



HRD Programme for Exchange of ICT Researchers and Engineers

PROJECT COMPLETION REPORT

Project Title:

**Digitalization of maternal and post-natal care system (DigiMAPS)
in the rural area in Indonesia
by using multimodal communications systems
to reduce mother and children mortality rate in Indonesia**

Chief Researcher

SAMUDRA PRASETIO

BANDUNG. MARCH, 2014



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Executive Summary

The development of Digitalization of maternal and post natal care systems (DigiMAPS) is dedicated to solve the problem in monitoring mother and children in the rural area in Bandung Indonesia. Previously the reporting systems are using paper based report that written by midwife in the integrated mother and child service area as the front service in rural area before reporting to central health centre in a district level. Furthermore this report should be delivered to the County health service then proceed to the Province health service to be ended to the Ministry of Health Jakarta. These reports are important for the stakeholders to make decision in case there is a problem in the front mother and child services. For this project we granted 56.697USD to develop the prototype.

Generally the project achieved and fulfilled the midwife and medical staff at Gunung Halu district West Bandung County Indonesia. They commented that this system helped them on monitoring and make reporting to the health office in above. During the project the team members visited the center of DigiMAPS in Japan, such as, Takamatsu as a center of telemedicine and medical IT, Red Cross hospital that already has the "Hello Baby Systems" to monitor the new baby born.

*The exchange program between Japanese and Indonesian researchers has increased team capabilities and experiences. The actual cost of the project is USD **54,817.94** or **96.69%** of the total budget approved. DigiMAPS has already field tried at Gunung Halu district on Dec 2013. At that time demo was performed by user i.e. midwife, nurses and volunteers. Based on the positive response from local and national agencies, DigiMAPS by using multimodal communication systems are considered as a feasible solution to enhance current communication solution for mother pregnant and children monitoring activities. As a result the solution will be further developed to be available in several locations in Indonesia.*

1 Project Information

1.1 Introduction

This project has been selected by Asia-Pacific Telecommunity as an APT Collaborative HRD Programme for Exchange of ICT Researchers and Engineers. This project commenced on March, 2013 and should be completed at the end of February 2014. The total budget approved for the project is USD 56.697.

The main activities for this HRD exchange programme are enhancing the monitoring and reporting systems in digital data for mother pregnant and baby newborn, developing medical application and introducing multimodal telecommunication solution which robust and easy to deploy in the rural area with limited communication facilities. Furthermore, the new proposed system has been tried in the field, not only to check its functionality but also to use as a media to show DigiMAPS solution to the local health government and academicians. This research project is mainly conducted by, Research & Development Center (RDC) of PT. Telekomunikasi Indonesia Tbk. (TELKOM), and fully supported by researchers from:

- a. University Electro Communication of Tokyo– Japan
- b. Faculty of Medicine Padjadjaran University/Hasan Sadikin General Hospital

Based on dissemination activities in the rural area, DigiMAPS team got a strong supporter which can be considered as DigiMAPS prospective users or operators for other rural area in Indonesia. Some of them are from:

- a. West Bangka County, Bangka Belitung Province Indonesia that consist of many small islands
- b. West Jawa Health Office Province
- c. Ministry of Health of Indonesia
- d. National Family Planning and Welfare Agency Indonesia

The researchers involved in this project are 9 (nine) Indonesian researchers and 2 (two) Japanese researchers. There are various competencies that involved in this project: satellite communications, application development, multimodal communication and social informatics expert.

1.2 Objectives

The purpose of DigiMAPS enhancement and dissemination are to develop new proposal for monitoring and reporting for mother pregnant and baby newborn in the rural area and at the same time to disseminate the system to other rural area in all over Indonesia.

The objectives of the projects are

1. To translate current maternity & postnatal reporting procedures into DigiMAPS in order to speedup reporting procedure and improve data accuracy.
2. To design and develop tele-maternal care system in order to connect midwife and medical doctor in rural and remote area with Obstetrics-Gynecology specialist in top referral hospital during maternity and postnatal events.
3. To design and develop Device, Network, and Application (DNA) for consultation

purpose and multimodality communication systems that supporting various user accesses including web-based, SMS and mobile application-based entry.

1.3 Project Team

This research project is conducted by TELKOM-RDC (Research & Development Center of PT. Telekomunikasi Indonesia Tbk.), and fully supported by researchers from:

- a. The University of Electro-Communications (UEC), Tokyo Japan
- b. Faculty of Medicine Padjadjaran University – Hasan Sadikin General Hospital Bandung Indonesia

The researchers involved in this project are 7 (seven) Indonesian researchers and 4 (four) Japanese researchers, as follows:

Table 1 Digimaps Team

No.	Name	Institution	Position in DigiMAPS Project
1.	Samudra Prasetyo	TELKOM	Project Manager
2.	Sony Ari Yuniarto	TELKOM	Accounting Coordinator
3.	Toshizumi Ohta	UEC	Researcher
4.	Hirohiko Suwa	UEC	Researcher
5.	Hadi Hariyanto	TELKOM	Technical Coordinator
6.	Winda Winanti	TELKOM	Researcher
7.	Yudi Tri Jayadi	TELKOM	Researcher
8.	Andri Qiantori	TELKOM	Researcher
9.	Agung Budi Sutiono	MEDICINE UNPAD	Researcher
10.	Ahmad Faried	MEDICINE UNPAD	Researcher
11.	Tono Djuwantono	MEDICINE UNPAD	Researcher

2 Summary of the Financial Statement

Summary of the financial statement is described in the following table:

Table 2 Summary of DigiMAPS Financial Statement

Item	Budget Approved (USD)	Cost Spent(USD)	Variance (USD)
Travel Expenses	9,972.00	9,000.13	971.87
Daily Allowances	9,800.00	2,240.00	7,560.00
Correspondence Expenses	60.00	0	60.00
Shipping Fees	0.00	0	0
Equipment Purchase Expenses	36,665.00	43,409.44	(6,744.44)
Miscellaneous	200.00	168.37	31.63
Total	56,697.00	54,817.94	1,879.06

- Fund transferred by APT (phase-1) = USD 34,018.00
- Cost spent until March 2014 = USD 54,817.94
- Total Current Balance = USD 20,799.94

The detailed information of this financial statement is described in the **Final Accounting Report**.

3 Brief Overview of DigiMAPS

According to 2010 KIA report (*Ina Hernawati, 2011, Directorate Maternal Health Care, Indonesian Ministry of Health*), West Java province contribute 19.8% of mother mortality in Indonesia, which is the highest compared to other provinces in Indonesia. In 2012, there were about 228 pregnant mother deaths per 100,000 pregnancies in West Java (Pikiran Rakyat, 18/01/2013). There are about 18 regions and 9 cities in West Java Province. Bandung Region contributed 46 mother deaths while West Bandung Region 28 deaths during 2012. Baby mortality rate in Bandung Region is about 34 among 1000 live births, which is very high compared to the target 23 per 1000 live births.

According to MENKES (*Ina Hernawati, 2011*), there are several causes of maternal deaths including bleeding/hemorrhage (27%), eclampsia/hypertension (23%), infection (11%), puerperium complication (8%), obstetric trauma (5%), obstetric umbilical (5%), obstructed labour (5%), abortus (5%), other causes (11%). While major neonatal deaths caused by asphyxia (35.3%), prematurity (32.4%), and sepsis (12%) (*Massee Bateman, USAID 2013*).

