used, for example ATM for financial sectors, logistics, or entrance and exit control for other enterprises</p>

No.	Items	Details															
2	Features (Strengths, weaknesses)	<p>The features of finger vein authentication compared to fingerprint, iris and face authentication are shown below.</p> <table border="1"> <thead> <tr> <th>Types</th> <th>Usability</th> <th>Problems</th> </tr> </thead> <tbody> <tr> <td>Finger vein</td> <td> <ul style="list-style-type: none"> •Difficult to counterfeit (No residue / invisible from outside) •High authentication accuracy •Non-touch (Clean) •Available for only living human </td> <td> <ul style="list-style-type: none"> •It is difficult to authentication in strong light place </td> </tr> <tr> <td>Fingerprint</td> <td> <ul style="list-style-type: none"> •Ultra small •Low cost </td> <td> <ul style="list-style-type: none"> •Possibility to be counterfeit (Ease of residual / replication) •Difficulty to obtain (Dry skin / grease etc.) •Psychological resistance (Unclean/ Possibility of crime occurrence) </td> </tr> <tr> <td>Iris</td> <td> <ul style="list-style-type: none"> •High authentication accuracy </td> <td> <ul style="list-style-type: none"> •Possibility to be counterfeit •Psychological resistance </td> </tr> <tr> <td>Face</td> <td> <ul style="list-style-type: none"> •Low psychological resistance •Non-touch (Clean) </td> <td> <ul style="list-style-type: none"> •Possibility to be counterfeit •Low authentication accuracy </td> </tr> </tbody> </table> <p>Finger vein authentication is difficult to counterfeit, high authentication accuracy is, only living human can be authenticated, so it is a very effective technology for services required high security.</p>	Types	Usability	Problems	Finger vein	<ul style="list-style-type: none"> •Difficult to counterfeit (No residue / invisible from outside) •High authentication accuracy •Non-touch (Clean) •Available for only living human 	<ul style="list-style-type: none"> •It is difficult to authentication in strong light place 	Fingerprint	<ul style="list-style-type: none"> •Ultra small •Low cost 	<ul style="list-style-type: none"> •Possibility to be counterfeit (Ease of residual / replication) •Difficulty to obtain (Dry skin / grease etc.) •Psychological resistance (Unclean/ Possibility of crime occurrence) 	Iris	<ul style="list-style-type: none"> •High authentication accuracy 	<ul style="list-style-type: none"> •Possibility to be counterfeit •Psychological resistance 	Face	<ul style="list-style-type: none"> •Low psychological resistance •Non-touch (Clean) 	<ul style="list-style-type: none"> •Possibility to be counterfeit •Low authentication accuracy
Types	Usability	Problems															
Finger vein	<ul style="list-style-type: none"> •Difficult to counterfeit (No residue / invisible from outside) •High authentication accuracy •Non-touch (Clean) •Available for only living human 	<ul style="list-style-type: none"> •It is difficult to authentication in strong light place 															
Fingerprint	<ul style="list-style-type: none"> •Ultra small •Low cost 	<ul style="list-style-type: none"> •Possibility to be counterfeit (Ease of residual / replication) •Difficulty to obtain (Dry skin / grease etc.) •Psychological resistance (Unclean/ Possibility of crime occurrence) 															
Iris	<ul style="list-style-type: none"> •High authentication accuracy 	<ul style="list-style-type: none"> •Possibility to be counterfeit •Psychological resistance 															
Face	<ul style="list-style-type: none"> •Low psychological resistance •Non-touch (Clean) 	<ul style="list-style-type: none"> •Possibility to be counterfeit •Low authentication accuracy 															
3	Specifications	<ul style="list-style-type: none"> •High authentication accuracy - FRR: 0.01% - FAR: 0.0001% - FTER: 0.03% or less 															
4	Sales result in domestic and overseas	<p>Sales began in 2002. In 2015, the cumulative total of about 300,000 units is shipped to domestic and overseas, and it has a 70% share of the vein authentication market (Source: Fuji Economy "2013/2014 Future prospect of security related market").</p> <p>Domestic: About 200,000 or more for financial, government agencies, municipalities, etc., about 80% of the 62 banks which decided to introduce the biometrics authentication of bank ATM, 12 thousand units for entering and leaving management</p> <p>Overseas: A cumulative total of about 52,000, of which 35,000 are utilized for identity authentication of social security beneficiaries.</p>															
5	Price (unit price)	Finger vein device unit cost 28,000 yen + software license, server system etc.															
6	Economic efficiency	Device for finger vein authentication can be connected to a highly adaptable Windows PC, and economic efficiency is high because initial investment is unnecessary.															
7	Safety of the technology	Because finger vein imaging uses near infrared rays, it has no effect on the human body.															
8	Comparison with competing technologies in target countries	In the target country, the Ministry of the Interior plans to use fingerprint information for civil identification. Because finger veins can be read only living human who has blood flow, it is suitable for the social security field that mainly provides benefits to survivors.															

2.2.2. Possibility of Contribution to Development Issues

(1) Contribution to national policy

This project is consistent with basic policies listed by the Ministry of Health, Labor and Welfare, Ministry of Internal Affairs and Communications, and Ministry of Economy, Trade and Industry respectively.

First of all, under the basic policy of the Ministry of Health, Labor and Welfare, promotion of comprehensive and integrated international cooperation such as "Social security / social welfare", "Improvement of work environment", etc. is mentioned as ASEAN as priority countries. Among them, efforts such as pension system and health system support are being implemented. This project will be applied to the management of insured persons, management of collection history and benefit history, etc. This will contribute to further promotion of this policy.

Secondly, in the international cooperation and cooperation policy of the Ministry of Internal Affairs and Communications in the field of information and telecommunications, there is the ASEAN Smart Network initiative, not only for infrastructure improvement such as broadband environment but also for "advanced application promotion application diffusion" as a purpose. This will contribute to the project will be applied to advanced applications conforming to this meaning and will also contribute to achieving this objective.

Finally, the basic policy of the Ministry of Economy, Trade and Industry is to prepare the environment for attracting private investment by carrying out economic cooperation on the development of economic development base such as infrastructure improvement and human resource development, with emphasis on ASEAN countries, Activating investment is a basic policy on international cooperation. This project will also provide products and services that conform to this, and will confirm to the purpose of revitalizing private investment.

(2) Contribution to target countries

In order to uniquely manage insured by insured registration with new ID, the NSSF had planned to eliminate duplicate insured registrations by comparing the fingerprint information of the insured who were registered in the past with the fingerprint information of the insured who are newly registered. However, since it takes a huge amount of time to verify the fingerprint information, this duplication check could not be carried out in actual operation. This is because if the collation process is performed on fingerprint information of all the insured, the number of processes increases in proportion to the number of registrants, and the processing time is prolonged.

Also, collation based on fingerprint information that has been introduced to Cambodia may be changed due to friction, it can be used even after death, so there is a risk of impersonation. Therefore, in the social security field where the living human become beneficiaries, finger vein authentication technology is useful since it can manage individual's information and realize benefits accurately and reliably by utilizing individual's unique and invariant biometric information. In addition, since Cambodia is based on agriculture, there are many agricultural workers, friction of fingerprint is likely to occur, so it is highly effective.

In this project, by using the same person candidate extraction technology function, finger vein authentication data is effectively narrowed down to verify the target who matches against one new registered person and verification of biometric information, it is possible to shorten the processing time for narrowed-down data which is more precise and reliable as shown in Figure 2.2-1.

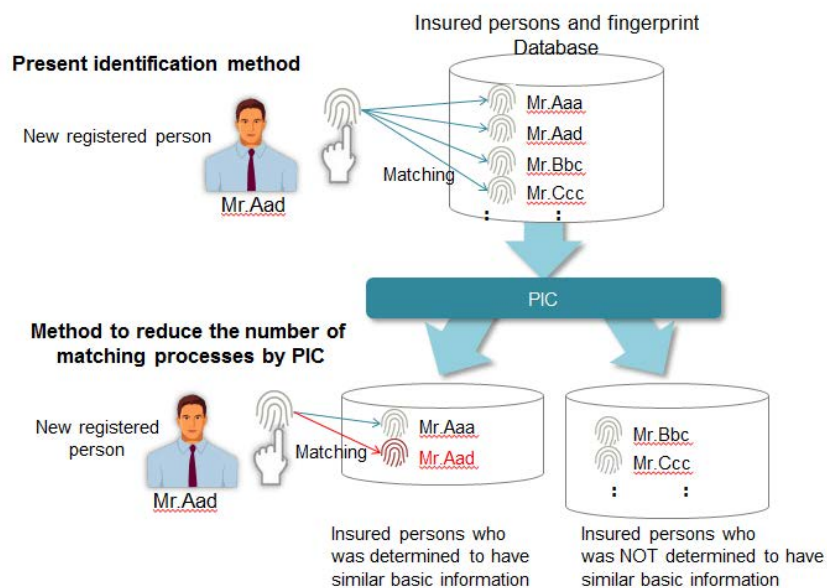


Figure 2.2-1 Image of shortening processing time by combination of PIC and biometrics authentication

This technology implements fast and accurate extraction of duplicate registrants and realizes unique management of insured person information. This will facilitate the application process of NSSF insured persons and can realize an accurate Social Security System. As a result, we can raise reliance of public to the system, increase the number of registrants to the system, and contribute to realizing a social environment in which workers can work safely.

Chapter 3 Project overview

3.1. Objectives and goals of the project

3.1.1. Objectives of the project

(1) Objectives of the project

This project aims to verify the utility of the disseminated technology and to nurture NSSF's understanding toward the technology. Furthermore, it is for increasing NSSF's motivation to install the social security ICT platform of which the technology occupies its core.

(2) Basic policy of the project

The basic policy of the project is as follows:

- Project team conduct verification quantitatively, based on actual operation
- Utility of the technology is verified when NSSF showed understanding toward the verification result

3.1.2. Goals of the project (Contribution to development issues of the country, region, and city)

To ensure accurate data collection of NSSF's new ID allocation, correct and quick processing of efficient duplication checking will realize smooth and reliable operation. Therefore, we set the target accuracy and performance (processing time) as the requirements of the individual identification function combining the same person candidate extraction function and biometric authentication technology (finger vein authentication), and in the demonstration experiment according to actual verification test that the technology suites requirements.

- Accuracy : 100%(*1)

Extract target data whenever any newly insured person has the past record of coverage

(*1) Exclude cases which incorrect attribute information is input

- Performance : 5 seconds

Processing time of duplication check for a newly insured person against 1 million insured person who already registered(*2).

Currently, duplication check has not been performed at actual administration, since duplication check utilizing fingerprint takes 3,805 seconds (under condition of *2). Thus, performance cannot be assessed.

By the verification result and invitation program, NSSF agreed that the technology shows high utility.

Table 5.1-1, Table 5.1-2, and Figure 5.1-1 shows the contents.

3.1.3. Goals of the project (Business side)

The project set goal as gaining NSSF's understanding toward utility of the project to be disseminated, and Hitachi's high technology of ICT for social security sector and increasing NSSF's motivation to introduce the social security ICT platform of which the technology occupies its core. Furthermore, method to localize personal identity check technology

and Biometric authentication technology (finger vein authentication) will be established in order to make the project a model case for disseminating the technology.

3.2. Contents of the project

3.2.1. Implementation schedule

Figure 3.2-1 shows implementation schedule of the project.

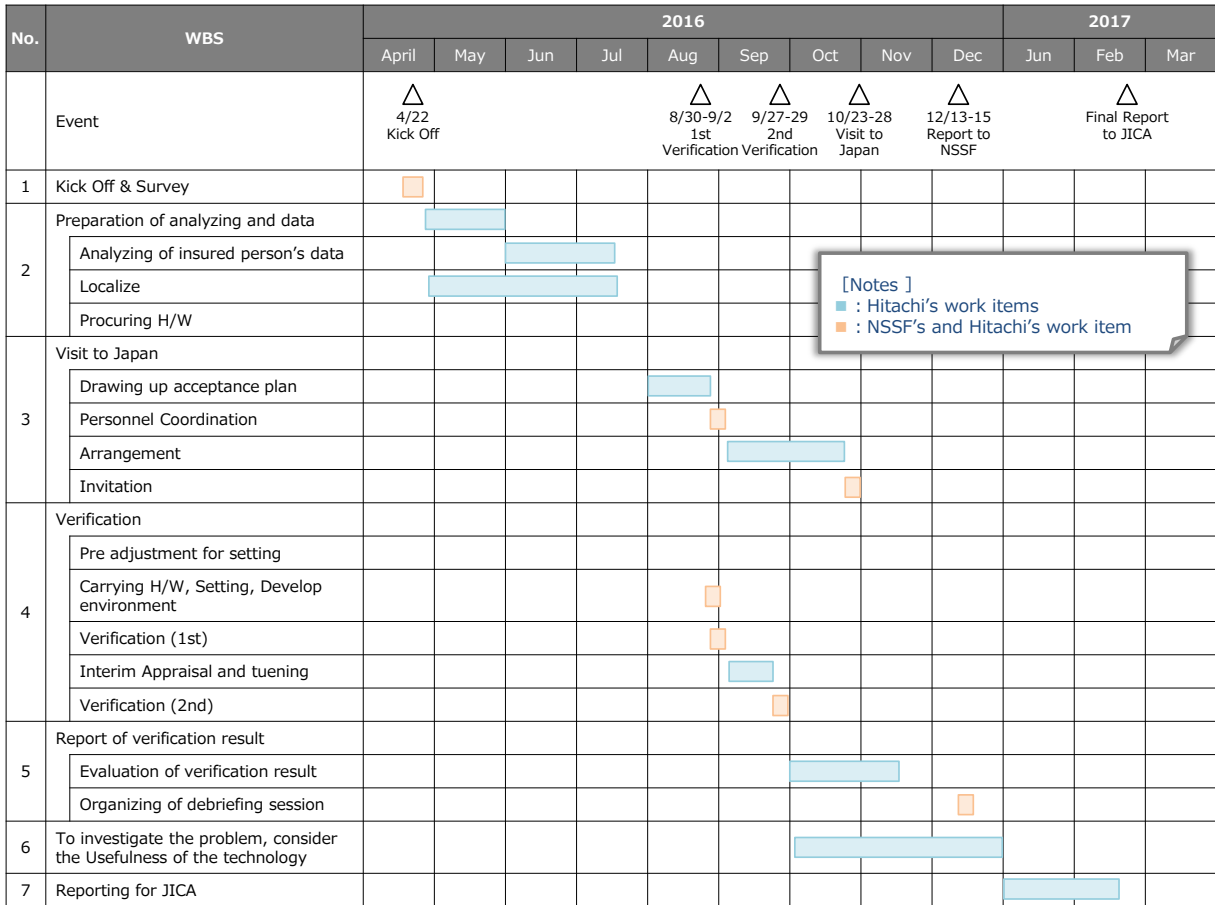


Figure 3.2-1 Implementation schedule of the project

3.2.2. Implementation structure

Table 3.2-1, 3.2-2 and Figure 3.2-2 show implementation structure of the project.

Table 3.2-1 Information of counterpart organization

No.	Item	Detail
1	Name	National Social Security Fund
2	URL	http://www.nssf.gov.kh/default/language/en/
3	History and mission	NSSF was founded with a view to manage the protection of social security in conformity with the National Law on Social Security and the Provisions of Social Security in pursuance of Sub-Decree. After comprehensive organization, NSSF have been implemented in late 2008.

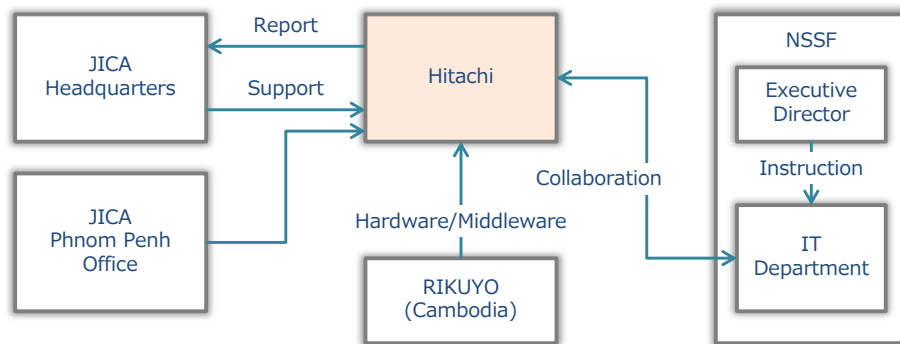


Figure 3.2-2 Structure of the project

Table 3.2-2 Roles of stakeholders

No.	Name	Role
1	JICA Headquarters	Supervise development of this project
2	JICA Phnom Penh Office	Coordinate related tasks such as communication with NSSF
3	HITACHI	Take charge of this project
4	RIKUYO (Cambodia)	Procure related hardware/ middleware in Cambodia
5	NSSF Executive Director	Supervise NSSF IT Department's activities
6	NSSF IT Department	Coordinate with local enterprises, conduct joint verification measures, and support such activities as analyses of existing data

3.2.3. Contents of implementation

To achieve the goal specified in “3.1 Object and goal of this project”, we conducted verification measures in the following steps. Figure 3.2-3 shows the image of those measures.

[STEP 1] Data analysis to localize the function of retrieving candidates of a specific person for Cambodia

[STEP 2] Obtaining information of newly registered persons and verifying biometrics (finger vein)

[STEP 3] Verifying the function of PIC

When we started the project, we received the request from NSSF: it wanted to verify whether it is possible to expedite the duplication check using the already collected data of fingerprint along with finger vein. Thus, the verification centered on the combination of the function of PIC and the technology of fingerprint authentication which NSSF used then. And it sought to confirm lingering impact of finger vein authentication on the current registration of insured persons in obtaining information and whether finger vein information could be obtained without errors.

For reference, NSSF requested us to procure our technology on finger vein authentication on conditions that we reported to them on technological improvement realized by Hitachi laboratory, along with the function of PIC.

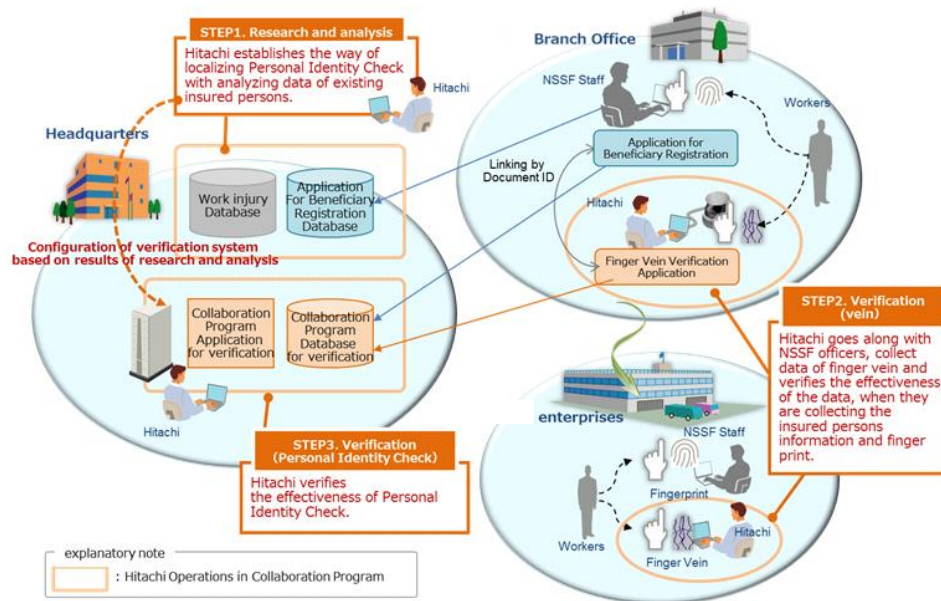


Figure 3.2-3 Concept image of the verification measures

With regard to the above three steps, Table 3.2-3 shows the specific contents and their goals and Table 3.2-4 shows the used equipment.

Table 3.2-3 The specific contents (summary) of the project and their goals

No.	Tasks	Activity plan					Specific contents	Goals (Status at the completion of the project)
	Items to be executed for business development within this project	1 st (CAM)	2 nd (CAM)	3 rd (CAM)	4 th (JPN)	5 th (CAM)		
1	Agree on current issues, research on information of insured persons, implementation plan of the project	-----					<ul style="list-style-type: none"> • Kick-off of the project with NSSF (Agree on issues, applied technology, and verification method) • Research and analysis on current information of insured persons 	<ul style="list-style-type: none"> • Agree on current issues and solutions with NSSF and have them understand the image of application of insured persons after verification • Plan on how to localize the method based on analysis of information of insured persons
2	Establish localization method of the applied technology	-----	-----				<ul style="list-style-type: none"> • Consider how to implement the applied technology • Tune implementation method through verifications 	<ul style="list-style-type: none"> • Establish localization method of the applied technology in Cambodia
3	Verify applicability to operation		-----	-----			<ul style="list-style-type: none"> • Obtain the information of insured persons working for local enterprises and their finger vein • Evaluate the accuracy and quality of the obtained information of the insured and their finger vein 	<ul style="list-style-type: none"> • Establish how to improve the current process to apply insured persons
4	Verify and evaluate accuracy and quality of the applied technology		-----	-----			(Same as the above)	<ul style="list-style-type: none"> • Judge whether to diffuse the technology based on its precision and quality
5	Training on the technology and Hitachi's product development method				-----		<ul style="list-style-type: none"> • Report on analysis on the information of insured persons • Session given by the laboratory team in charge of finger vein • Session on the function to check a specific persons • Site visit to a hardware manufacturing factory • Session on software quality control • Site visit to Hitachi Innovation Forum • Introduction on the Japan's social security scheme 	<ul style="list-style-type: none"> • Deepen NSSF's understanding on utility of the technology • Motivate NSSF to introduce the technology • Have NSSF understand excellence of Hitachi's product development method and increase their confidence in Hitachi as a partner
6	Report on verification result and propose on solution of the issues					-----	<ul style="list-style-type: none"> • Host a session to report on verification result for NSSF (including a proposal on system to solve the issues) 	<ul style="list-style-type: none"> • Motivate NSSF to introduce a social security system harnessing the technology
7	Education related to making use of verification environment					-----	<ul style="list-style-type: none"> • Provide NSSF with a training on how to make use of the verification environment 	<ul style="list-style-type: none"> • Explain to NSSF about necessary information to maintain the verification environment

Table 3.2-4 The equipment used in the project

No.	Equipment name	Model number	Price	Qua.	Use	Delivered date	Installed location
1	System x3500 M5 Model J2J (including extended memory, display, etc.)	5464J2J	\$9,657.60	1set	Data processing and management server	2016.8	NSSF HQ
2	HP ProBook 650	E6P32AV-BDHV	\$1,140.00	5	PC for obtaining/ authenticating finger vein	2016.8	NSSF HQ
3	AT-GS910/8 L2 Switch	2329R	\$67.20	2	Connector switch between server and PC	2016.8	NSSF HQ
4	LAN cable (3m)	LD-CTT/BU3/RS	\$18.00	5	Connection cable between server and PC	2016.8	NSSF HQ
5	LAN cable (5m)	LD-CTT/BU5/RS	\$24.00	5	Connection cable between server and PC	2016.8	NSSF HQ
6	Power strip	TAP-MG3811N	\$48.00	3	Extension power cable between server and PC	2016.8	NSSF HQ
7	Finger vein device	PC-KCA110	—	5	Special device for obtaining / authenticating finger vein	2016.8	NSSF HQ
8	KES for Business	KL4863JAMFP-W000	\$49.20	15	Anti virus software	2016.8	NSSF HQ
9	Windows Server 2012	P73-06285	\$940.80	1	Server OS license	2016.8	NSSF HQ
10	Windows Server 2012 CAL	R18-04281	\$39.60	5	Server OS access license	2016.8	NSSF HQ
11	Microsoft SQL Server 2014	228-10354	\$956.40	1	Database for verification system	2016.8	NSSF HQ
12	SQL Server 2014 CAL	359-06117	\$222.00	5	Database access license	2016.8	NSSF HQ
13	Office Pro Plus 2016	79P-05552	\$540.00	5	Office license	2016.8	NSSF HQ

Chapter 4 Result of the project

4.1. Kick-off activities

4.1.1. Objectives of kick-off activities

We conducted the kick-off activities to:

- Host the kick-off meeting between NSSF, JICA and Hitachi (explain and agree on the plan of the project)
- Research items necessary to verify the project
- Confirm the procedure to introduce and maintain the equipment to procure

4.1.2. Contents of the implementation

Table 4.1-1 shows the contents of the kick-off activities

Table 4.1-1 Contents of the kick-off activities

No.	Date	Activity and location	Detail
1	4/20 AM	[Activity] Pre-kick-off meeting [Location] JICA Phnom Penh Office	Pre-kick-off meeting
2	4/20 PM	[Activity] Meeting on how to procure and maintain the equipment, etc. [Location] RIKUYO office	Discuss how to install and maintain the related equipment with a local vendor
3	4/21 AM	[Activity] Kick-off meeting [Location] NSSF Headquarters	Kick-off meeting on the project between NSSF (Executive Director, Department), JICA and Hitachi
4	4/21 PM	[Activity] Meeting with IT Department [Location] NSSF Headquarters	Meeting with NSSF's IT Department to explain the details of the project and the things to be coordinated and requested and to agree on them
5	4/22 PM	[Activity] Meeting with IT Department (continued) [Location] NSSF Headquarters	(Same as the above)

4.1.3. Details of the implementation

1) Kick-off meeting

JICA explained the mission and details of the scheme to promote diffusion of commercial technology. Hitachi explained the project plan document (implementation process, applied technology, activities in Cambodia, etc.). NSSF understood them.

NSSF declared the kick-off of the project and NSSF, JICA and Hitachi agreed to cooperate on the project.



In addition, NSSF had an opinion that they would like to verify whether it is possible to speed up duplication check with fingerprint information which already collected besides finger vein authentication, so we agreed in the corresponding direction.

2) Meeting with IT Department

We explained the specific contents of the applied technology, target value in verification, implementation process and overall role demarcation. NSSF agreed on them. Also, we conducted a demonstration about finger vein authentication system. NSSF understood how to obtain finger vein information in Cambodia.

Furthermore, NSSF understood how to localize PIC function.



The following items are what NSSF IT Department agreed on in the meeting:

- To obtain data necessary to localize (analyze data) PIC function
- To explain the current process to obtain fingerprint information of insured persons (NSSF conducted a demonstration on its related system), the procedure of application of insured persons, and how to obtain finger vein information
- The verification schedule on obtaining finger vein information, etc.
- To confirm how to manage biological information and ID of insured persons and the current issues

4.1.4. Implementation result

In the kick-off meeting, triggered by the declaration of NSSF, the agency, JICA and Hitachi agreed to collaborate for the successful implementation of the project. Also, since NSSF agreed on the verification process of the project, we obtained the database of insured persons, which we needed to localize PIC function.

Because of the opinion from NSSF that they would like to verify whether it is possible to speed up duplication check with fingerprint information which already collected besides finger vein authentication, in addition to carrying

out the "same person candidate extraction technique", the finger vein authentication verifies whether the present insured persons registration operation is delayed by the information acquisition operation, and whether the finger vein information can be acquired accurately without error, so we decided to work on further verification.

4.1.5. Work after the 1st local activity

After the 1st local activity, we analyzed the data of insured persons and understood the current status and issues. Based on them, we established the processing method of the technology of retrieving candidates of a specific person.

(1) Data analysis on insured persons

We selected candidate items of key information (data identifying key) to identify a certain insured person based on our achievements related to PIC (Personal Identity Check) in Japan and the results of hearings in Cambodia. We analyzed the data of insured persons based on those items.

Table 4.1-2 Viewpoint of research for item of insured persons data

No.	Item	Viewpoint of research
1	ID number	Combination structure of registered character category, relation with nationality, etc.
2	Name	Validity of inputted code, existence of middle name, etc.
3	Sex	Male-to-female ration, etc.
4	Date of birth	Existence of errors, coincidence rate of date, year and month of birth, etc.
5	Location of birth	Existence of needless code, distribution of Province

[Analysis on ID number]

The value of ID number of insured persons varied according to nationality and ID category. It turned out to be likely that the ID of insured persons of Cambodian nationality could a data identifying key. In the meantime, we concluded that it was risky to judge duplication of insured persons only by the ID number since we had heard in the hearings that multiple national IDs or passport IDs could be issued to a single person. Table 4.1-3 shows the details of the analysis result.

<Case 1> Registering the national ID of a Cambodian citizen

Most data were eight-digit number strings. Apart from 67 cases, we didn't find any duplication. Thus, it was likely that the ID could be used as a data identifying key.

<Case 2> Registering the passport ID of a non-Cambodian person

90% of data fell into the three format patters shown in from No. 5 to No. 7 of Table 4.1-3. Also, apart from one case, we didn't find any duplication. Thus, it was likely that the ID could be used as a data identifying key.

<Case 3> Registering the other ID than national ID and passport ID

Values of the IDs didn't base on any format patterns and 80% of the data weren't populated (NULL). Thus, we judged that it was difficult to use any of them as a data identifying key.

Table 4.1-3 Analysis result of ID numbers of insured persons

No.	Case	Category of registered value	Cambodian Nationality		Foreigner		Total	
			# of items	Ratio [%]	# of items	Ratio [%]	# of items	Ratio[%]
1	Case 1	NNNNNNNNN(*)	74,600	99.068	28	32.184	74,628	98.991
2		No value (NULL)	204	0.271	0	0.000	204	0.271
3		Others	498	0.661	59	67.816	557	0.739
4		(Total)	75,302	-	87	-	75,389	-
5	Case 2	XNNNNNNNN(*)	57	57.576	33	2.379	90	6.057
6		XNNNNNNNN(*)	18	18.182	926	66.763	944	63.526
7		XXNNNNNNNN(*)	2	2.020	314	22.639	316	21.265
8		No value (NULL)	1	1.010	0	0.000	1	0.067
9		Others	21	21.212	114	8.219	135	9.085
10		(Total)	98	-	1,387	-	1,485	-
11	Case 3	No Value (NULL)	14,479	85.796	14	82.353	14,493	19.224
12		Others	2,397	14.204	3	17.647	2,400	3.183
13		(Total)	16,876	-	17	-	16,893	-

(*)"N":Number(0-9),"X":Alphabet

[Analysis on name of insured persons]

We analyzed first names and last names of insured persons focusing on tendency of registered values and validity of inputted code, etc. Table 4.1-4 shows the summary of the analysis.

- All data of insured persons had a first name and last name
- Some data had invisible character codes or space codes
- Only 1.5% of all data were inputted in alphabet (1,447 out of 93,767)

Once invisible codes and space codes are cleaned off, it was likely that first names and last names in Khmer could be used as a data identifying key.

Table 4.1-4 Result of analysis on names of insured persons

Items	Record Total	Minimum Size	Maximum Size	Average Size	Invisible Character Contained within	Consecutive Space Code	Only Khmer Character	Only Alphabet and Numeric	Khmer Character and Alphabet and Numeric
First name	93,767	1	22	3	148	0	92,172	1,447(23)*	0
Last name	93,767	1	28	5	160	4	92,196	1,447(23)*	1(1) *

()* :Cambodian

[Analysis on sex and date of birth]

We analyzed dates of birth of insured persons focusing on tendency of inputted value, existence of errors, ratio of coincidence of date, year and month of birth. The result of the analysis is shown in Figure 4.1-1 and Figure 4.1-2.

Since the rate of populating data was 100%, sex can be used as a data identifying key. And yet, it couldn't work independently because it could only divide the information of all insured persons in two.