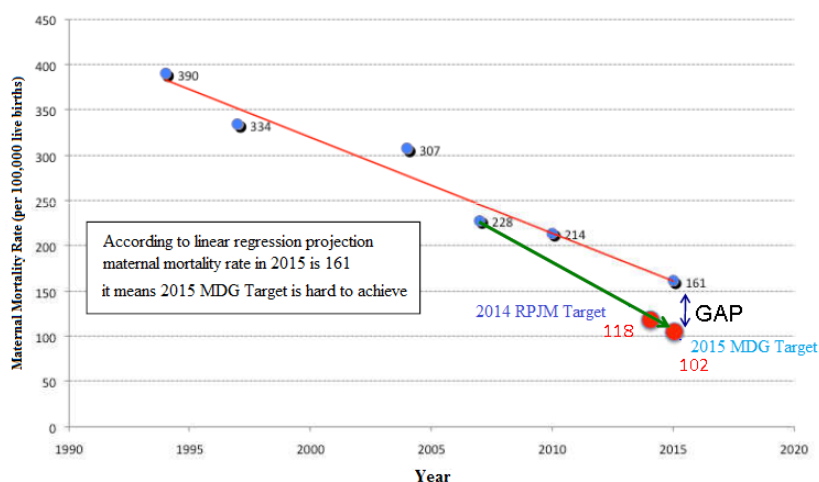
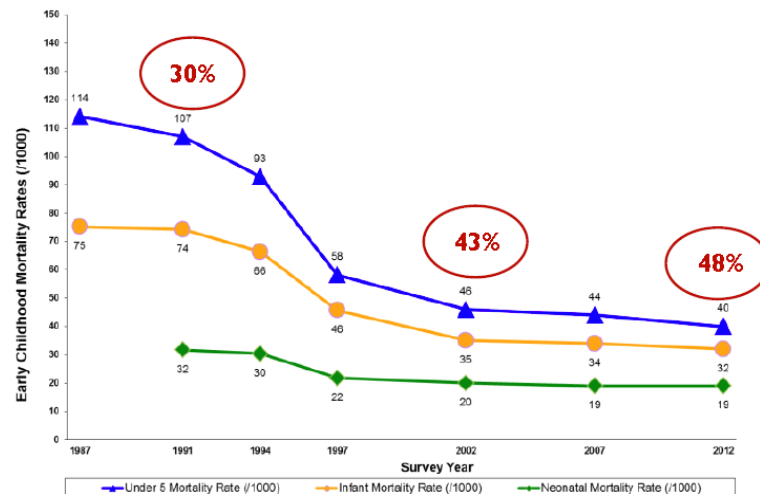


Figure 1. The trend of maternal mortality rate in Indonesia (DEPKES, 2011)

Indonesia has spent a lot of effort to reduce both maternal and neonatal mortality rate. The significant improvement has been achieved as can be seen from Figure 1 and Figure 2. However as shown from the graphs, it is still difficult to achieve 2015 MDG targets, unless hard works and revolutionary approaches can be done in the period of 2013 – 2015.



**Figure 2. The trend of neonatal mortality rate in Indonesia
(Dr. Masee Bateman, USAID, 2013)**

In order to achieve MDG target of reducing maternal mortality rate, Indonesia government have run several studied and programs and come to the following recommendations (compiled from dr. Ina Hernawati, 2011):

- a. Strengthen recording and reporting system through
 - Standardize operational definition and performance indicator calculation
 - Reporting process should be done in time on monthly basis from distric level, region, province and national level
 - Data validation & analysis should be performed by each region/city level
- b. Mapping and identify of potential district/local clinics which have significant impact to the reduction of mother mortality
 - Improve health facility and programs management to prevent complication
- c. Human resource development to improve skill, number and distribution (coverage) of medical staffs
 - To reduce prevalence level and Case Fatality Rate for pregnancy with complication
- d. Improve health facility and increase the number of births in health facilities (Pn Coverage)

ICT in some extends can help government to achieve the first two recommendations, therefore as an ICT project, DigiMAPS tries to improve recording and reporting system in order to help government monitoring, Improving health facility and managing the program to prevent complication.

DigiMAPS is a HRD program for exchange of ICT researchers/engineers through collaborative research between Indonesian and Japanese experts funded by **Asia Pacific Telecommunity** (APT, supported by extra budgetary contribution by Japan) and TELKOM.

DigiMAPS covers collaborative research in the field of broadband deployment, e-health applications, mobile communication technologies, new approach for rural ICT

infrastructures and technologies for realizing ubiquitous network. The objectives of this project are

- To translate current maternity & postnatal reporting procedures into DigiMAPS in order to speedup reporting procedure and improve data accuracy.
- To design and develop tele-maternal care system in order to connect midwife and medical doctor in rural and remote area with Obstetrics-Gynecology specialist in top referral hospital during maternity and postnatal events.
- To design and develop Device, Network, and Application (DNA) for consultation purpose and multimodality communication systems that supporting various user accesses including web-based, SMS and mobile application-based entry.

DigiMAPS under Asia Pacific Telecommunity (APT) J2 Project focused on ICT solutions for the electronic version of mother-children health record called KIA Online. By this initiation, it can benefit to speed up and maintain data accuracy of KIA and area-based health report (PWS-KIA). The linkage between KIA, Cohort and PWS-KIA can be maintained in the online version of KIA. It can reduce the effort of midwives in the villages to input the same data for different forms of KIA, Cohort and PWS-KIA (compared if they are done in paper-based version). In addition the calculation of statistical data of PWS-KIA can be done automatically by the system.



Figure 3. DigiMAPS Service Features and Its roadmap

In conclusion, the online version of KIA can speed up the reporting and reduce the efforts of inputting data and reporting processes. DigiMAPS also propose Tele-Obgyn using telepresence video conferencing platform. This facility can help to minimize the gap between Midwives and Obgyn Doctors coverage as indicated in the third recommendation. In order to support these features implemented in Rural area, a multimodal communication solution is proposed to enable any kind of telecommunication infrastructure, hence this report is made.

3.1 Profiles of Gunung Halu

Gunung Halu is located in West Bandung District. The road infrastructures are still very poor. It took 2 hours from local clinics (Puskesmas) in Gunung Halu to the nearest referral hospital (RSUD) in Cililin District. Therefore Gunung Halu public health service (Puskesmas) becomes the center of medical services in this district which support 9 villages. Figure 4 shows the Gunung Halu Distric Map and some photos.

Every month, Gunung Halu Puskesmas has to report about maternal and children health (KIA/ Kesehatan Ibu dan Anak) to the Health Department (Dinas Kesehatan) of West Bandung district. In order to report the KIA, Gunung Halu Puskesmas has to gather the statistical data called PWS (Penelusuran Wilayah Setempat) report from midwives in 9 villages in Gunung Halu. Currently, the sources of PWS reports (KIA Book, Cohort Report and Helping Book, etc) are still in paper based.



Figure 4. Gunung Halu Situation

To gather all required data in paper based format require significant work for midwives in the villages. In fact that the midwives are already occupied with medical health works in the village (not only KIA aspect), makes reporting work carried as separate activities prior to the deadline. The poor road condition makes the coordination process is very hard. And the delay report submission from midwives can cause delay report submission from Puskesmas to DINKES. Paper based data source leads to accuracy and consistency problems.

Table 3. Health facilities and Paramedics in Gunung Halu

Parameters	Gunung Halu Distric
People	53.676
Wide Area	11312 Ha
Villages	9
Hospital (Ponet)	-
Puskesmas (Poned)	1
Puskesmas Branches	9
Posyandu	100
Cadres	560
General Doctors	2
Specialist Doctors	-
Midwives	15
Paramedics	13
Trained Paraji (traditional medical practitioner)	39

3.2 Communication Solutions

In this sub-section the development of communication solution for DigiMAPS project will be explained based on the framework shown in the figure 5.