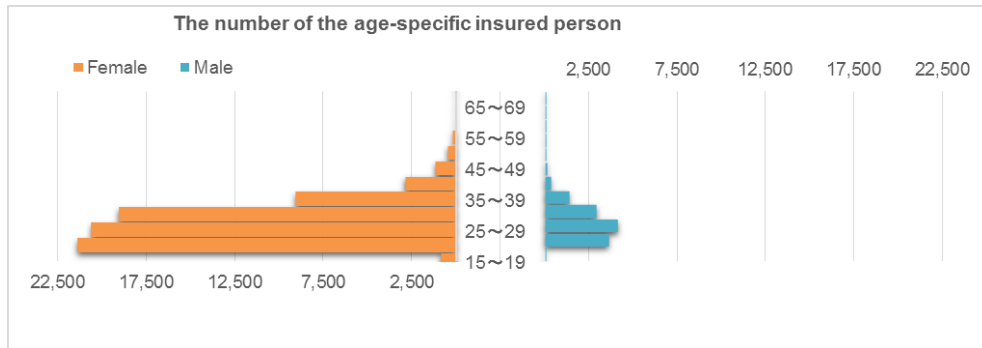


Figure 4.1-1 Histogram of insured persons by age

When it comes to date of birth, day and month revealed a certain bias (cases of early date were detected much more frequently than those of late date in every month) as shown in Figure 4.1-2. Thus date of birth was not reliable enough to be used as a data identifying key.

In the case of year of birth, data bias was negligible enough to be used as a data identifying key. That said, the validity check needed to be conducted due to some erratic data (ex. future year, extraordinarily old year) as shown in Table 4.1-5.

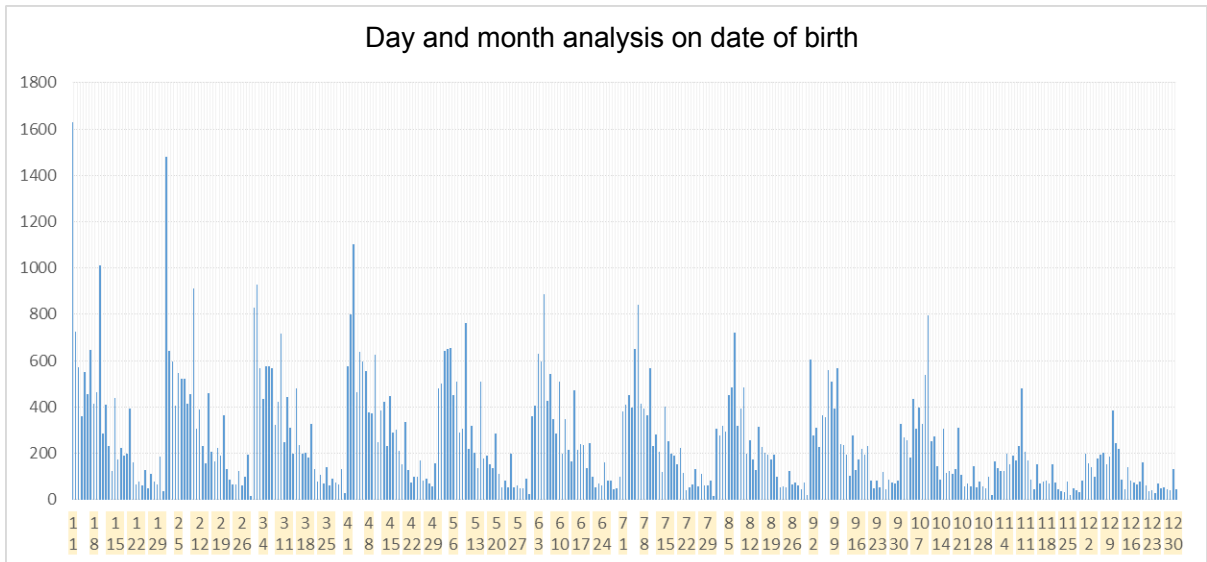


Figure 4.1-2 Result of analysis on date of birth of insured persons

Table 4.1-5 Result of analysis on erratic data of year of birth of insured persons

Year of birth that may be too old			
Year	Age	Female	Male
1951	65	7	3
1950	66	6	2
1949	67	2	4
1948	68	2	1
1947	69	5	0
1946	70	2	2
1945	71	1	1
1944	72	2	3
1942	74	0	1
1941	75	0	2
1882	134	2	0

Date of birth that may be too young			
Year	Age	Female	Male
2015	1	9	0
2014	2	10	0
2013	3	1	0
2010	6	2	0
2002	14	2	0

Future year of birth			
Year	Age	Female	Male
2993	-977	1	0
2019	-3	1	0

[Analysis on location of birth of insured persons]

The results of analysis on location of birth of insured persons focusing on tendency of inputted value, existence of needless code, distribution of Province are shown in Table 4.1-6 and Figure 4.1-3. Since the registration program had made it necessary to populate data in Province (choose from candidates or input freely), all items had some data (no NULL). However some items had other data than the candidates. For instance, one item out of 18,366 of PreyVang Province was thought to be a typo.

When it comes to data of minor local unit to Province (District, etc.), inputted data couldn't be used as a data identifying key since they varied a lot mainly due to the fact that a data inputting rule was not established.

Since data of Province should be chosen from candidates, their values fell in a limited range of variation. Although the data were biased toward a certain area, we found no need of modification. The reason is that we thought we analyzed the data most of which had been collected from the area. We judged that we had to be careful in handling erratic data of persons born overseas or those out of the range of candidates. However, basically speaking, data of location of birth could be used as a data identifying key.

Table 4.1-6 Analysis result of the birth place data of insured persons

No.	Province	Khmer	Total
1	Banteay Meanchey	បន្ទាយមានជ័យ	93
2	Battambang	បាត់ដំបង	849
3	Kampong Cham	កំពង់ចាម	12,156
4	Kampong Chhnang	កំពង់ឆ្នាំង	3,123
5	Kampong Speu	កំពង់ស្ពឺ	10,194
6	Kampong Thom	កំពង់ធំ	6,977
7	Kampot	កំពត	4,178
8	Kandal	កណ្តាល	8,871
9	Koh Kong	កោះកុង	167
10	Kratie	ក្រចេះ	641
11	Mondul Kiri	មណ្ឌលគិរី	3
12	Oddar Meanchey	ឧត្តរមានជ័យ	42
13	Preah Vihear	ព្រះវិហារ	42
14	Prey Veng	ព្រៃវែង	18,366
15	Pursat	ពោធិ៍សាត់	1,315
16	Ratanak Kiri	រតនគិរី	9
17	Siemreap	សៀមរាប	497
18	Stung Treng	ស្ទឹងត្រែង	19
19	Svay Rieng	ស្វាយរៀង	8,459
20	Takeo	តាកែវ	12,322
21	Phnom Penh	ភ្នំពេញ	3,440
22	Kep	កែប	9
23	Pailin	ប៉ៃលិន	13
24	Preah Sihanouk	ព្រះសីហនុ	124
25	Tboung Khmun	ខេត្តត្បូងឃ្មុំ	0
Total			47,336

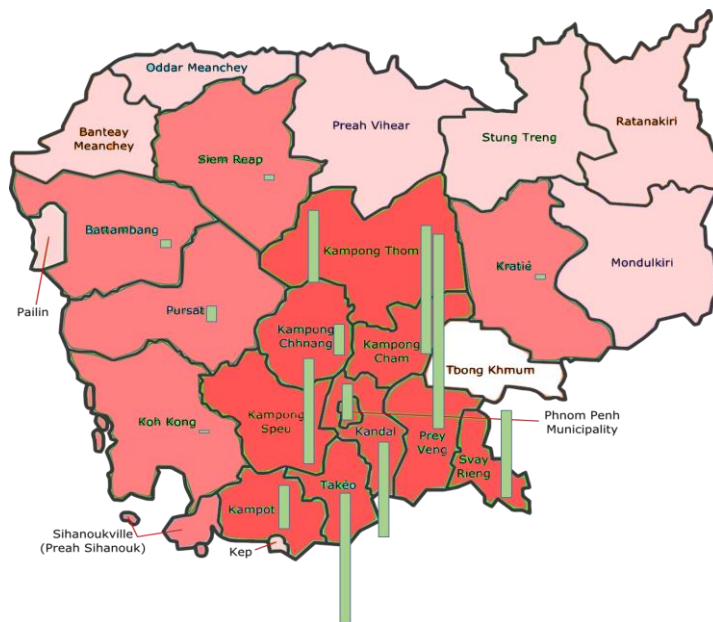


Figure 4.1-3 Analysis result of the birth place data of insured persons

(2) Formulation of PIC processing system

The processing system of PIC was decided by analyzing the requirement of PIC function in this project and the insured persons data.

Data cleaning system for each data specification key and fluctuation range to identify the same person were also determined by the analysis result. The patterns of data specification keys for the verification were fixed by organizing each number of insured persons extracted by each specific key shown on Table 4.1-7 in order to realize the efficiency (processing speed) determined by requirement definition.

Table 4.1-7 Formulation of data specification key

Pattern	1	2	3	4	5	6	7	8	9
First Name	○	○	○	○	○	○	○	○	○
Last Name		○							
Province of Birth			○			○	○	○	
Year of Birth				○		○		○	○
Sex					○		○	○	○
Number of GROUP	492	34,419	3,211	6,295	753	26,364	4,815	32,434	8,915
Maximum Insured person in a GROUP	4,920	130	1,036	380	4,261	84	929	80	323
Average Insured person in a GROUP	180.01	2.57	27.58	14.07	117.62	3.36	18.39	2.73	9.93

4.2. The 1st verification activity

4.2.1. Objectives of the 1st verification activity

The operations as below were implemented on the 1st verification in order to evaluate the accuracy and efficiency of PIC function localized for the verification environment.

- Construction of the system environment for the verification and operation confirmation
- Implementation of Personal Identity Check (PIC) verification
 “Selection and verification of finger vein info. at local enterprises” “Verification of PIC”
- Analysis of verification result

4.2.2. Contents of the implementation

Table 4.2-1 shows the implementation contents of the 1st verification.

Table 4.2-1 Implementation contents of the 1st verification

No.	Date	Implementation items and Locations	Overview
1	8/29 PM	[Activity] Explain the project and install procured equipment [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Explain implementation items of the 1st verification • Carry in and install the procured equipment • Verify the equipment (confirmation of initial operation)
2	8/30	[Activity] Construct a verification environment [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Set up network connection • Construct server verification environment (OS, DB etc.) • Construct PC environment (OS, middle ware)
3	8/31	[Activity] Construct a verification environment [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Construct server verification environment (Continued) • Confirm the validation of PIC • Back up server environment • Construct verification environment of finger vein and confirm the validation
4	9/1 AM	[Activity] Select and verify the information of finger vein information. and insured persons [Location] Minebea	<ul style="list-style-type: none"> • Visit local enterprises (Select finger vein information.) *Accompany with staffs of JICA Phnom Penh Office • Execute the demonstration of PIC to the staffs of JICA Phnom Penh Office
5	9/1 PM	[Activity] Implement PIC [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Implement PIC with selected data
6	9/2 AM	[Activity] Implement PIC [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Implement PIC with selected data (continue the operation of previous day)
7	9/2 PM	[Activity] Report the verification results [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Evaluate and report the finger vein verification • Report the result of PIC verification

4.2.3. Details of the implementation

1) Explanation of the implementation and installation of the procured equipment

The IT officers of NSSF and Hitachi agreed with the schedule of the 1st verification, which contained installation/setting of server and PC, and the verification of finger vein information and PIC. To deepen the understanding of concrete system operations, we executed a demonstration and explained PIC technology. There were no serious problem to install the equipment and normal operations were confirmed.



2) Construction of the verification environment

Environment construction and validation for the server and PC were implemented smoothly.



3) Verification of selected information of finger vein and insured persons

Information of insured persons and their finger vein was collected at the local enterprise (Minebea).

In order to soften the anxiety of insured persons and to make the experiment smoothly, we prepared leaflets to explain the finger vein device and the pad to suggest the place to put a hand.

The process to collect the information is showed on Figure 4.2-1.



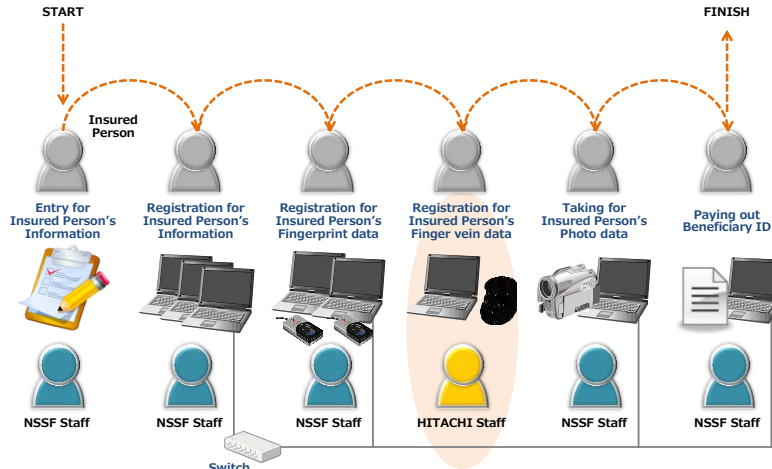


Figure 4.2-1 Process to collect information of insured persons and their finger vein

4) Verification of PIC

Duplication check with PIC was implemented for the insured persons data collected at Minebea. The accuracy and efficiency of PIC was verified by comparing with the duplication check result with fingerprint information.

4.2.4. Result of the implementation

The processing time for duplication check can be shortened dramatically by using PIC.

The collecting process at the local enterprise was also implemented without any problems and the verification result was the assumed one. Table 4.2-2 shows the efficiency analysis result of PIC. Table 4.2-2 shows the efficiency analysis result of selected data. Based on this analysis result, the following performance and accuracy were evaluated, and Pattern 8 was selected as the optimum pattern.

- The performance value is the fastest when converting to 1 million people
- As a result of personal identification by fingerprint collation, there is nothing excluding him / herself.

Table 4.2-2 The efficiency analysis result of selected data

Pattern	ID	First Name	Last Name	Province of birth	Year of birth	sex	Extracted form base for filter				Finger Print Matching				
							Ave Count	Min Count	Max Count	Total Time(s)	Ave Time(ms)	Min Time(ms)	Max Time(ms)	Total Time(s)	Ave Time(ms)
1		•					3,160.92	3	9,504	6.82	61.98	16	34,800	519.68	4724.39
2		•	•				15.16	0	96	5.44	49.44	0	562	4.02	36.57
3		•		•			385.71	1	2,731	5.40	49.12	15	9,579	73.07	664.25
4		•			•		1,509.74	0	6,123	5.63	51.14	32	21,204	259.64	2360.33
5		•				•	2,680.50	3	8,218	5.52	50.18	31	32,237	447.15	4065.01
6		•		•	•		183.56	0	1,786	5.72	51.99	15	6,282	36.12	328.36
7		•		•		•	313.42	1	2,375	5.39	48.99	16	9,172	59.89	544.43
8		•		•	•	•	147.32	0	1,523	6.05	54.95	0	6,250	28.74	261.26

The processing time of duplication check with PIC is 316ms, the sum of Average Process Time of Extracted From Base by Filter and that of Finger-Print Matching.

4.3. The 2nd verification activity

4.3.1. Objectives of the 2nd verification activity

The operations as below were implemented on the 2nd verification.

- Implementation of PIC verification
 - “Collection and verification of finger vein information. at local enterprises” “Verification of PIC”
- Report the verification result

4.3.2. Contents of the implementation

Table 4.3-1 shows the implementation contents of the 2nd verification.

Table 4.3-1 Implementation contents of the 2nd verification

No.	Date	Implementation items and Locations	Overview
1	9/27 AM	[Activity] Explain the contents of the 2 nd verification Pre operation check for the 2 nd verification environment [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Explain the schedule of the 2nd verification and make agreement • Implement operation check of equipment for verification at local enterprises
2	9/27 PM	[Activity] Collect and verify the information of finger vein and insured persons [Location] HO HSIN TAI LIMITED	<ul style="list-style-type: none"> • Collect the finger vein information of insured persons
3	9/28 AM/PM	[Activity] Verification of PIC [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Verify PIC
4	9/29 AM/PM	[Activity] Report the implementation result to NSSF -Report the verification result -Explain operation process of server environment -Explain the curriculum of the visit to Japan [Location] NSSF Headquarters	<ul style="list-style-type: none"> • Report the verification result of the 1st verification • Operate server environment (activate/back up etc.) Explain the processes • Explain the overview of curriculum and schedule of visit to Japan
5	9/29 PM	[Activity] Report the verification to JICA [Location] JICA Phnom Penh Office	<ul style="list-style-type: none"> • Report the result of the 2nd verification

4.3.3. Details of the implementation

1) Verification of information collection of insured persons and their finger vein

We visited the local enterprise (HO HSIN TAI LIMITED) and participated the NSSF officers who collect insured persons information.

We adapt the same method to collect information of insured persons and their finger vein as that for the 1st verification.



2) Report of the implementation result to NSSF

We report the result of the 1st verification to NSSF.

It makes the officers to understand the function and the efficiency of PIC to solve the duplication of insured persons. The comments are as below.

- We could understand how PIC extracted the same person from the concrete data
- We could understand that PIC enabled to shorten the processing time comparing to fingerprint matching without it.



We explained the operation methods to NSSF officers as the use of server environment to implement PIC, for example activation, shutting down and back up.

3) Verification of PIC

Accuracy and efficiency have been verified by comparing the duplication check result with PIC and that without PIC. The duplication checks were implemented with collected data of insured persons at the local enterprise, HO HSIN TAI LIMITED.

4.3.4. Result of the implementation

The processing time for duplication check can be shortened significantly by using PIC. However, there are also the data which cannot be found by PIC (see the details in Chapter 5). The process to collect finger vein was implemented smoothly and the assumed result was obtained.

4.4. Technical improvement of finger vein authentication

We requested Hitachi Laboratory to accelerate finger vein authentication and realized the performance to satisfy the requirements of this project even if all items were verified by finger vein authentication. In addition, in this research we have realized the following two goals with a view to using finger vein authentication for insured persons registration in Cambodia.

- (1) Since officers of the current NSSF brought standalone PCs to the enterprises to perform the registration process, the processing time required to satisfy the requirement also in the hardware performance of the PC has been realized.
- (2) In the future, it is assumed that NSSF headquarters are connected by the network from the entire Cambodia network and duplication check of whole nation scale is carried out, realizing the method securing performance scalability and precision (other person acceptance rate).

4.5. Invitation to Japan

The contents of the activities for the invitation program are as follows.

4.5.1. Objectives of invitation program in Japan

The purpose of the invitation program is to deepen NSSF's understanding of the disseminated technology and motivate them to introduce of this technology and social security ICT platform based on this technology, and to gain its confidence to Japan and Hitachi through each operation.

4.5.2. Invitees

The three invitees from IT division in NSSF are as below

- Mr.Chy Sour : Deputy Director of Information Technology Division
- Mr.Chhim Vicheka : Information Technology Division
- Mr.Thong Sophal : Information Technology Division

4.5.3. Curriculum and schedule

Table 4.5-1 shows the curriculum and schedule of the invitation program.

Table 4.5-1 Curriculum and schedule of the invitation program

Date	Time	Style	Content	Place
10/24	~07:00	Arrival	Arrival at Narita airport	-
	10:00~11:30	Meeting	Orientation	Chiyoda, Tokyo

Date	Time	Style	Content	Place
10/25	09:30~12:00	Meeting	Session by Hitachi	Chiyoda, Tokyo
	15:00~17:30	Inspection	Hitachi Hadano factory tour (Server manufacturing factory)	Hadano, Kanagawa
10/26	09:30~11:30	Session	Session by a visiting lecture	Chiyoda, Tokyo
	13:30~15:00	Inspection	Hitachi Yokohama factory tour (Software manufacturing factory)	Yokohama, Kanagawa
	15:00~16:30	Inspection	Inspection of Hitachi Yokohama laboratory (Introduction of finger vein technology etc.)	Yokohama, Kanagawa
10/27	09:00~17:00	Observation	Visit Hitachi Innovation Forum 2016	Chiyoda, Tokyo
10/28	11:05~19:55	Coming back	Leave at Haneda airport	—

4.5.4. Contents of the implementation

1) Session by Hitachi

We had the session about the efficiency of PIC from the analysis results of insured persons' information. Besides, we proposed the countermeasures, such as operation improvements and system repair, against the present problem of the registration of insured persons.



2) Hitachi Hadano factory tour

We visited Hitachi's manufacturing factory, which produce the disseminated technology, to get NSSF's confidence as a partner. Inspections of manufacturing factory of servers and storage were included in the factory tour.



3) Session by visiting lecture

This session introduced the case studies in Japan such as social security scheme and installation of database, and discussion of future system in Cambodia.

4) Hitachi Yokohama factory tour

We introduced the processes and methods of quality assurance(QA) for software development and environments for the development of large-scale systems.



5) Inspection of Hitachi Yokohama laboratory

We have training program about the overview of biometrics authentication technologies (Types and features of fingerprint, iris etc.), mounting technologies of finger vein authentication and current technology trend etc.



6) Visit Hitachi Innovation Forum 2016

We participated Hitachi Innovation Forum, which Hitachi hold every year to introduce cutting edge technologies of wide range of field such as social, industry, energy etc. to the participants from inside and outside of the country.



4.5.5. Result of the implementation

In the invitation program, the invitees tried to understand Hitachi's technologies with a will. They asked a lot of questions and shared their comments through out the program. This curriculum coincided with demand of invitees and could deepen the understanding of the disseminated technology by preparing the specialist for each content and coordinators who understood Cambodian culture and the situation of NSSF and had knowledge of social security scheme and ICT.

The comments of the invitees are as follows.

“We are interested in the finger vein technology which enable to search one person's data from 1.5 million data sets within 50 seconds. Besides this technology will be very important to register the new NSSF members (newly registered insured persons).”

“I could understand QA know-how managed by the great team which is in charge of all the issues related to the quality optimized to develop application at Hitachi Yokohama factory. There is no team like this in NSSF. It's obvious that we need to have something to manage the quality of IT application before the system running.”

4.6. Report on verification results to NSSF

4.6.1. Objectives of the verification result report to NSSF

The two main contents of the verification result report, which create the will to introduce the social security system, are as follows.

- Result report of the verification in Cambodia
 ”Verification result report of PIC and finger vein system”
 “Proposal for present problems and the countermeasures”
- Hand over the verification environment (Train the operation methods)

4.6.2. Contents of the implementation

Table 4.6-1 shows the implementation contents of verification result report for NSSF.

Table 4.6-1 Implementation contents of verification result report for NSSF

No.	Date	Implementation items and Locations	Overview
1	12/13 AM	[Activity] •Pre-meeting with IT Department •Prepare final report(Presentation environment) [Location] NSSF Headquarters	•Explain the overview of verification result report and make an agreement •set up the demonstration environment for verification environment
2	12/14 AM	[Activity] Verification report for JICA [Location] JICA Phnom Penh Office	•Explain the contents of final report for NSSF and make an agreement
3	12/14 PM	[Activity] Verification result report for NSSF and JICA Phnom Penh Office [Location]NSSF Headquarters	•Explain the contents of verification result report •Q&A session
4	12/14 PM	[Activity] Adjust the method of insured persons’ management system with PIC [Location] NSSF Headquarters	•Confirm the method of systematization of future system according to the verification result (Operation method and required function)
5	12/15 AM	[Activity] Handing over the verification environment (server, PC etc.) Explanation [Location] NSSF Headquarters	•Explain the operation environment for the verification environment •Q&A session

4.6.3. Details of the implementation

(1) Verification result report for NSSF and JICA Phnom Penh Office

We reported the verification result of PIC from the verifications in Cambodia and analysis result in Japan. In terms of efficiency, the processing time to match 1,000 data against 232,266 data will be 0.08 hour with Hitachi’s PIC technology while 245.5 hours with the present system in NSSF. It means that this technology enables to improve the efficiency 99.97% (The details will be explained in Chapter 5).

There are some data set which can not be extracted as duplication data because the input data such as name or the date of birth are totally different, which seems to input the information of another persons. Therefore, improvement of the quality of the management data of insured persons is necessary to solve this problem. Then we propose the countermeasures by extract the duplicate/improper data from the result of the analysis and supposing causes of the errors.



The possibility to utilize PIC for other public operations (future practical uses of private information in Cambodia) was also explained (Figure 4.6-1)

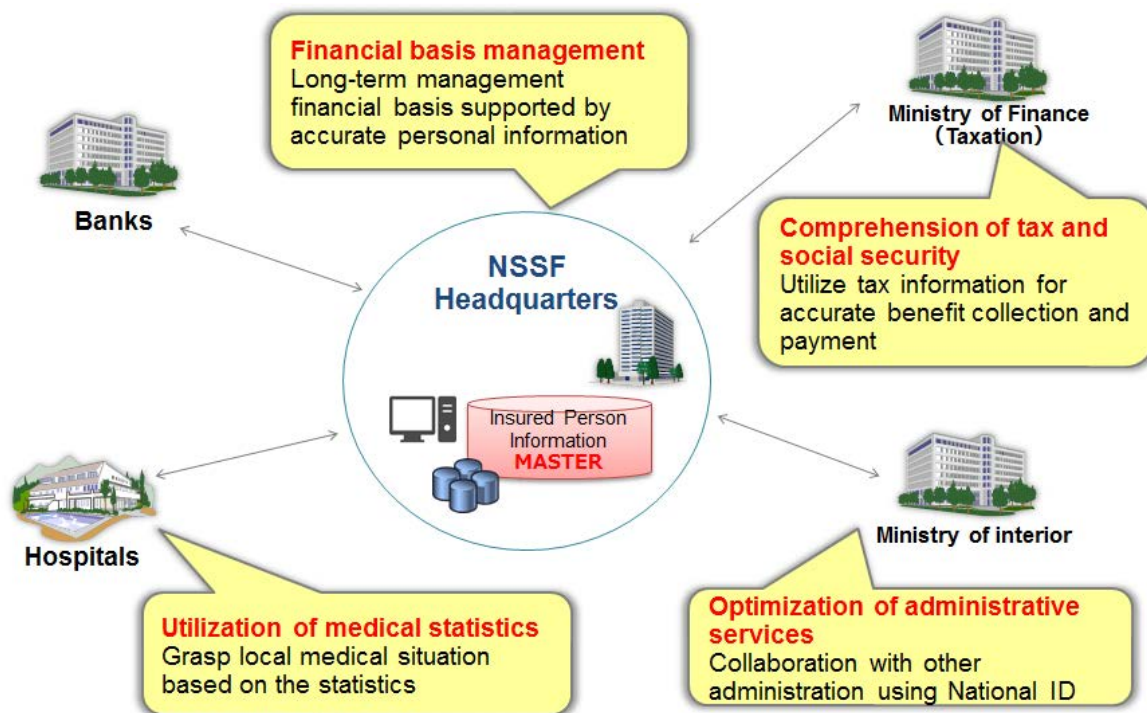


Figure 4.6-1 Utilization of PIC for other public operation

The comments of the invitees are as follows

- We understand that PIC enables much higher speed processing than previous NSSF method and the Hitachi's proposal is effective
- This proposal should be introduced to MOI as well
- Japanese government has support Cambodia since the war ended.
- Not only Japanese government but also Japanese citizens are always supportive. We would like you to continue to support us



Chapter 5 Summary (Evaluation for the implementation result)

5.1. Results of the project (Contribution to the target country, region, and city)

Because of the opinion from NSSF that they would like to verify whether it is possible to speed up duplication check with fingerprint information which already collected besides finger vein authentication, in addition to carrying out the "same person candidate extraction technique", the finger vein authentication verified whether the present insured persons registration operation is delayed by the information acquisition operation, and whether the finger vein information can be acquired accurately without error.

We report the verification result to NSSF as outcome, which the disseminated technology, PIC, satisfied the aimed precision of requirement definition and efficiency (processing time) as expected. In the allocation of new ID that is useful for accurate insured persons data collection and management, NSSF appreciated that they can complete duplication check of insured persons accurately and quickly and realize smooth application operation. Regarding finger vein authentication, Hitachi also verified and proposed using duplicate fingerprint information or finger vein authentication only, and that it can also be used for national ID management, and from the effectiveness in the proposed technology future business development is highly expected.

(1) Verification result for quantification requirements

Table 5.1-1 and 5.1-2 show verification results of accuracy and efficiency of PIC in actual operation environment.

Especially the efficiency was much faster than the requirement as indicated in Figure 5.1-1. Duplication check with fingerprint was not implemented because it takes much more time when fingerprint used in present operation.

Table 5.1-1 Outcome (Accuracy and efficiency speed)

Verification in Cambodia	Implementation / Collection of data	Processing time for all registration and per 1 registration		Accuracy of identification
		PIC & Fingerprint	Fingerprint	
The 1st verification (Minebea Cambodia, Co.Ltd)	[New registration data] 545 persons [Cumulative insured persons data] 232,266 persons	<ALL> 2.9 m <Per 1> 0.3 s	<ALL> 133.8 h <Per 1> 883.7 s	545 persons/ 545 persons (100%)
The 2nd verification (HO HSIN TAI LIMITED)	[New registration data] 421 persons [Cumulative insured persons data] 232,266 persons	<ALL> 2.0 m <Per 1> 0.3 s	<ALL> 103.3 h <Per 1> 883.7 s	416 persons/ 421 persons (98.8%)

Table 5.1-2 Desired values and achievements

Outcome	Desired value	Achievement
Accuracy	Extract the same person 100% by matching existed insured persons information.	100% *Except the cases that totally different attribute information are input
Efficiency	The matching process will be implemented within 5 seconds against 1,000,000 data set of existed insured persons information	1.3 seconds *Calculate the processing time for 1,000,000 data set using the average number of the results of the 1 st and the 2 nd verification

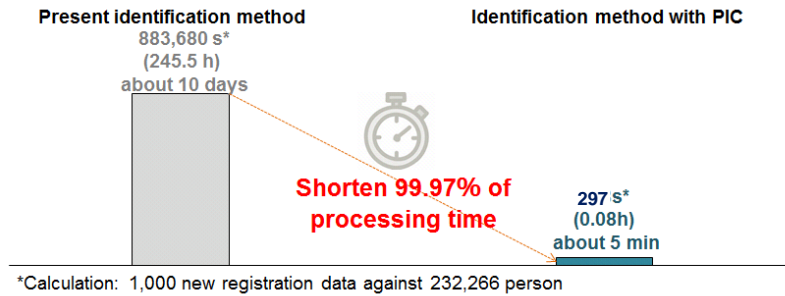


Figure 5.1-1 Efficiency improvement by PIC

In terms of accuracy, however, only 5 persons were extracted in the 2nd verification, because information of different person was input by operation mistakes. The 5 extracted data themselves can not be treated by PIC technology, but the accuracy will be improves by improving the operations and systems to register insured persons. We also proposed improvement plans shown as follows.

(2) Proposal to improve system and system operation based on existing fingerprint authentication

The operations shown on Table 5.1-3 are implemented for one insured persons at the registration work places.