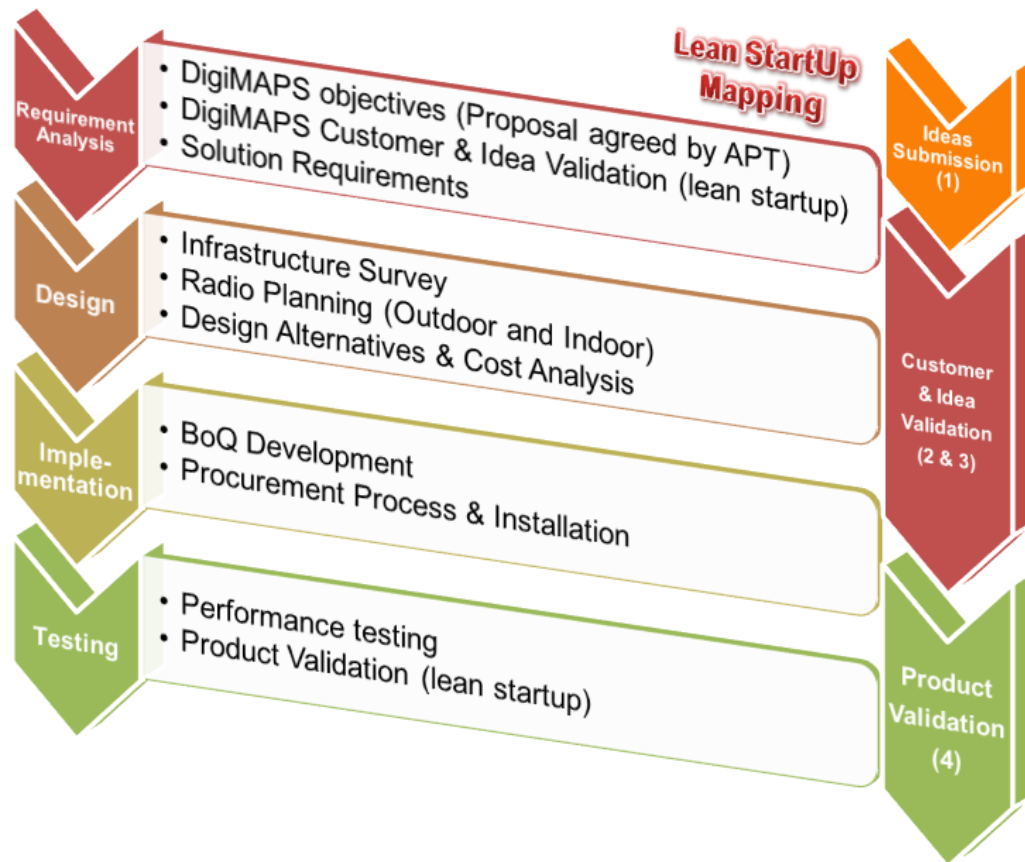


Figure 5. Development of Communication Solution and Lean StartUp Mapping

3.2.1. Requirement Analysis

As can be seen from figure 5, the requirement of communication solutions are derived from DigiMAPS proposal and lean startup customer-problem-solution fit.

The third objective of DigiMAPS stated in chapter 1.2 was considered as one of important requirements for DigiMAPS which are to design and develop Device, Network, and Application (DNA) for consultation purpose and multimodality communication systems that supporting various user accesses including web-based, SMS and mobile application-based entry. Multimodal communication system consist of several access network including Broadband wireline (xDSL), 2G Cellular, 3G Sellular, WiFi and VSAT IP as can be shown in the figure below:

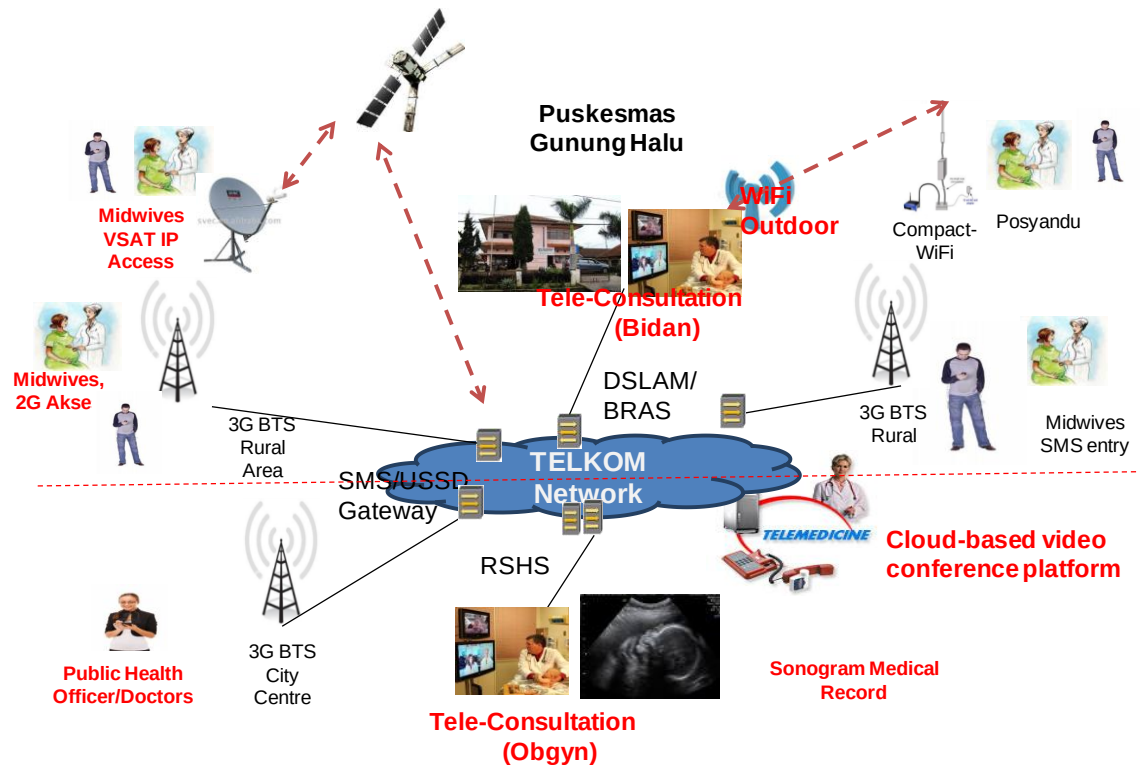


Figure 6. DigiMAPS Multimodal Communication System

The DigiMAPS proposal is considered as the official reference accepted by APT Secretariat. It covers the objectives, concept, architecture, target users and budget. In terms of lean innovation management, the DigiMAPS proposal can be considered as an initial idea of DigiMAPS.

The initial idea of DigiMAPS was further verified by using lean innovation management. Based on activity 2 and 3, DigiMAPS team has conducted customer-problem-solution verification as shown in figure 7 and figure 8.

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Project Name: _____ Team Leader Name: _____

Track Pivots	Start	1st Pivot	2nd Pivot	3rd Pivot	4th Pivot
Customer Hypothesis	Tip: For two-sided markets, always validate the riskier side first DINKES KBB	DINKES KBB			
Problem Hypothesis	VIEW & POST PROCESSING STATISTICAL DATA	Remember: Start one side or a Do Not Do LATE DELIVERY AND IN-CONSISTENCY			
Solution Hypothesis	Tip: Do NOT define a solution until you've validated the problem	IMPROVEMENT OF PROCEDURES USING KIA ONLINE			

Design Experiment

Tip: Clear all post-its from this area after each experiment is completed

LACK OF OFFICERS	POOR RESPONSIBILITY
DATA DELIVERED USING ONLINE & OFFLINE	HIGH LOAD OF OFFICER / MIDWIVES
POOR NETWORK INFRASTRUCTURE	TECHNICAL PROBLEM ON EXISTING APPLICATION

Riskiest Assumption

POOR RESPONSIBILITY

Which Core Assumption has the highest level of uncertainty?

Method

EXPLORATION

Will effectively test your RAC? Explanation, Pitch, or Concierge

Minimum Success Criterion

1/1

We will accept no validation?