Table 5.1-3 Overview of operation to register insured persons

Process	Operation	Detail	Special note
1	Check the application	<ul style="list-style-type: none"> •Check the application •Hearing with the insured person if there are some obscure points and blanks 	Operations on desk
2	Input the application information	<ul style="list-style-type: none"> •Input the application contents using PC •The register system notifies application ID after registration •Complete the application form to input a handwritten ID •Hand the for to the insured 	Application ID is 10 digit
3	Register fingerprint	<ul style="list-style-type: none"> •Input application ID written on the application form and search the target information •Register the fingerprint data in the searched information of insured person. •Put the fingerprint on the form and hand it to the applicant 	Collect fingerprint of both hands
4	Shoot and register face image	<ul style="list-style-type: none"> •Input the application ID written on the application form and search the target information •Register the phot in the searched information of insured person. ••Collect the form 	Photo of upper half of the body

The application IDs are input by the officer after the operation named “Process 3. Fingerprint registration” on Table 5.1-3, but sometimes improper information are input because of mistypes.

Moreover, we propose the countermeasures to improve the data quality by analyzing 93,767 data of insured person collected at kick off visiting in April to investigate the causes of low quality of the attribute information.

The analysis results and the proposed measures are shown on Table 5.1-4 and Figure 5.1-2 respectively.

Table 5.1-4 Results of the reinvestigation if insured persons information

No.	Patterns of improper data	Detail	Assumed causes
1	Inaccurate basic information	Different character string of the name :27 Different date of birth :85 Different birth place :5 Different ID card number : 106	<ul style="list-style-type: none"> • Error in application forms • Input errors
2	Registration of photo and information of another person	Biological information (fingerprint) is matched but the registered face phot or personal information seems different :479	<ul style="list-style-type: none"> • Input fingerprint information or face photo into another persons data • Different basic information from that registered before is applied
3	Duplicated registration	Same biometric into (fingerprint) is registered within the same enterprise or in another one :550	<ul style="list-style-type: none"> • Duplication check in not implemented because it takes long time for fingerprint matching.

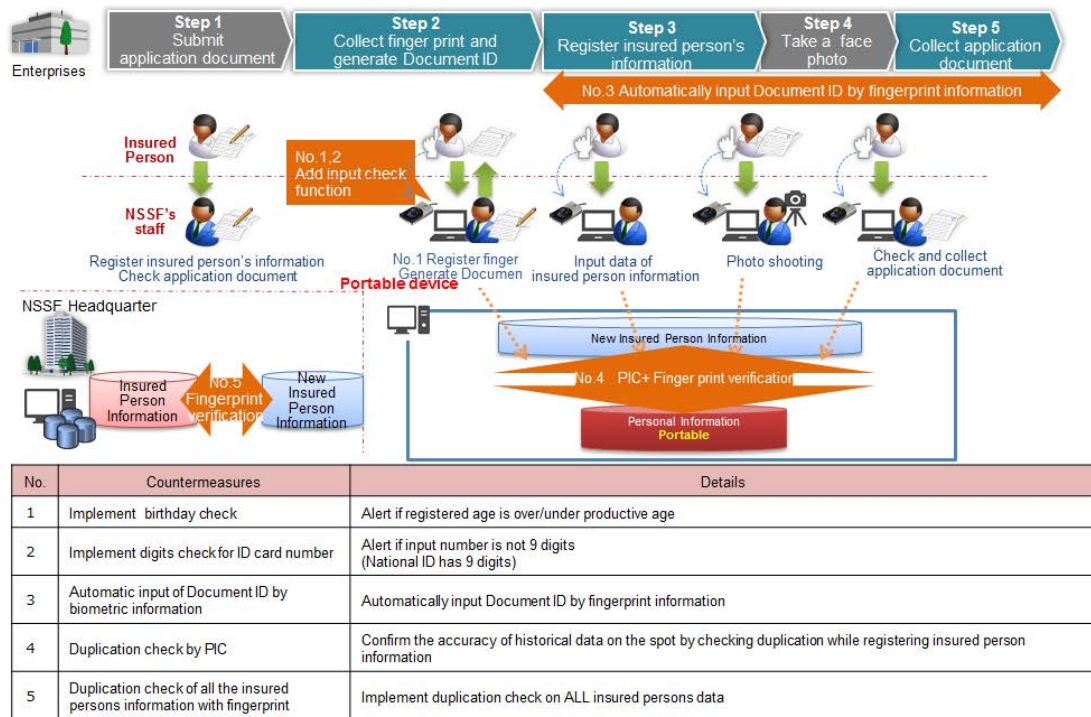


Figure 5.1-2 Proposed countermeasure for system improvement to register insured persons

(3) Improvement suggestion with finger vein authentication

This verification shows that PIC and additional operation improvement enable duplication check to realize efficient operations by inputting accurate attribute information and securing the consistency of data. In addition, NSSF recognized the duplication check with only biological information without manual input is more suitable for long-term operation because it is difficult to completely remove the operation mistakes through this project.

In addition, we requested Hitachi’s laboratory to make finger vein authentication high in processing speed, which achieved satisfied speed of matching process with finger vein authentication. Therefore there are two goals in anticipation of the introduction of finger vein authentication for the registration of insured persons in Cambodia.

The present insured person registration of NSSF is implemented with a stand-alone PC brought by NSSF officers at a local enterprise. Therefore, processing time has been shortened to satisfy the requirement with the performance of the PC’s hardware. In addition, the method to satisfy enough extensibility of the performance and the accuracy was established in anticipation of the expansion of the network connecting NSSF’s headquarters and all the branches to implement duplication check in all over the country in the future.

The research result was reported to NSSF by the laboratory in the invitation program. We also proposed the system improvement by introducing finger vein and got a positive evaluation. The invited officers commented that we would like to introduce the system (Figure 5.1-3 shows the contents).

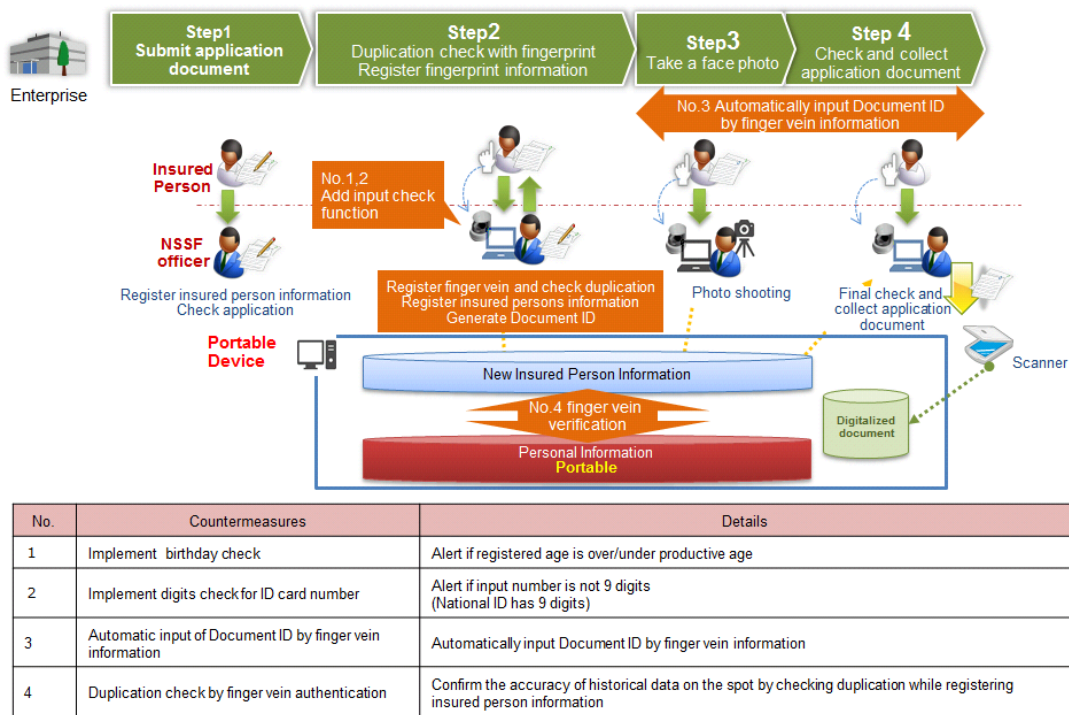


Figure 5.1-3 Image of system improvement with finger vein

5.2. Results (Business side) of the project, remaining problem and its solution policy

Table 5.2-1 Overview of the implementation and achievement

No.	Task	Schedule and result					Achievement and evaluation	Remaining task and solution
	What to do for business development in this project	1 st (Local)	2 nd (Local)	3 rd (Local)	4 th (Japan)	5 th (Local)		
1	Make an agreement for project plan and investigate present issues and insured persons information	■■■■■ ■■■■■					Done Made the agreement to implement the project with NSSF, JICA and Hitachi Investigated about 230 thousands information of insured persons	N/A
2	Verify the localize method of the technology	■■■■■ ■■■■■	■■■■■ ■■■■■				Remained Analyzed insured persons' data and investigated the input method of Khmer letter. Localized PIC function for Cambodia Systematized the localize process	[Task] Investigation of this technology in other countries [Solution] Investigate the utility of the technology in other countries
3	Verify the adaptability of operations		■■■■■ ■■■■■				Done Register the finger vein information on the process to apply the insured person Confirmed that the processing time and error would not cause the operation processes.	N/A
4	Verify/evaluate the accuracy and efficiency of the technology		■■■■■ ■■■■■				Done Verify the utility of duplication check by combining PIC and fingerprint authentication implemented by NSSF now Confirm the improvement of the accuracy by introducing finger vein authentication	N/A
5	Conduct the training of the technology and Hitachi's products				■■■■■ ■■■■■		Done • Made the participants deepen the understanding of the PIC and Social Security ICT System Increased NSSF's desire to introduce them • Made the participants deepen the understanding of Japan and Hitachi.	N/A
6	Report the verification result and propose the countermeasure for the issues				■■■■■ ■■■■■		Done Improved the quality of insured persons Proposed the countermeasure to improve the accuracy of PIC	N/A
7	Conduct the training of verification environment				■■■■■ ■■■■■		Remained Made the operation manual to implement PIC with the server introduced in this project However, the system improvement is necessary to implement this function efficiently	[Task] Fundraising for the system improvement to utilize the technology [Solution] Support NSSF in terms of fundraising techniques.
8	Consider a local partner and decide a commercial distribution		■■■■■ ■■■■■				Done Established the commercial distribution with local partner through procuring materials and system environment construction for this project Grasp the technical level of local partner	N/A

5.2.1. Results of the project (Business side)

(1) Motivate the counterpart to introduce the technology and Social Security ICT System platform

The verification result shows NSSF the effect to introduce the technology which enables consisted management of insured persons. Besides, because of Hitachi's experiences of ICT system related to social security such as pension in Japan and high quality, it has told NSSF that this technology and social security ICT platform realized these topics as bellows.

- Unique management of insured persons to be the foundation of accurate and stable social security scheme management
- Realization of long-term insurance which requires insured persons information management over 50 years
- Expansion of social security scheme, and flexible response to expansion of target persons

There seems the motivation to introduce the technology we proposed and Social Security ICT System because NSSF told us to plan to request the support from a donor. NSSF also advised us to propose the disseminated technology to Ministry of Interior.

(2) Localization of PIC function

We established the localization method for PIC in order to make this project the model case of technology disseminating.

- i) Organize the qualified data items and analyze the patterns of duplicated input by analyzing database
- ii) Analyze the case when improper information is input by searching the data input methods, and letters of target countries and character cords.
- iii) Set up the hypothesis of the patterns to input improper into according to the analysis results of i) and ii) and localize the PIC functions based on the hypothesis
- iv) Verify the PIC functions localized on iii) and improve the accuracy and efficiency by repeating tuning

(3) Technical improvement of finger vein authentication

Hitachi Laboratories improved collation method of finger vein authentication and also improved verification performance and expandability. As a result, it became possible to realize personal identification on a national scale only with finger vein information.

5.2.2. Issues and solution policy

We provide technical support for NSSF to receive financial support from a donor and to coordinate within the government.

- Verify whether the localization method established in this project is adapted in other countries
- Verify the validity of the high speed finger vein authentication in the practical uses
- Secure the required fund to introduce PIC and Social Security ICT System

Chapter 6 Business development plan of this project

6.1. Business objectives and goals

6.1.1. Expected results through business (Contribution to target socio-economic development in the target country, region, and city)

(1) Business objectives

Introduction of disseminated technology realizes accurate and unique information management of insured. Furthermore, we aim to contribute to the realization of a society where people can work safely, with fairly and equitably operated Social Security Scheme, by means of Social Security ICT system centered on database constituting this technology.

(2) Business goals

We aim to introduction of Social Security ICT Platform and PIC function to Cambodia and ASEAN countries such as Myanmar, Laos, etc., and proposal of National management to Government of Cambodia.

6.1.2. Outcome

The expected amount of sale will be 15 million in 2018, 500 million in 2019 and 500 million in 2020 by introducing PIC and Social Security ICT System.

6.2. Business development plan

6.2.1. Business overview

Propose processes of introduction of PIC and Social Security ICT System, and civil identification are as follows.

(1) Introduction process PIC and Social Security ICT System

i) Research and selection of target countries

Search the management method of insured persons and problems related to social security in order to select a target country/ public organization for business development.

ii) Verify the disseminated technology and promote the understanding of the technology

The field verification to confirm the validity of high speeded finger vein authentication and to judge whether the localization of PIC function is possible was implemented in order to make the counterpart understand the validity of disseminated technology and Social Security ICT System which Hitachi propose.

iii) Make an agreement on the schedule of ICT introduction

We propose the gradual introduction of ICT system according to the budget as needed, which is shown on Figure 6.2-1.

In order to realize the accurate management of insured persons, the introduction of PIC is proposed to the countries which do not have accurate management system of insured persons. (①).

Social security ICT platform based on the DB consist of this technology is introduced to the countries which do not have know-how to manage long term insurance information such as pension (②). Social security ICT platform can be introduced step by step according to the expansion of the coverage of the social security scheme. Therefore, a part of the platform is introduced first and will expand the function with complicating the scheme year after year by the economic development and demographic changes (③).

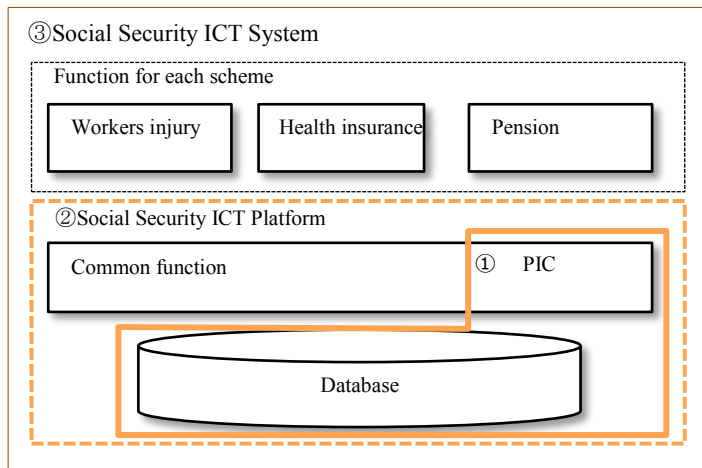


Figure 6.2-1 Image of Social Security ICT System

iv) Consideration of ministries collaboration

It is considered whether the system coordination with other ministries is possible or not in order to improve the data accuracy, operation efficiency and administration services with data linkage between ministries.

v) Migration method to the new system and operation and operation maintenance method after system operation

In order to study more optimal system introduction and maintenance method, we discuss with the concerned Government agencies on the following points and make proposals for Government agencies to take the initiative and promote.

(a) Consideration of efficient and precise ICT system migration method

To divert current ICT system assets and to efficiently operate the ICT system, we will concentrate ICT systems and promote infrastructure. Furthermore, the PIC is used in order to link the same person's information from the data distributed for each system and integrate with the same ID.

(b) Preparation to use the system to its fullest

To effectively utilize PIC functions and Social Security ICT Platform, it is necessary to promote insured persons to join. To that end, we will consider and support the optimal placement of the system with concerned Government agencies, to promote the public's understanding of social security, the establishment of the system operation system of the government side, and the promotion of insured registration.

- Acquisition of public understanding: Appeal benefits of Social Security services to gain public understanding and raise people's willingness to join.

- Establishment of the system operation structure of the Government side: For example, in Cambodia, to secure the system operation structure of the government side, collaboration management system between local governments and central government will be established. Local governments such as communes which are the implementation organizations, and agricultural cooperative, because 80% of the citizens are farmers there, can be utilized as private enterprises for the registration and contribution of the insurance
- Optimal arrangement of systems promoting insured person registration: Install finger vein devices at various places such as, offices of Government organizations that issue passports and licenses, related to National information management and insured management, and private organizations such as hospitals to prepare cards for medical treatments and widely register attribute information and finger vein information of insured. At the same time, we propose a finger vein authentication system for attendance management etc. to enterprises in target countries, and promote utilization of finger vein information collected by companies in social security field

(c) Securing operation maintenance system

Collaborate with users and local business partners to introduce the ICT system, thereby developing human resources necessary for maintaining and managing the system.

vi) Technology support to NSSF

To deepen the understanding of related ministries and agencies for introducing personal identification function and social security ICT infrastructure, Hitachi supports the introduction effect and explanation of technical contents. In order to secure funds by requesting assistance to donors, Hitachi also support by presenting reference estimates etc. to calculate required costs.

(2) Proposal procedure for National information management ICT system (Cambodia)

Cambodia has formulated the National Strategic Plan for Identification in the Kingdom of Cambodia (NSPI), and is promoting uniquely identifying citizens, including the construction of ICT systems, and improving the accuracy of statistical information.

Records of birth, marriage, death, etc., which are the basis of public management, are registered in Family Book. Also, Family Book is used for self-certification in the issuance of National ID and Passport. In order to promote NSPI from the viewpoint of ICT, we propose ICT system centering on Family Book shown in Figure 6.2-2. In this proposal, we will propose the PIC function to match PIC function to data among different ICT systems in order to secure uniqueness.

National information management through PIC functions will help improve efficiency, accuracy and service to citizens in various fields of Government administration services including Social Security as shown in Figure 6.2-3.

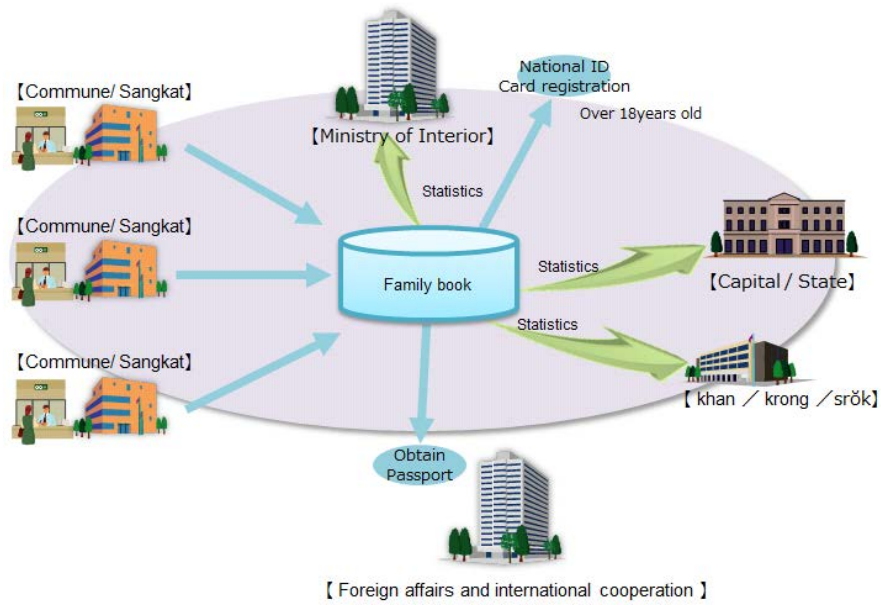


Figure 6.2-2 Image of National information management ICT system centered on Family Book

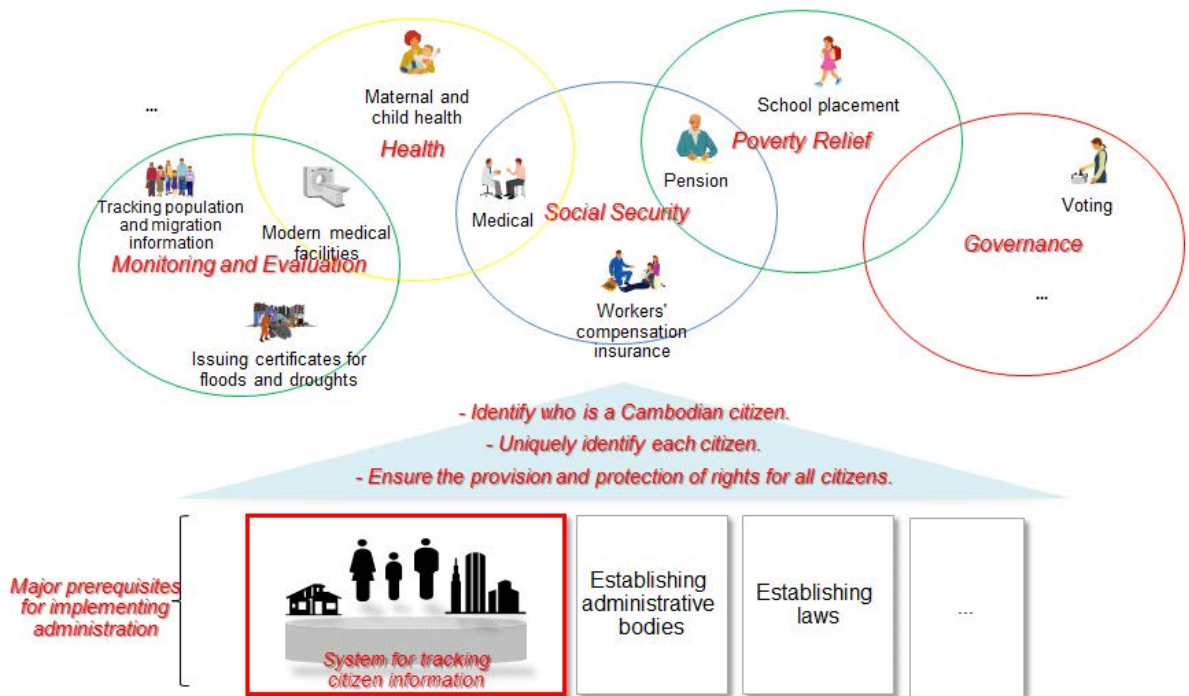


Figure 6.2-3 Effects of National information management on the overall administration

Figure 6.2-4 shows the image of developing business to ASEAN countries by taking the above steps (1) and (2).

- Phase1: It will be a model case to demonstrate specific functions in Cambodia and lead to continuous technology dissemination.
- Phase2: We will introduce the technology demonstrated in Phase 1 to the Government of Cambodia.
- Phase3: Propose ICT system that supports social security system with database built at Phase 2 as the core and receive order (Including orders for donor support). Continuously, we aim for proposal and ordering in countries with features similar to Cambodia such as Myanmar and Laos.
- Phase4: We will expand this technology to other important administrative systems such as civil identification, etc.

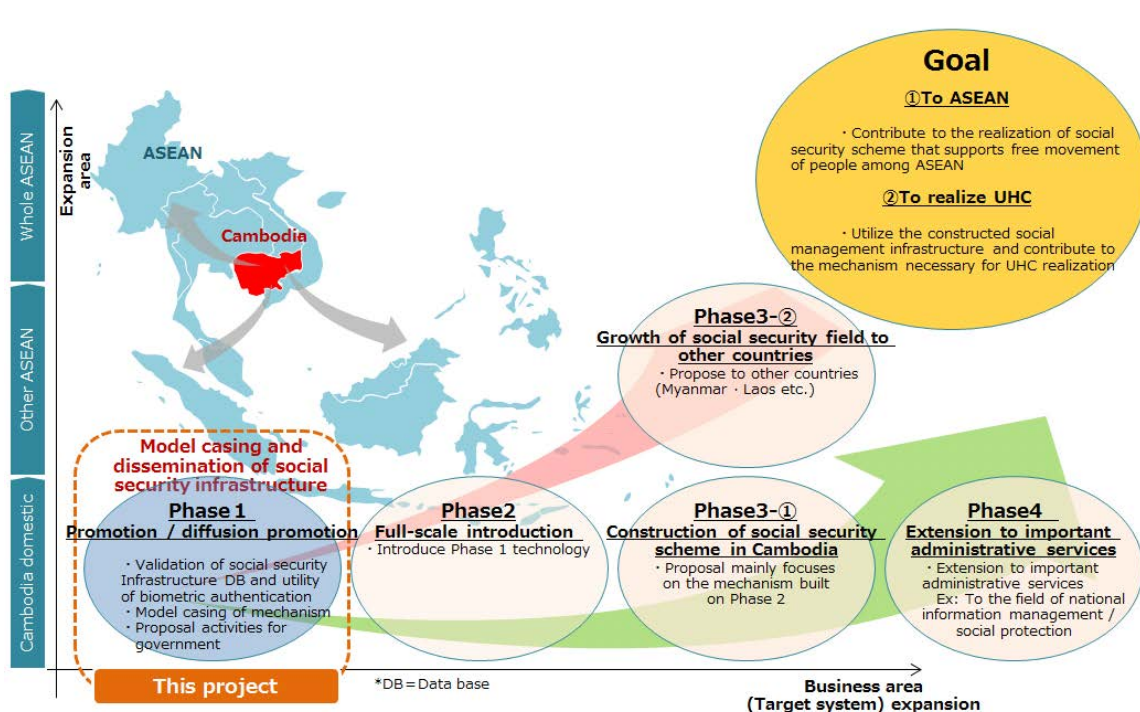


Figure 6.2-4 Image of system introduction phase in ASEAN

6.2.2. Business target

The population of the first target country, Cambodia is 16 million and the insured persons are about 1 million. The more the economics will develop, the more enterprises will be covered by social insurance. The market will expand.

The target countries after Phase 3 are divided into 3 groups in terms of the difficulty of personal identification. We focus on division A and B to investigate for next business development.

Table 6.2-1 Target countries after Phase3

High ↑ Difficulty of personal identification ↓ Low	Division	Country	Feature (Hypothesis)	Population
	Division A	Cambodia	Civil identification system has not been organized	15 million
Myanmar		62 million		
Lao PDR		6 million		
				83 million
Division B	Indonesia	Civil identification system has been organized but there is duplication and the system can be improved	249 million	
	Philippine		99 million	
	Vietnam		90 million	
				438 million
Division C	Thailand	Civil identification system has been organized	68 million	
	Malaysia		30 million	
	Singapore		5.4 million	
	Brunei		0.4 million	
				104 million
Total in ASEAN countries				625 million

6.2.3. Business implementation structure

One of our company policies is to provide service to a local government directly as shown on Figure 6.2-5. However, we plan to collaborate with a local enterprise if there is no associated enterprise.

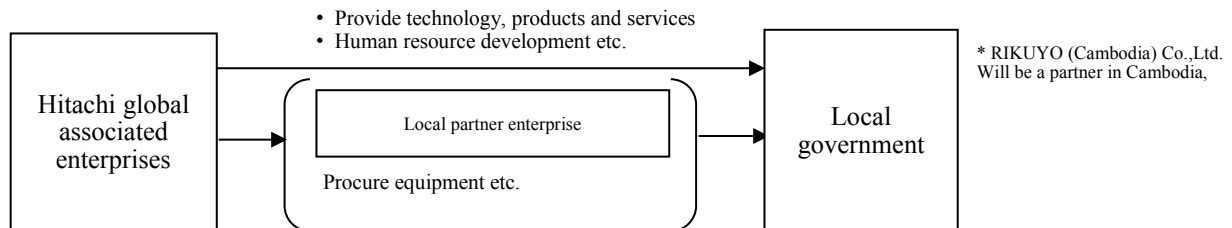


Figure 6.2-5 Business development system

6.2.4. Business deployment schedule

The schedule of business development indicated in 6.2.1 is shown on Table 6.2-2.

Table 6.2-2 Schedule for business development

(Dec. 2016)

No.	Country	Case	Task	Schedule				Situation
			Implementation items for business development	FY 2016	FY 2017	FY 2018	FY 2019	
1	Cambodia	PIC/Social security ICT platform	Search and select a target country/governmental organization					Done for this project
2			Verify the disseminated technology and promote the understanding of the validity	■■■■■■■ ■■■■■■■				Implement verification at local Make agreement on the validity Investigate finger vein
3			Make an agreement on the schedule of ICT introduction	■■■■■■■				Organize it with a financial plan
4			Make an agreement on the method to introduce new system to maintain the operation after the system running	■■■■■■■				Implement with ICT introduction plan
5			Technical support for NSSF	■■■■■■■				Started technical support for the proposal for P3H Proposal for MEF will be planed.
6			System introduction (PIC)			■■■■■■■		—
7			System introduction (Social security ICT platform)				■■■■■■■	—
8			Civil identification	Search and select a target country/governmental organization	■■■■■■■			
9	Myanmar/Lao PDR	PIC/Social Security ICT platform	Search and select a target country/governmental organization	■■■■■■■ ■■■■■■■				Discover that duplication is the problem in both Myanmar and Lao PDR
10			Verify the disseminated technology and promote the understanding of the validity		■■■■■■■	■■■■■■■		—
11			Make an agreement on the schedule of ICT introduction etc.				■■■■■■■	—

6.2.5. Plan of investment and funding

Table 6.2-3 shows the investment amount and assumed sales amount after 2016

Table 6.2-3 The investment amount and assumed sales amount after 2016

Phase	Items	1	2	3	4
FY		2016	2017	2018	2019
Investment amount (million yen)	Sales activity gee	24	24	24	24
	Research expense	12	0	0	0
Sales amount (million yen)	PIC function	0	0	15	0
	Social security ICT platform	0	0	0	500

6.2.6. Status of competition

Biometrics authentication systems such as fingerprints, faces, irises, etc. are studied and developed by companies in various countries. Since the finger vein authentication system uses the internal phleboplasty, it is extremely difficult to forge by the third person's thief and only the living person with blood flow can authenticate, so security is strong. Furthermore, since our proprietary technology is put into practical use in our finger vein authentication system, it is different from other companies by high security and proprietary technology.

The PIC function based on the name identification technology recognizes that there is no competition with other companies.

(1) Cancelable biometrics

Since biological information is sensitive information of an individual which can not be changed like password, strict security control is necessary. Cancelable technology encrypts biological information and verifies it. If the information leaked from the server or the communication path occurs, by re-converting the parameter registration to update the (encryption key) information (converted biological information), it is possible to disable the registration information leaked.

(2) PBI (Public Biometric Infrastructure)

Without IC card and password from information device connected to the Internet, it can use electronic certification, electronic signature, encryption function of PKI (Public Key Infrastructure) .

6.2.7. Business development issues and solution policy

In biometrics authentication technology, fingerprint authentication has already been introduced in many countries. In order to newly introduce finger vein authentication, it will be difficult to stop the use of fingerprint authentication and discard the collected information to this point. Technique features and application scenes are different between fingerprint authentication and finger vein authentication. For example, it can be utilized for criminal investigations because fingerprint can be taken from what a person touches or pictures. On the other hand, finger vein can not be detected easily because the finger vein information exists inside of your bodies. Therefore, it can be utilized for asset management such as ATM.

The proposal policy is to utilize both of the authentications by separating the roles according to their features.

6.2.8. Risks assumed in business development and its countermeasures

Expected risks and the countermeasure are shown on Table 6.2-4.