Results

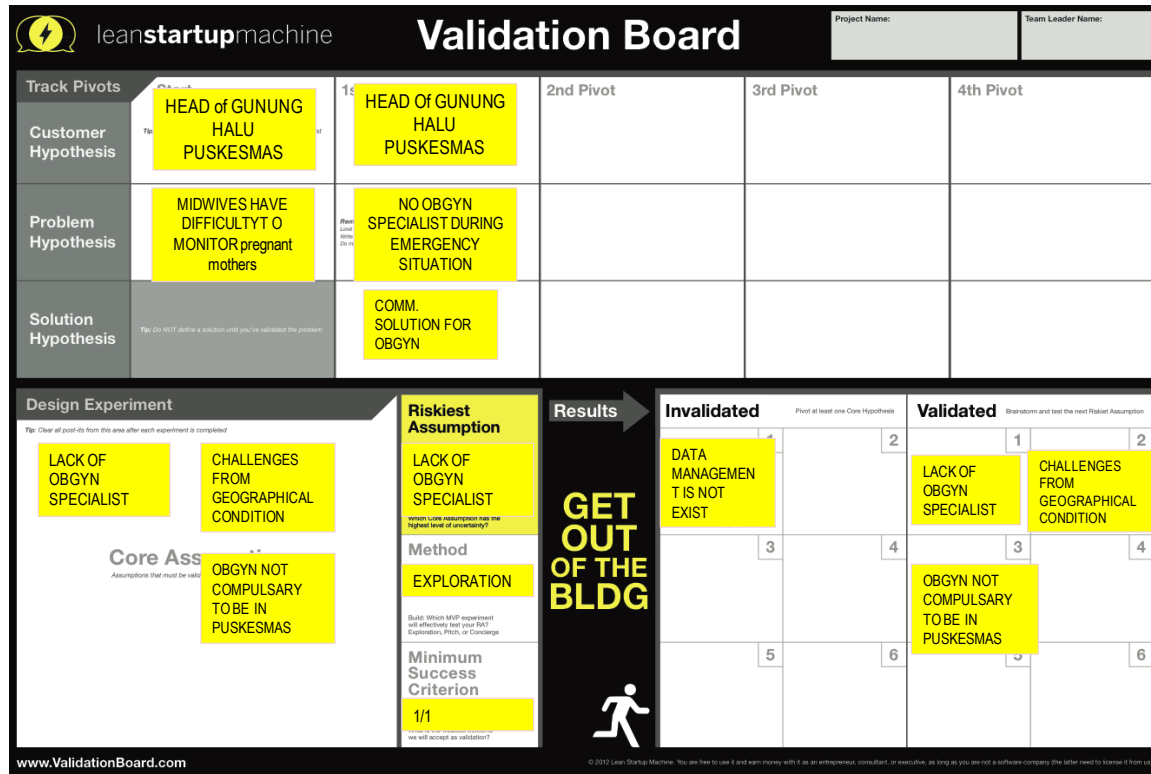
GET OUT OF THE BLDG

Invalidated	Validated
Pivot at least one Core Hypothesis PAPER BASE DATA REPORTING From an experiment in these boxes Record data & learnings separately 2	Brainstorm and test the next Riskiest Assumption 1
3	LACK OF OFFICERS 3
4	DATA DELIVERED USING ONLINE & OFFLINE 4
5	POOR NETWORK INFRASTRUCTURE 5
6	POOR RESPONSIBILITY 2 HIGH LOAD OF OFFICER / MIDWIVES 4 TECHNICAL PROBLEM ON EXISTING APPLICATION 6

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Figure 7. Validation board for KIA Online



leanstartupmachine Validation Board

Project Name: _____ Team Leader Name: _____

Track Pivots	1st Pivot	2nd Pivot	3rd Pivot	4th Pivot
Customer Hypothesis	HEAD of GUNUNG HALU PUSKESMAS	HEAD of GUNUNG HALU PUSKESMAS		
Problem Hypothesis	MIDWIVES HAVE DIFFICULTY TO MONITOR pregnant mothers	NO OBGYN SPECIALIST DURING EMERGENCY SITUATION		
Solution Hypothesis		COMM. SOLUTION FOR OBGYN		

Design Experiment	Riskiest Assumption	Results
Tip: Clear all post-its from this area after each experiment is completed Core Ass Assumptions that must be valid LACK OF OBGYN SPECIALIST CHALLENGES FROM GEOGRAPHICAL CONDITION OBGYN NOT COMPULSARY TO BE IN PUSKESMAS	Riskiest Assumption LACK OF OBGYN SPECIALIST Method EXPLORATION Minimum Success Criterion 1/1	Invalidated DATA MANAGEMEN T IS NOT EXIST Validated LACK OF OBGYN SPECIALIST CHALLENGES FROM GEOGRAPHICAL CONDITION OBGYN NOT COMPULSARY TO BE IN PUSKESMAS

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Figure 8. Validation board for Tele Obgyn

From figure 8, we can conclude that communication system called Tele-Obgyn will be used in order to make Obgyn specialist available during a consultation event. As a result of intensive correspondence and discussion between DigiMAPS Team and NEC, Spontania video conference system will be used as part of DigiMAPS solution. Figure 9 shows Spontania system configuration.

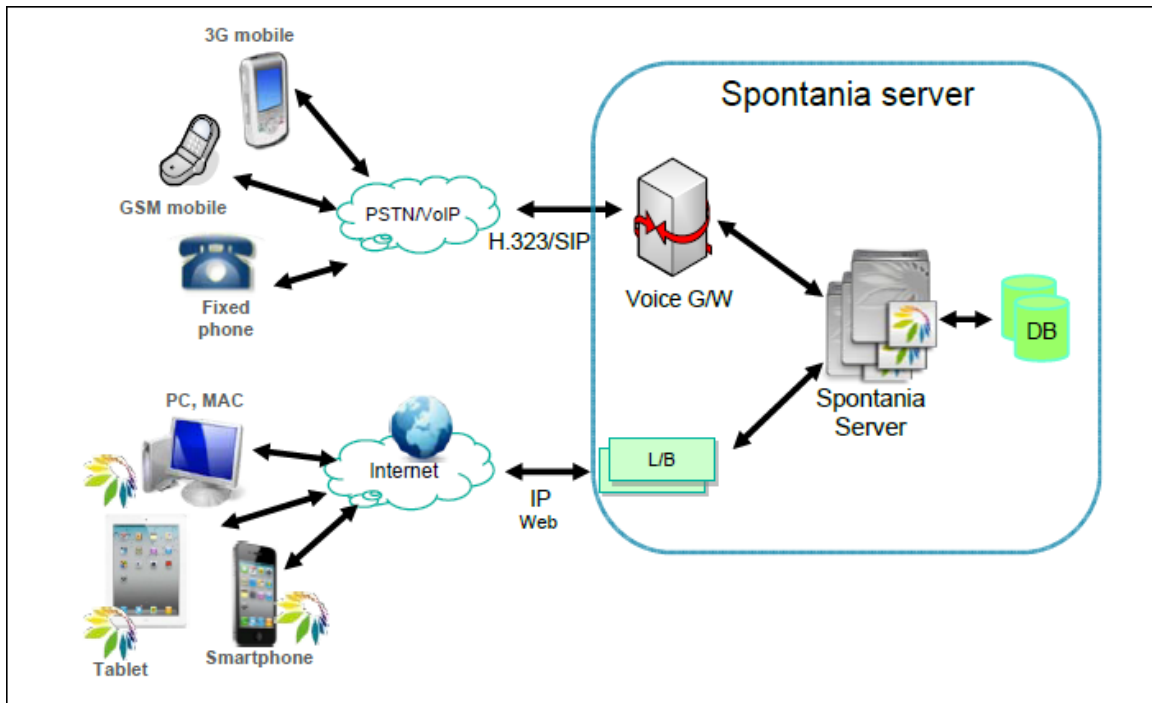


Figure 9. Spontania System Configuration (NEC Indonesia, 2013)

Spontania Tele-Obgyn supports the following features:

- **Co-browsing:** to allow sharing a internet browser session with other participants
- **Application and video sharing:** to allow sharing any application installed on a PC/device with other participants
- **Remote Control:** to allow a participant to take control of other PC
- **File Transfer:** to allow a participant to send/cross transfer medical image or any kind of files rapidly and securely
- **Electronic whiteboard:** share and edit a joint workspace
- **Polling:** take real time polls on specific topics
- **Session recording:** record a Spontania session for playback later
- **Extended desktop:** supports extended desktop view for multi-monitor setups
- **Live text chat:** communicate using instant messages direct from the Spontania UI
- **One-click invites:** invite other participants to the Spontania session with a single click

From figure 7, KIA Online has developed by DigiMAPS team in order to improve recording and reporting of KIA. This application can be considered as a web-based application which can be accessed anywhere and anytime.

Based on DigiMAPS proposal and lean startup outcomes, the communication solution requirement can be summarized as on table 4

Table 4. Communication Requirement for DigiMAPS

Req. #	Requirement Description	Notes
1.	The solution should address multimodal communication accesses including xDSL, WiFi, 2G, 3G and VSAT IP	DigiMAPS Proposal
2.	The DigiMAPS solution shall be accessed from Hasan Sadikin Hospital, Gunung Halu Puskesmas, Midwives and Posyandus near Gunung Halu Puskesmas	DigiMAPS Proposal
3.	The DigiMAPS solution shall be accessed by users web-based, mobile application-based entry and SMS	DigiMAPS Proposal
4.	The DigiMAPS communication solution shall be reliable enough to support Tele-Obgyn system which enable Obgyn doctor (in referral hospitals) and midwife (in Gunung Halu) to access a medical record (KIA Online), video conferencing and medical images transfer (USG).	Lean Startup, Tele-Obgyn/Teleconsultation system
5.	The DigiMAPS communication solution shall be reliable enough to support KIA Online which enable officers in DINKES and PUSKESMAS to access, entry, validate and monitor KIA and PWS KIA data anytime and anywhere	Lean Startup, KIA and PWS Online
6.	The DigiMAPS applications (KIA Online and Tele-Obgyn) should support access from PC and mobile terminals transparent to the operating system and different screen size	Lean Startup, KIA Online and Tele-Obgyn
7.	The DigiMAPS communication solution shall support minimum 128 kbps bandwidth to allow video conference service	Lean Startup, Tele-Obgyn

3.2.2. Communication Design

The communication accessed were designed by considering survey result, radio planning result and implementation cost. It is important to know the public communication infrastructure available in Gunung Halu, therefore several survey activities were performed in order

- to get the information of telecommunication infrastructure in Gunung Halu especially in Gunung Halu Districts, Celak and Cilangari, where the DigiMAPS system will be tried
- to get the coordinates of main target places and the performance of existing infrastructure.

Table 5 shows the survey result of telecommunication infrastructure available in Gunung Halu district.

Table 5. Survey Result of Telecommunication Infrastructure in Gunung Halu

Location	Coordinates	Existing Infrastructure	Notes
Puskesmas, Gunung Halu	7° 1' 28.77" S 107° 18' 48.42" E	xDSL 384 kbps 3G	xDSL 384 kbps → upgradable to 2-3 Mbps
Dokter Ponet, Gunung Halu	7° 1' 31.72" S 107° 18' 44.39" E	3G	3G DL : 1.8 Mbps, UL 1.1 Mbps, ping 57 ms
Bidan Lilis, Gunung Halu	7° 1' 24.30" S 107° 18' 46.93" E	3G	3G DL: 1.9 Mbps, UL: 1.3 Mbps, ping 77ms
Bidan/Pustu Cilangari	7° 2' 45.6" S 107° 13' 19.81" E	3G	3G DL : 2.1 Mbps, UL 345 kbps, ping 92 ms
Posyandu Montaya	7° 1' 34.80" S 107° 18' 41.83" E	3G	3G DL : 1.8 Mbps, UL 1.1 Mbps, ping 57 ms
Bidan Enden, Celak	7° 0' 26.30" S 107° 21' 31.77" E	2G – Edge/GPRS	DL : 21 kbps, UL : 0 kbps → requires alternatives, not possible to access web
Hasan Sadikin Hospital	6° 53' 54" S 107° 35' 52" E	3G & Internet/Intranet	Internet DL : 0.47 – 1.92 Mbps, UL : 0.29-039, ping 53-161 ms

The survey results were very useful in order to plan the communication solution based on the real condition in Gunung Halu and Hasan Sadikin Hospital.

In general, Gunung Halu Puskesmas and Hasan Sadikin Hospital have internet access using broadband wireline. The broadband speed is enough to support DigiMAPS applications. However we have decided to upgrade the connection in Gunung Halu Puskesmas to match with the broadband connection in Hasan Sadikin Hospital. In order to support Tele-Obgyn accessible from PC/wide screen TV, we have decided to upgrade into Speedy 3 Mbps to support multimedia application.

In most locations, midwives near Puskesmas Gunung Halu, and midwives in 8 other villages can access internet using 3G services from either TELKOMSEL or XL. However, midwives Enden who is the most senior/experience midwives in Gunung Halu, should be supported by other broadband accesses, because the existing 2G data service will not be able to access DigiMAPS applications.

3.2.2.1. Communication for Bidan Enden, Celak

We have studied the possibility to implement point-to-point WiFi between Puskesmas and Bindan (midwife) Enden which are geographically separated about 5.36 kilometers. In this case, we use Atoll planning tool to map both location in digital map and observe how line of sight (LOS) can be achieved.

There are two possibilities to achieve LOS:

- setup two towers with @ 110 meter high in Gunung Halu Puskesmas and Bidan Enden House/Pustu
- setup three towers with @ 20 meter high in Gunung Halu Puskesmas, repeater location and Bidan Enden House/Pustu.

Figure 10 shows the LOS Analysis, the WiFi P2P solution with 2 towers and 3 towers.

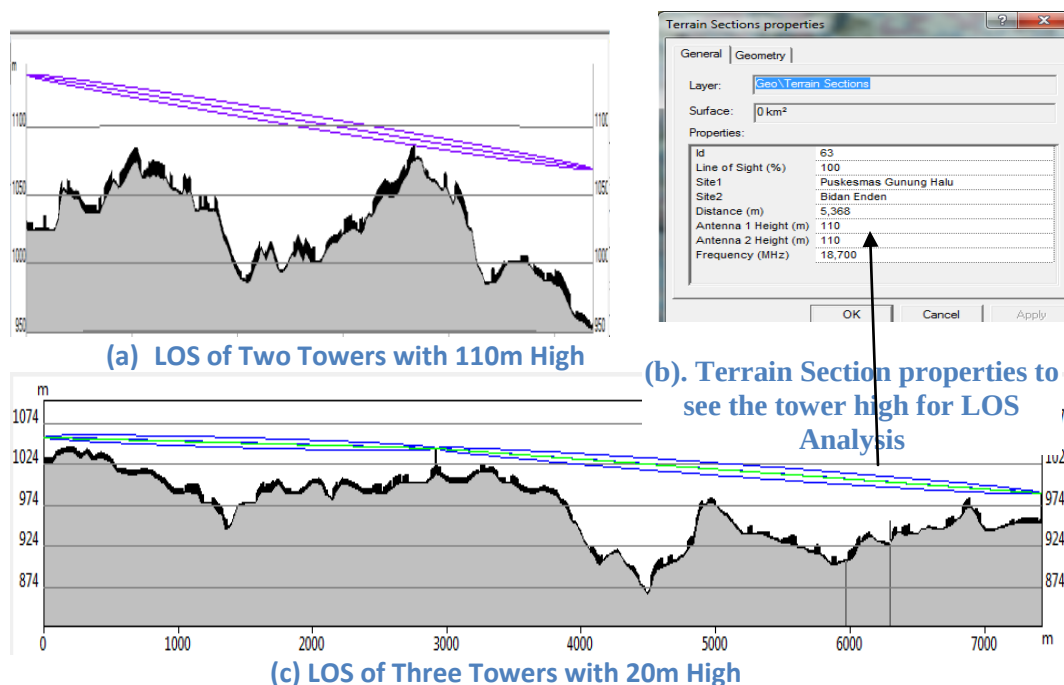


Figure 10. LOS Analysis using Atoll Planning Tool

P2P WiFi solution obviously requires to build towers to place the WiFi outdoor access points. To setup the tower, it requires a permit from authority and people nearby. Before choosing the best options we analyse the cost of implementation as shown in Table 6.

Table 6. Cost Estimation for P2P WiFi link

P2P WiFi Link	Number of Towers	
	2 Tower (@ 110m)	3 Tower (@ 20m)
Price of Tower (2mil/m)	Rp. 440 millions	120 millions
Land Rental Cost (10x10, 25/mil/tower/year)	Rp. 50 millions	75 millions
WiFi equipment cost without cabling/accessories	Rp. 3 millions	6 millions
Total Cost	493 million	201 millions
DigiMAPS Budget for tower	USD. 4,300	USD. 4,300

It can be seen, that implementing P2P WiFi link between Puskesmas and Bidan Enden is not feasible because of budgeting issue. Therefore we assess the possibility to use VSAT IP solution. VSAT IP solution has been considered to give midwife access to KIA-Online and Tele-Obgyn (if the delay is accepted). The VSAT IP service we propose is 512 kbps (DL)/256 (UL) with average 128 Kbps DL/UL. The cost estimation can be seen in table 7.