Table 6.2-4 Assumed risks and the countermeasures

No.	Risk	Measure	Overview
1	Risk from exchange fluctuation	Cushion	Add up the risk of exchange fluctuation as cost
2	Risk of procurement and staffing	Avoidance	Procure the equipment or software which are available in each country
3	Risk of unstable political situation	Acceptation	Select the target country by investigating the political situations. Watch the situation until it will be safe enough if the risk has become apparent

6.3. Collaboration possibilities with ODA project

6.3.1. Necessity of collaborative project

The social security system centered on the databases that constitute the disseminated technology will be the ODA project to be cooperated and will be explained below by taking Cambodia as an example.

(1) JICA's approach to the health care sector in Cambodia

To support the achievement of the development goals based on the "Quadrilateral strategy" of Cambodia, "Promotion of social development" in JICA raises health and medical care. Again, we also recognize that assistance centered on the maternal and child health care field, which is the priority issue of the SDGs, will be implemented, including the viewpoint of enhancing the health care system.

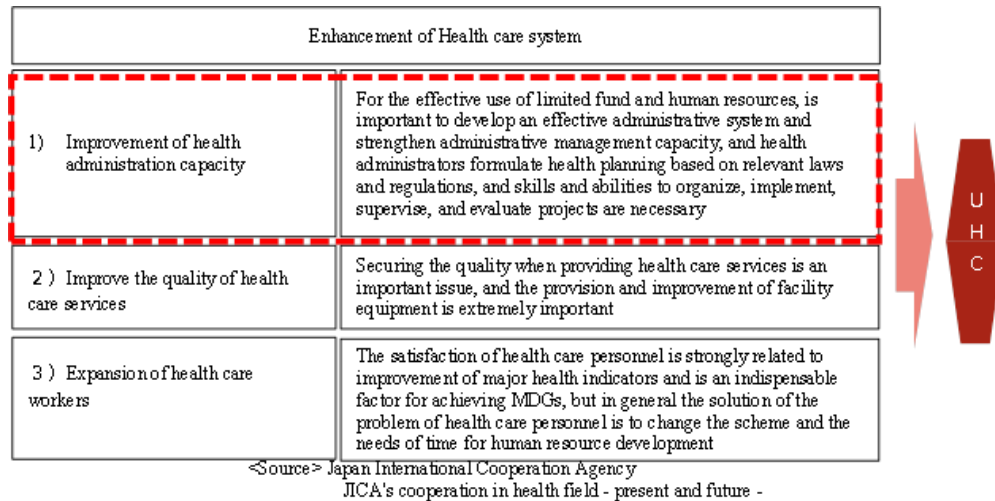


Figure 6.3-1 Measures to enhance the insurance system in Cambodia

Regarding "1) Improvement of health administrative capacity" in strengthening the health system shown in Figure 6.3-1 and it is considered that utility of the ICT system is effective as shown in Figure 6.3-2.

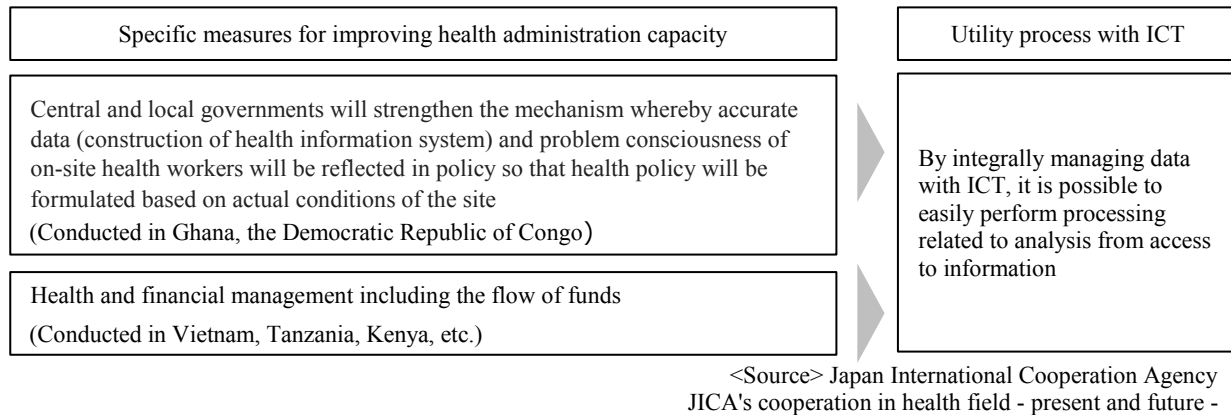


Figure 6.3-2 Measures for improving insurance administrative capacity and utility of ICT

(2) Issues on Improvement of Social Security System in Cambodia

For the improvement of the Social Security system in Cambodia listed in the "Quadrilateral strategy" of Cambodia, it is necessary to solve the issues of Table 6.3-1. These issues can be solved by the disseminated technology by this project and the Social Security ICT System shown in Figure 6.2-1.

Table 6.3-1 Issues in expanding the social security system in Cambodia

No.	Classification	Issues	Solution	
			This project	ODA collaboration
1	Personal identification and management of insured	Personal identification has not been done accurately and duplicate registration has occurred.	○	-
2		We are conducting insured registration again to maintain insured information, but it takes time to perform the registration process, and it has become gradual maintenance (It is not a fair service because services cannot be provided to unregistered employees).	○	-
3		Lack of know-hows on mechanisms of long-term management and operation of insured information.	○	-
4	Construction of the rules and infrastructure to operate the Social Security system and UHC, including the Health insurance system	Lack experience and technology in developing and maintenance management of ICT for long-term operations (including cash management).	-	○
5		Since the ICT system is built for each system, it is necessary to construct individual systems every time the system is added, the expandability is low, and the utility of comprehensive information is restricted.	-	○
6	Secure transparency of social security system management	Transparency is low for implementing appropriate contribution collection and benefit processes.	-	○

6.3.2. Supposed business scheme

A grant aid or an ODA loan is assumed.

6.3.3. Solid contents of collaborative project

Assume that the Social Security ICT System shown in Figure 6.2-1 above is to be constructed as an ODA project targeted for cooperation.

Attachment

- ✧ Attached. Session materials

References

- ◇ Future prospects for security related markets Fujitsu Economy
- ◇ JETRO Cambodia Labor Manual
- ◇ JICA Cooperation in insurance sector - present and future -

Attached. Session materials

- **Project Plan**
- **Final Report**

- **Project Plan**

Project Plan for JICA Collaboration Program with the Private Sector for Disseminating Japanese Technologies

PROGRAM FOR INDIVIDUAL IDENTIFICATION TECHNOLOGY WITH BIOMETRICS
OF SOCIAL SECURITY IN CAMBODIA

21 April, 2016

Hitachi, Ltd.

© Hitachi, Ltd. 2016. All rights reserved.

Table of contents

1. Background and Purpose
2. Technology and Verification
3. Operation in Cambodia
4. Schedule

1. Background and Purpose

1. Background

NSSF has been preparing identification and management system for insured persons in order to begin new social security scheme. Currently fingerprint authentication is used for the identification of insured persons. However, because of increase of insured persons In near future, biometric matching needs more time for identification, so that the operation will not go smoothly. Further solutions to reduce these time will be necessary.

In order to promote the enforcement of social security scheme in Cambodia without problem, we would like to verify Hitachi's technical usefulness as JICA's program.

2. Purpose

Through operation in Cambodia and visiting Japan, we would like NSSF officers to understand our technology, "Personal Identify Check Technology " as this solution. In addition, we would like to understand wider applicability of "Biometric Authentication (Finger vein)".

(1) Operation in Cambodia

Verifying "Personal Identify Check Technology "and "Biometric Authentication (Finger vein)" at actual operation in NSSF.

(2) Visit to Japan

Further understanding of the technology is expected on visiting to Japan by NSSF officer. Also session for future model of social security scheme in Cambodia will be presented.

2. Technology and Verification

2.1. Personal Identify Check Technology

■ Characteristics of this technology

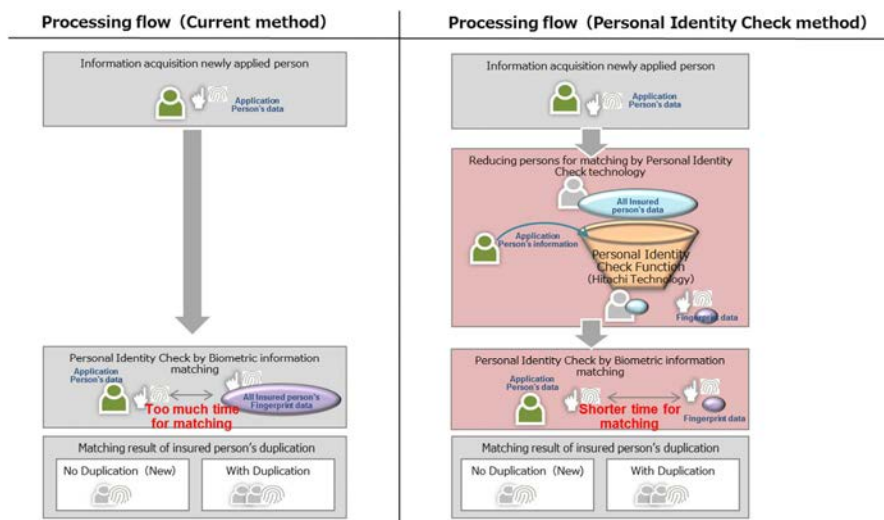
Extracting number of target to biometric authentication by using attribute of insured persons, it makes possible the registration time independent of the number of insured persons.

■ Verification details

(1) Advance operation: It is operated to localize Personal Identity Check function with analysis of existing data and considering the rule of reducing persons for matching by related information.

(2) Verification details:

- Measuring processing time of reducing persons for matching and biometric matching by Personal Identity Check
- Quality confirmation of duplicated persons check by reducing person for matching



2. Technology and Verification

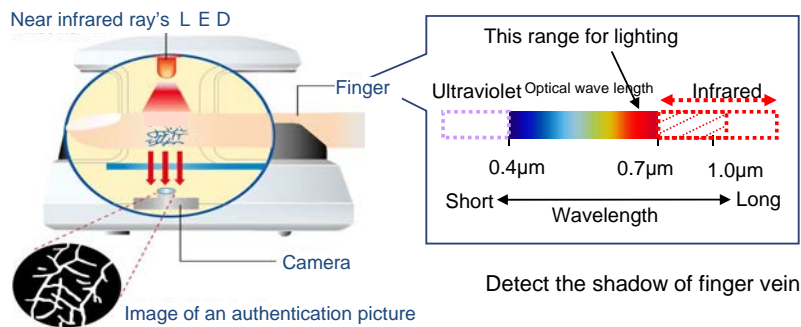
2.2. Biometric Authentication (Finger vein)

- Characteristics of this technology
Finger vein pattern is unique and remains unchanged once a person reaches adulthood.
It is possible with using finger vein information to use biometric information is difficult to be copied and not so affected by finger prints worn away.

- Verification details

- (1) Advance operation: Considering the way of acquiring finger vein information based on work flow for registration of insured person in company which is promoted by NSSF.
- (2) Verification details : Registration and authentication of finger vein information in line with work flow for registration of insured person.

Authentication technology developed by Hitachi which can identify person by finger vein pattern's pictures with illuminating fingers by near infra red (Light using for infrared camera and remote, and harmless to human).



3. Operation in Cambodia

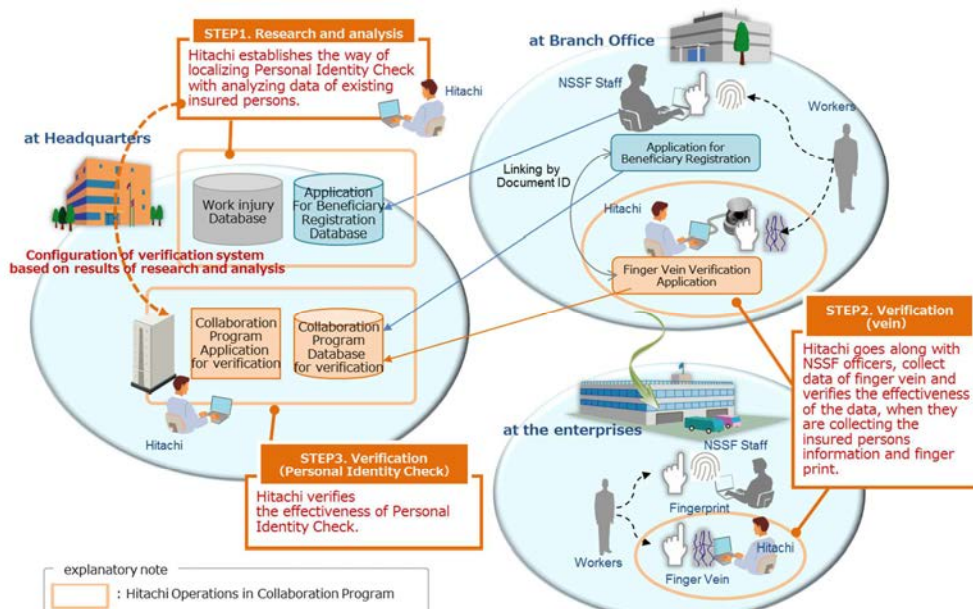
3.1. Verification

Overviews

The followings are verified in Cambodia.

- [STEP 1] Data analysis for Cambodian localizations of the personal identification check.
- [STEP 2] Acquisition of new insured persons information and verification of biometric authentication. (finger vein)
- [STEP 3] Verification of the personal identification check.

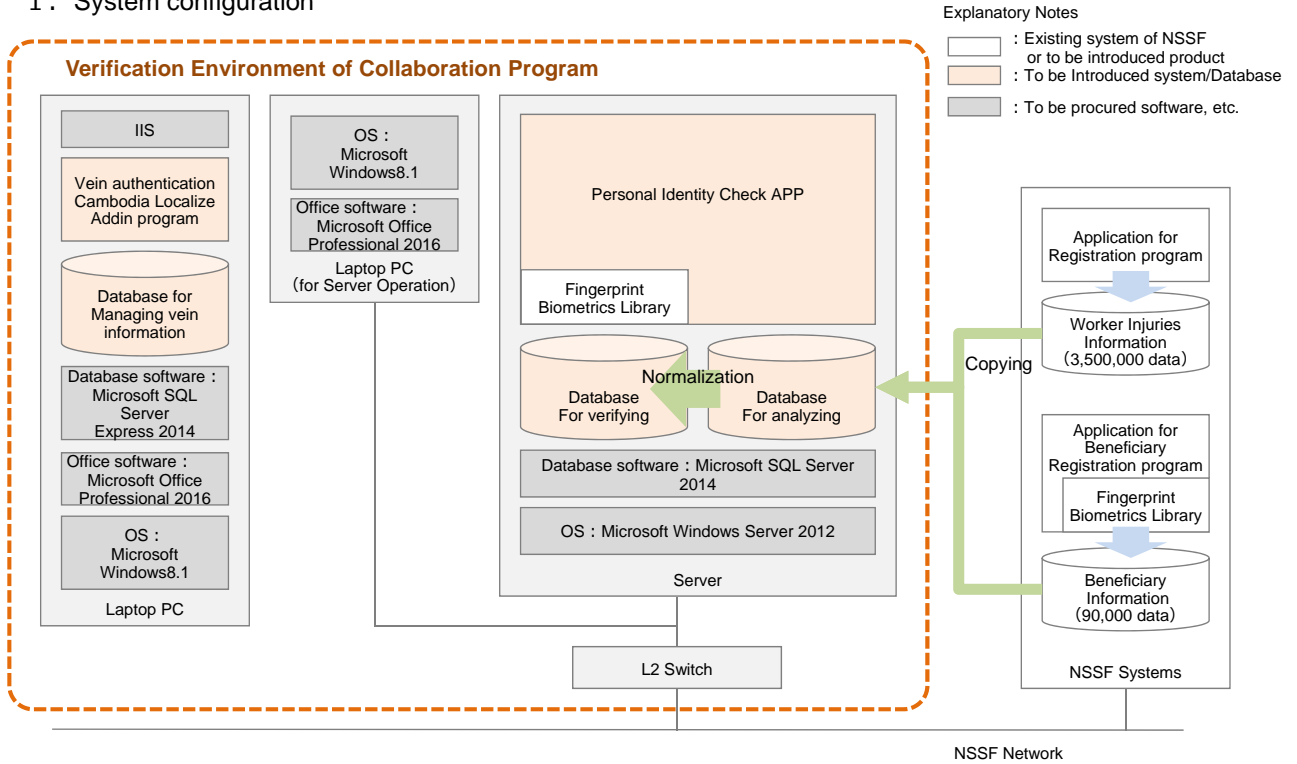
Acquired data in [STEP 2] are used in [STEP 3].