Table 7. Cost Estimation for VSAT IP link

VSAT IP	Rental Period	
	12 months	3 months
Land Cost	Rp. 5 million	Rp. 5 million
Cost of VSAT (8mil/month)	Rp. 96 million	Rp. 24 million
First Installation	Rp. 6 million	Rp. 6 million
Total Cost	Rp. 107 million	Rp. 35 million
DigiMAPS Budget	USD 4,500	USD 4,500

It can be seen from the table, the VSAT IP solution is relatively expensive in the long period rental, however for product validation purpose, it is still possible to rent for 3 months period. The cost for 3 months rental is within DigiMAPS budget, therefore this option was selected to allow Bidan Enden to enjoy DigiMAPS solution within product validation period.

3.2.2.2. Indoor Communication Solution for Community Health Center (Puskesmas) of Gunung Halu

Along with speedy 3 Mbps installation, we design the indoor coverage for Puskesmas, therefore KIA Online can be accessed within Puskesmas Building. From initial measurement it was found that a single AP will not able to cover all Puskesmas building as can be seen from figure 11.

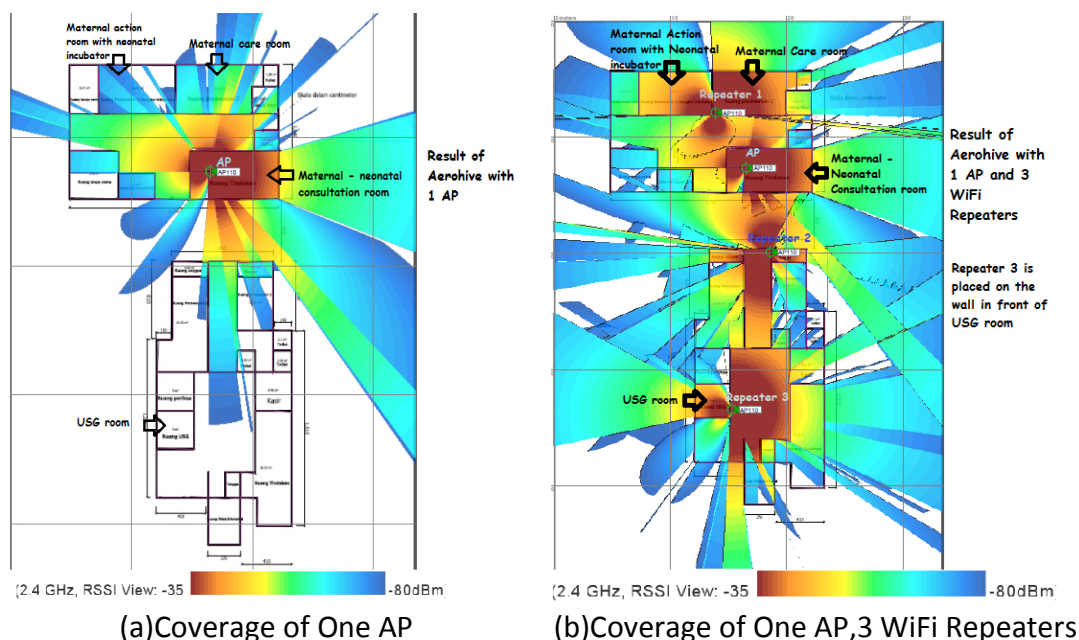


Figure 11. The coverage of indoor AP and repeters in Puskesmas Gunung Halu

The coverage of one AP placed in the maternal-neonatal office initially was measured. The result was used to calibrate the coverage prediction of Aero-hive WiFi indoor planning tool. Based on the simulation, one AP and three repeaters are required to cover Puskesmas including maternal-neonatal house and USG room in the main building. The repeaters are placed at a location where the signal strength of the AP or the repeater is around -63 dBm.

Table 8. Coverage estimation of WiFi indoor installed in Puskesmas

Rooms	Condition based on Aerohive planning tool
Maternal Neonatal consultation room (main AP)	Good received signal . The RSSI is about -35 dBm until -40 dBm. The room is covered by excelent signal strength.
Maternal care room (Repeater 1)	Good received signal . The RSSI is about -35 dBm until -40 dBm. The room is covered by excelent signal strength. Without repeater the signal from main AP was -74 dbm
Behind the back door of main building (repeater 2)	Good received signal . The RSSI is about -35 dBm until -50 dBm, the RSSI of a little part of thye room is -60 dBm. The room is covered by excelent signal strength. Without repeater the signal strength from main AP around -60 dBm
On the wall in front of the USG room (Repeater 3)	Good received signal . The RSSI is various and the best is -35 dBm, but a little space of this room is not covered. This is not a problem as long as most of the space of the room is covered by WiFi signal.

3.2.2.3. Outdoor Communication Solution to Cover Gunung Halu District Center

Posyandus are located in every Rukun Warga (RW) house, Puskesmas Pembantu (Pustu) and Village Office. There are 100 posyandus in Gunung Halu districts which are distributed within 9 villages. We only limit the design in Gunung Halu centre of distric. The purpose of this design is to provide a model of communication solution to cover Posyandus location. In addition, it is to make use of the new speedy 3 Mbps installation in Puskesmas. So the midwives and candres can access KIA Online from Posyandu, Midwives house location near Puskesmas, with free of charge. In order to achieve this purpose, the speedy connection in Puskesmas is extended to the centre of distric office. In the distric office, there is a communication tower which allowed to be used by DigiMAPS team with low rental cost. By using this tower, Posyandus can have internet access using P2P and P2MP WiFi Outdoor as can be seen from the figure 12.

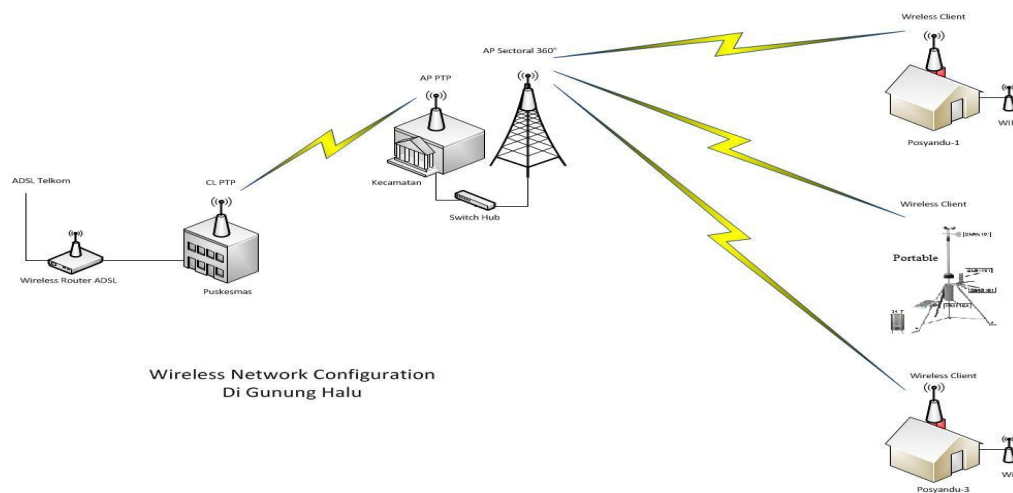


Figure 12. Outdoor Mesh Wifi Network Configuration to cover Posyandu in Gunung Halu

xDSL Modem which's located at Puskesmas Gunung Halu is used as the backhaul network. By using P2P WiFi, we can have internet link from Puskesmas Office to the Distric Office. In order to make P2P, we connect the Modem+Wifiadsl with the Access Point (AP) that will be put at the Puskesmas building on the second floor. The P2P network uses the AP as the main point and Tower Wifi at district office as the second point. From that point in distric office, we uses P2MP WiFi outdoor to spread the WiFi signal to the wireless clients in Posyandu, Doctor and midwife houses.