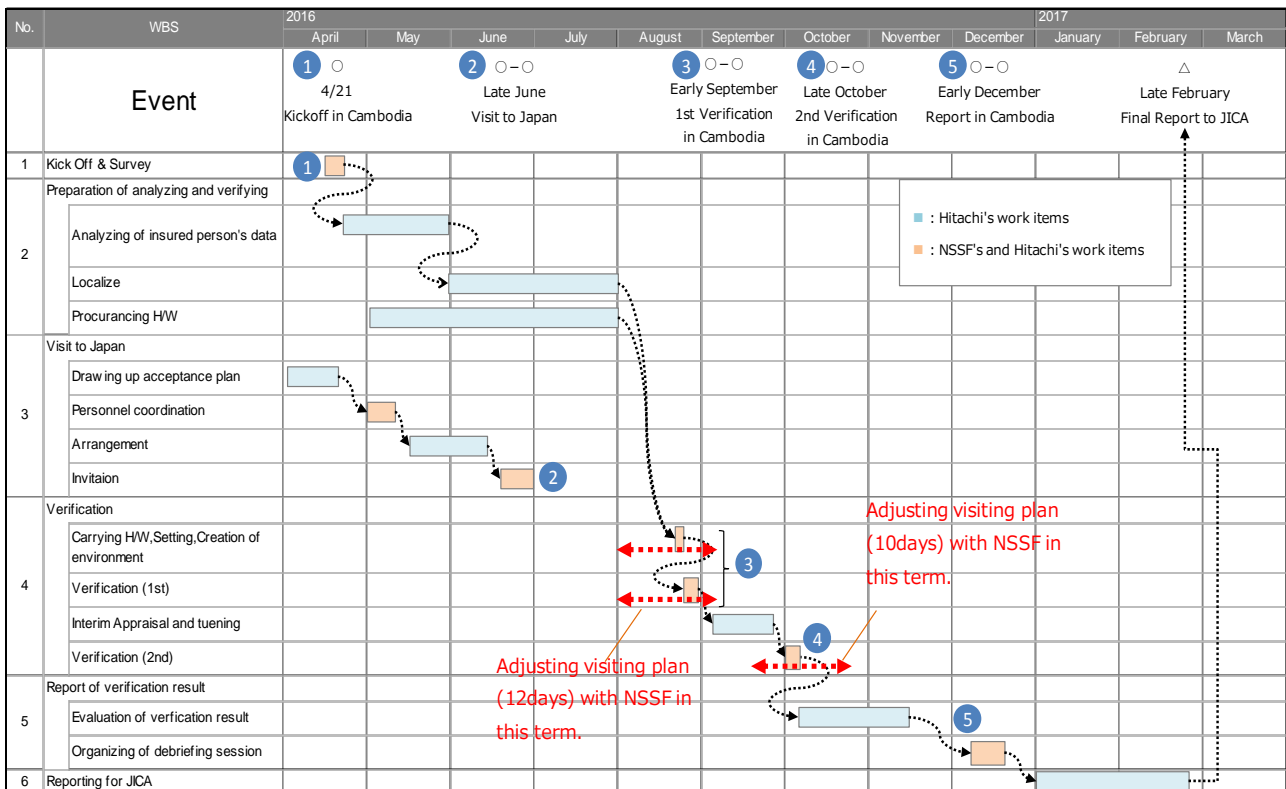
3. Operation in Cambodia

3.2. System configuration of Verification Environment

1. System configuration



4. Schedule



- **Final Report**

Final Report for JICA Collaboration Program with the Private Sector for Disseminating Japanese Technologies

PROGRAM FOR INDIVIDUAL IDENTIFICATION TECHNOLOGY WITH BIOMETRICS
OF SOCIAL SECURITY IN CAMBODIA

14 December, 2016

Hitachi, Ltd.

© Hitachi, Ltd. 2016. All rights reserved.

Introduction

Collaboration Program started in April 2016, and we have successfully completed demonstration experiments in Cambodia and Visiting Japan. We appreciate NSSF's deep understanding and supporting Collaboration Program.

Today we would like to share verification result. In addition, we propose ideas that can contribute to NSSF through the tasks of insured persons registration at verification.

Contents

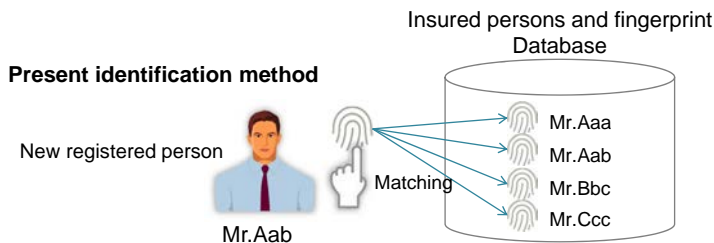
1. Verification result of Collaboration Program
2. Proposal for improvement of insured persons registration system

1. Verification result of Collaboration Program

1.1 Background and purpose of Collaboration Program

Background

Currently, NSSF has worked on identification of the same person and maintenance of ID in order to register insured persons information without duplication toward the start of new social security scheme. Identification of the same person is realized by fingerprint matching of all insured persons. However with present identification method if the number of insured persons increases in the future, fingerprint matching time will also increase and operation can not be performed efficiently, so further countermeasures are required.



Processing time takes longer due to increase of both number of registered persons and matching process when new fingerprint information matches with all data in DB.

Collaboration Program

In order to solve this problem and to promote administration of social security scheme in Cambodia, we verify validity of Hitachi's technology as JICA collaboration program.

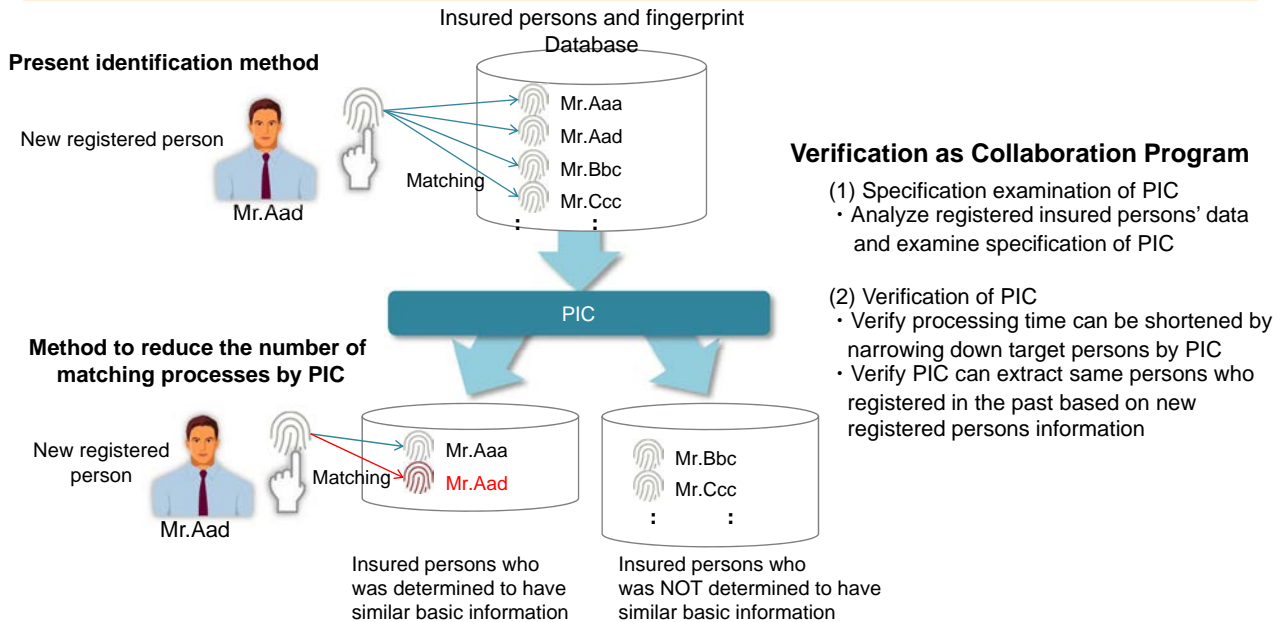
<Hitachi's technology>

Personal identification function by combination of **Personal Identity Check (PIC)** and biometric authentication that effectively narrows down target persons to be matched against a new registered person.

1.2 Personal Identity Check (PIC) overview and verification

PIC overview

- PIC compares basic information (name, place of birth, etc.) of 2 different persons' data, and technology for judging whether 2 data belong to the same person.
- In the case of the data of basic information is greatly different, PIC can not judge it as belonging to the same person. So sufficient examination and verification are required.



Hitachi Confidential

© Hitachi, Ltd. 2016. All rights reserved.

4

1.3 Specification of Personal Identity Check (PIC) part 1

We analyzed insured persons data and examined specification of PIC that is most suitable for Application operation of NSSF.

(1) Information selection to compare

In Japan, basic information is compared with name, gender, date of birth, and address. According to analysis result of insured persons data and interview, combination of the basic information to be compared by PIC was selected first name, place of birth, and year of birth.

No.	Basic information	Analysis of insured persons data and results of interview	Data used for PIC	Countermeasures to improve accuracy of judgment
1	ID (National ID or passport ID)	<ul style="list-style-type: none"> • Some data were registered with incorrect numbering system • A person may have multiple IDs 	None	—
2	Name (First Name, Last Name in Khmer)	<ul style="list-style-type: none"> • Incorrect input is small amount • First name rarely changes 	First Name	Data special editing *Details will be shown in next page
3	Place of birth	<ul style="list-style-type: none"> • Incorrect input is small amount 	Place of birth	None
4	Date of birth	<ul style="list-style-type: none"> • Incorrect input of month and day are large amount compared to year • Incorrect input of year which is different few years from actual year 	Year of birth	Target comparison have extra 10 years range from registered year of birth
5	Gender	<ul style="list-style-type: none"> • The amount of female registrants is large 	None	—

Hitachi Confidential

© Hitachi, Ltd. 2016. All rights reserved.

5

1.3 Specification of Personal Identity Check (PIC) part 2

(2) Identity judgment method

Similarity judgment (Not $A = B$, but $A \cong B$) is required in consideration of incorrect input text for information such as name. Similarity judgment is realized by grouping similar characters and special editing of name data through characteristics of Khmer letters.

(A) Example: different character data was entered due to an incorrect input even though the same name was entered.

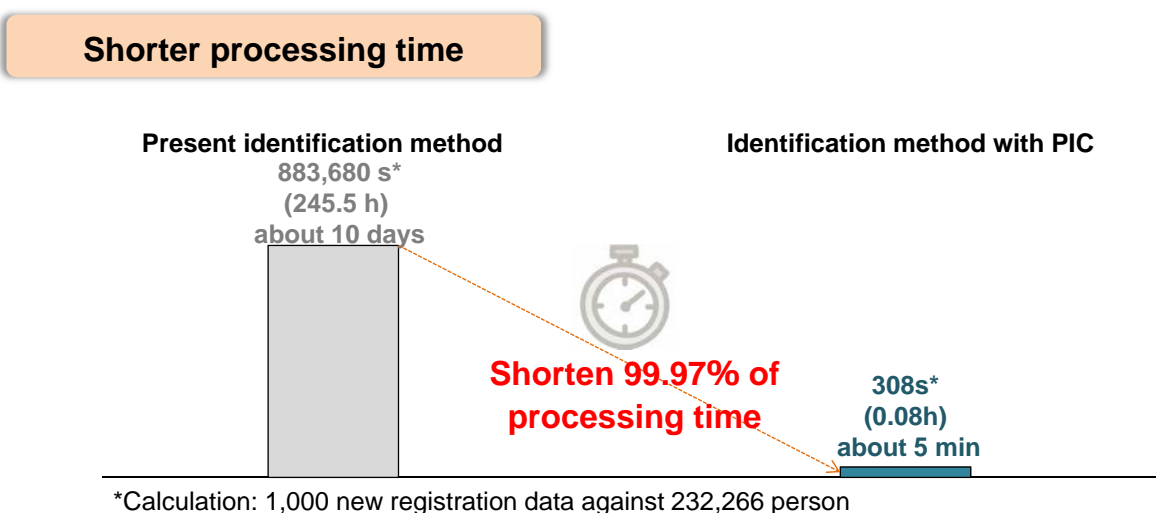
No.	Actual data sample	
	Name A	Name B
1	ឆា	ចា
2	ក្រ	ក្រ
	តាំ(ត+៉+ាំ)	តាំ(ត+ាំ+៉)

(B) Example: Editing and judging character data of name
In the case of incorrect input of consonants
Consonants with a possibility of misreading are determined as the same character

Group	Determined as the same character sample
A	ក ក ត ត ត ត ត
B	ឆា ចា

1.4 Summary of verification result of Collaboration Program

We make a processing time comparison between present identification method and PIC.
The verification has resulted in **shorter processing time of personal identification**



1.5 Verification result of Collaboration Program

3 verifications were implemented in Collaboration Program. Following table shows each result. In the 2nd verification, 5 cases were verified as new registration even they have registered before.

Verification in Cambodia	Implementation / Collection of data	Processing time for all registration and per 1 registration		Accuracy of identification
		PIC & Fingerprint	Fingerprint	
Rehearsal verification (Papillion Textile Cambodia, Co.Ltd)	[New registration data] 110 persons [Cumulative insured persons data] 172,821 persons	<ALL> 0.6 m <Per 1> 0.3 s	<ALL> 16.4 h <Per 1> 538.3 s	110 persons/ 110 persons (100%)
The 1st verification (Minebea Cambodia, Co.Ltd)	[New registration data] 545 persons [Cumulative insured persons data] 232,266 persons	<ALL> 2.9 m <Per 1> 0.3 s	<ALL> 133.8 h <Per 1> 883.7 s	545 persons/ 545 persons (100%)
The 2nd verification (HO HSIN TAI LIMITED)	[New registration data] 421 persons [Cumulative insured persons data] 232,266 persons	<ALL> 2.0 m <Per 1> 0.3 s	<ALL> 103.3 h <Per 1> 883.7 s	416 persons/ 421 persons (98.8%)

2. Proposal for improvement of insured persons registration system

2.1 Quality improvement of registered insured persons information

To extract ALL duplication data, quality of registered insured persons information should be improved by better operation and system.

(1) Inaccurate data found by analyzing 93,767 insured persons

#	Inaccurate data pattern	Details	Assumed reasons	Operation	System	Countermeasures
1	Inaccuracy of basic information	Inaccurate name spell : 27 Inaccurate birth year : 85 Different notation method of birth province : 5 Inaccurate registration of ID card number : 106	Incorrect input of application information/ Basic information	○		Show confirmation page at the end of registration in order to compare application contents or photo
					○	Add accuracy check function for input number
2	Registration of another person's photo/basic information	Portrait and personal information is suspected inaccurate while biometric (fingerprint) information is matched : 479	Incorrect input of document ID when fingerprint/Portrait is registered Registered information itself was different	○		Check registered data at each operation step
					○	Automate Document ID input with biometric information
					○	Implement duplication check to find suspected data which couldn't be found by PIC
3	Duplicated registration of insured person	Same biometric (fingerprint) data was registered in same or another enterprise : 550	Processing time takes too long		○	Implement duplication check with PIC and fingerprint matching at target enterprises

2.2 Future image of administrative services in Cambodia

Accurate registration of insured persons information will be a basis of various administrative services