The coverage prediction of P2MP WiFi outdoor is shown in figure 13

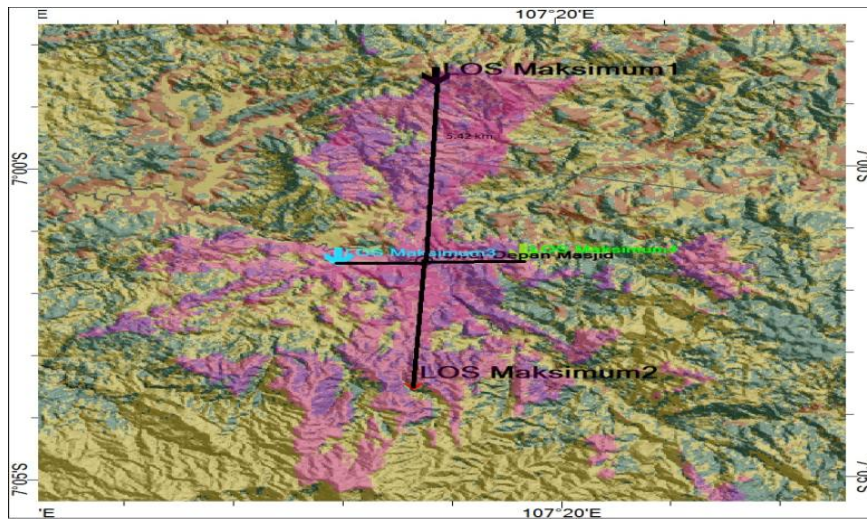


Figure 13. Coverage Estimation of P2MP WiFi in Gunung Halu District

3.2.3. Implementation of Multimodal Communication System

DigiMAPS applications are enabled by multimodal communication framework. The framework identified by the following basic assumptions:

- The communication networks are focus on public broadband IP network either using wireless or wireline approaches whenever applicable in the target area.
- The communication solutions considers various device requirements including PC, tablet, and smartphone, thanks to the web-based and android-based application concepts, DigiMAPS application has been developed by considering these two concepts.
- The communication platforms are designed to support Software as a Service (SaaS) in cloud computing terminology, rather than client-server approach.

These approaches have several advantages including capex-opex efficiency for targeted users (government, health staffs, midwives and doctors), minimum maintenance efforts by the users and can be leveraged easily to cover both rural, suburban, urban areas in the wider scales. However we also understand if the target users (ie. Public health department, clinics, hospitals) may want to keep KIA Online database in their intranet for security reasons. The DigiMAPS system can adopted easily with the cost of

- building intranet/extranet to cover several clinics, hospitals and midwives
- investing in communication platform including video conferences system, application servers and data storages
- Investing in human resources for maintenance the system.

For the context of DigiMAPS project in Gunung Halu, in order to see the impact of DigiMAPS system to the health service performance in Gunung Halu district, several development activities are required including:

Table 9. The implementation Phases of the DigiMAPS infrastructures

No.	Infrastructure Types	Implementation Phases
1.	3G Infrastructures are available, without additional deployment	Not applicable, since already available
2.	xDSL upgrade in Puskesmas Gunung Halu	1 st Phase 1, July 15, 2013, done
3.	WiFi access point for maternal-neonatal building	1 st Phase 1, July 15, 2013, done
4.	WiFi P2P & P2MP to cover Posyandus in Gunung Halu central	2 nd Phase, Sept 15, 2013, done
5.	WiFi repeaters to cover Puskesmas Building	2 nd Phase, Sept 15, 2013, done
6.	VSAT IP to cover Bidan Enden in Celak	2 nd Phase, Oct 1 – 15, 2013, done

3.2.4. Verification and Testing of 1st Phase Trial

The first product verification test has been performed in July 2013, which mainly for

- Knowledge sharing and demo of Tele-Obgyn and KIA Online application
- Verifying KIA & PWS-KIA Online application (prototype version)
- Testing of Tele-Obgyn performance over xDSL and 3G service
- Verifying communication design for VSAT IP, WiFi tower for P2MP, Repeaters placement for the 2nd phase infrastructure deployment in September 2013.

Knowledge sharing and demo for KIA Online and Tele-Obgyn had been performed successfully. While the application verification has been done and reported separately by DigiMAPS application team.

Table 10. Summary of Performance Measurement of xDSL link and 3G Flash in Gunung Halu Puskesmas

Performance Indicator	Speedy 3Mbps	3G Flash Ultima 3GB
Throughput Upstream	0.30 Mbps	1.32 Mbps
Throughput Downstream	2.04 Mbps	4.35 Mbps
Average Delay	139 ms	162 ms
Average Jitter	41.2 ms	17.8 ms
Packet Loss	15.9%	0 %
Estimated MOS Audio	1.0	3.7

Tele-Obgyn solution has been provided as Software as a Service (SaaS) in TELKOM Sigma cloud computing facilities. The system was running well on mobile terminal and PC/laptop when the trial was done. The video conference enabled a midwife in Gunung

Halu communicate with a doctor in Hasan Sadikin Hospital. During the conversation, the video communication using xDSL was not really smooth because of delay in the network. Fortunately the communication using mobile device with 3G flash could be done with better quality compared to the one using xDSL link.

We managed to investigate the network quality by using the online measurement tool from www.ringcentral.com and provide the test result summary as in Table . We further investigate the problem in xDSL by sending ping packet to Spontania server 118.97.213.131. The result confirms the one from ringcentra.com that the xDSL performance is not optimum. The upstream delay was unstable, and loss connection was often occurred, resulting 6-8% packet loss. This is to explain why the MOS score for xDSL was very low compared the one using 3G Flash. By using this finding, we escalated the issue to TELKOM Speedy contact, and now the link has been improved.

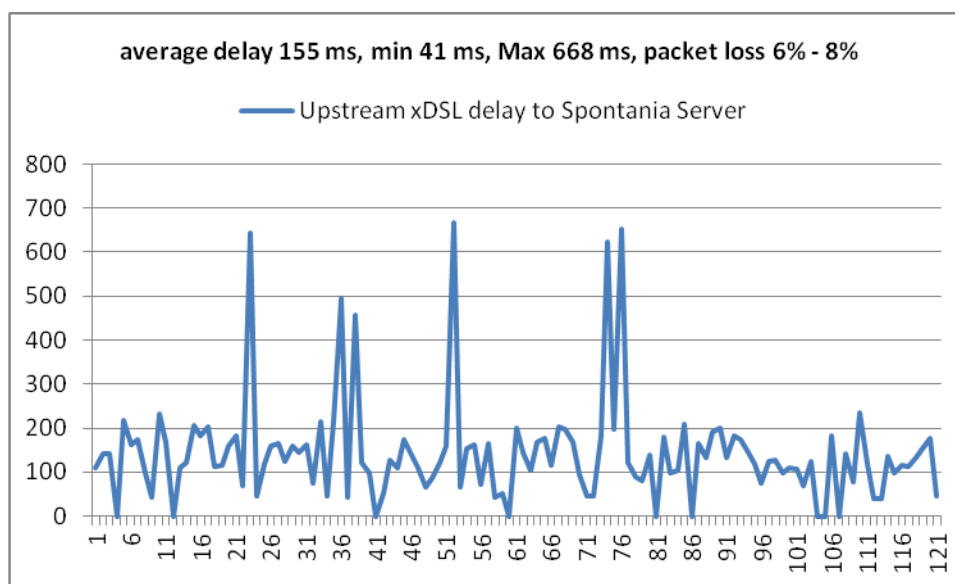


Figure 14. Upstream Delay Performance of xDSL link in Gunung Halu

Regardless the problem in xDSL link, we still managed to achieve the objective by using 3G Flash. Thanks to Spontania system, which could be accessed from mobile devices. In addition we managed to get valuable feedback for DigiMAPS KIA and PWS Online. We also were able to confirm our VSAT and WiFi P2MP facilities and got permission to do installation for the second trial conducted in September 2013.

3.2.5. Verification and Testing of 2nd Phase Trial

In the end of September 2013, we managed to have a complete set of multimodal communication facilities in Gunung Halu which consist of

- improved xDSL link for Gunung Halu Puskesmas, including all indoor WiFi installation within Puskesmas Building

- P2MP WiFi coverage to cover Posyandus and selected a maternal house near Puskesmas.
- VSAT IP Instalation in a maternal house (Ms Endah, a midwife).

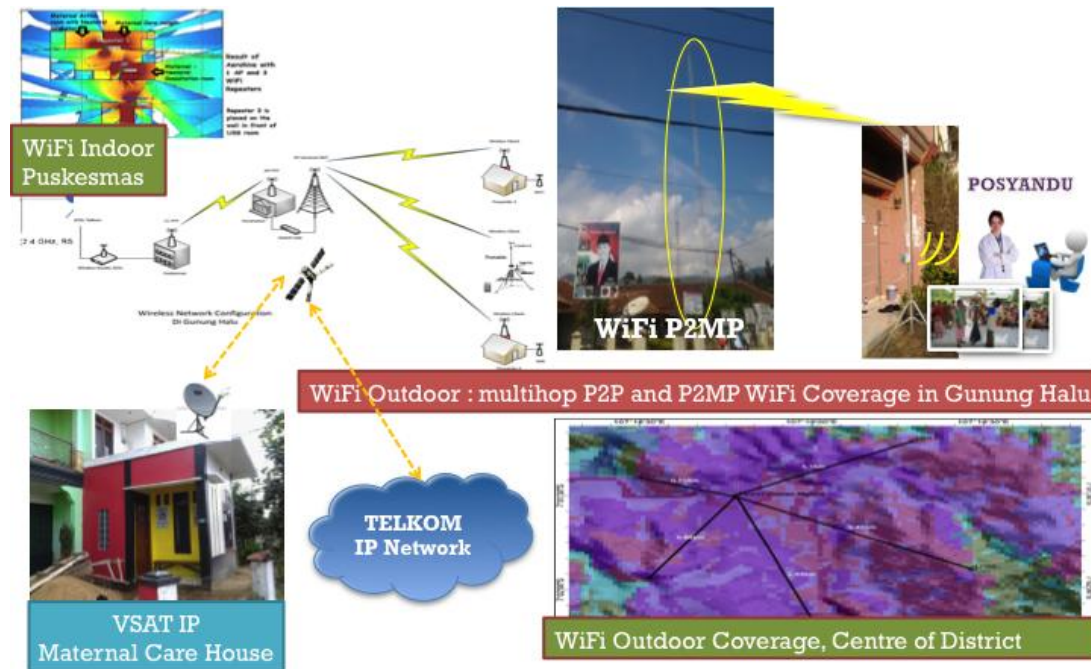


Figure 15 Multimodal Communication Facilities in Gunung Halu District

The WiFi P2MP has been installed on top of 30 meters-tower in the centre of Gunung Halu Distric. Since the main xDSL backhaul installed in Puskesmas Building, and separated about 200 meter long, WiFi multi-hop was also installed to support WiFi P2MP facilities. With this configuration there are two advantages can be enjoyed by the midwives in Gunung Halu:

- they can have access to KIA Online and Tele-Obgyn both in indoor and outdoor, including in Posyandu location
- they can utilize and optimize the existing xDSL backhaul with relatively larger coverage.



Figure 16. WiFi P2MP in Gunung Halu

(a) WiFi Tower

(b) WiFi Measurements using portable WiFi clients for Posyandu

We conducted the measurement to ensure the performance of DigiMAPS application as can be shown in the following table. Based on the measurement which conducted 5 times in locations including Puskesmas Indoor (xDSL and 3G), Puskesmas Outdoor (3G), and Midwives maternal house outdoor for 3G and WiFi.

Table 11. Summary of Performance Measurement of xDSL, WiFi P2MP and 3G Services in Gunung Halu (2nd Phase Trial)

Performance Indicator	xDSL 3Mbps Puskesmas	3G Indoor Puskesmas	WiFi P2MP Outdoor	3G Outdoor
Throughput Upstream	0.45 Mbps	0.336 Mbps	0.456 Mbps	0.344 Mbps
Throughput Downstream	2.93 Mbps	1.998 Mbps	1.686 Mbps	1.96 Mbps
Average Delay	49 ms	114 ms	49.4 ms	57 ms
Average Jitter	9.6 ms	152 ms	29.2 ms	55.9 ms
Packet Loss	0.012	0.65%	1.65%	0.85%
Estimated MOS Audio	3.2-4	1	2.6	2.7

The xDSL performance is much improved to support Tele-Obgyn if it is compared to the result during the 1st trial. Now xDSL link can be used to support Tele-Obgyn application. 3G is relatively good, however the MOS and delay are fluctuated depend on the user activity in 3G network, radio propagation (indoor vs outdoor) and data subscription (3G QoS). It can be seen that the delay in indoor was deteriorated due to multipath fading and network load.

WiFi performance received from P2MP WiFi is relatively good, however in terms of MOS is less than 3, there for it is not recommended to use Tele-Obgyn application outside Puskesmas for emergency consultation purpose, but for communication in general purpose can be used instead.

VSAT IP has been installed in Bidan Enden's maternal house in Celak Village, Gunung Halu. The VSAT IP service is 512 Kbps/256 Kbps with committed information rate is 128 Kbps. The VSAT IP uses Ka Band and provided by IPSTAR.

Table 11. VSAT IP Performance in Celak, Gunung Halu

VSAT IP	min	max	average
delay (ms)	545	1424	982
Upstream Speed (kbps)	128	512	-
Downstream Speed (kbps)	128	256	-
Tx	-	48.9	48.8
Rx signal (dBm)	-	70	70
Toll Es/No (dB)	-	-	12.5
STAR Es/No (dB)	-	-	20.8

Based on feedback from Bidan Enden, the VSAT IP can be used to access the internet (KIA Online), however due to high rain fall rate in Gunung Halu, the performance is depended on the weather condition. Therefore if VSAT IP will be used for DigiMAPS Project it is recommended to use C-Band solution which has better performance in high rain-fall rate area. In terms of fluctuation in delay, it can be concluded that Tele-Obgyn cannot be used with the such high delay.



Figure 17 VSAT IP in Celak, Gunung Halu
(a) maternal house
(b) VSAT IP measurements

3.2.6. Summary of Multimodal Communication Solution

Basic approach of multimodal communication solution is

- Use available public broadband IP communication networks
- If not available, than setup WiFi and/or VSAT IP (leased line)
- Support multi-devices, multi-operating-system & multi-screen
- Web-based and Mobile Apps.
- Cloud computing (SaaS) approach for DigiMAPS application (Tele-Obgyn and KIA Online)
- Can be adopted in both rural and urban

Benefit of Multimodal Communication from customer perspective

- Less capex/opex
- Managed services: Government does not require to have IT specialist

Challenges of Multimodal Communication related to KIA Online

- Data privacy (confidentiality) and security of KIA data need to be further evaluated
- New SaaS Business models, need to be validated and confirmed to the prospective users

Tabel 12 provides the summary mapping of DigiMAPS features and communication mode can be used in DigiMAPS context.

Table 10. DigiMAPS Features and Communication Mode Mapping

DigiMAPS Apps.	Requirement	VSAT IP	2 G	xDSL +WiFi indoor	3G
KIA Online	Narrow band	√	Semi-online	√	√
PWS-KIA	Narrow band	√	Semi-online	√	√
Tele-Obgyn	Min 128 Kbps	High delay	NA	√	√
Coverage		Remote area	Rural/suburban	Suburban/urban	Suburban/urban
Advantage		support remote area	Large coverage	High speed and stability	High speed
Drawback		High rent cost	Low speed	Coverage limited	Limited coverage in suburban/rural, Low Speed in urban

3.3 Application Solutions

As part of project deliverable, the application has developed by using Lean Innocation Management framework as described in the beginning of this chapter. There are two applications that has developed during the project in order to meet the basic requirement of the project. The application solution has been developed and implemented on Gunung Halu will be explained in section below.

3.2.7. KIA Online

KIA Online includes engine and multimodal data entry systems allowing prospective users to exploit any means of broadband communication systems available in city and rural area. For trial purposes in Gunung Halu, we will use WiFi technology to connect local health center (Puskesmas) to several Midwife located in nearby and remote area. In the rural area, the challenge not only comes from communication infrastructure but also electricity. Therefore we have proposed a communication package system comprises communication devices and application to support Midwife, volunteer and docter.

KIA Online has designed to capture the maternal and post natal data, reveal the data into report and enhance capabilities of the midwife through it simplicity. The KIA Online engine has been tailored to accommodate current data format and protocol already implemented in the field.

Basic requirement of the KIA Online has come from user need validation process, the users and their problem has been validated in the beginning of project. Since the software of maternal and post natal care system has been developed base on practical user interaction in the representative location.

The illustration of KIA Online as described in the figure 18 below.

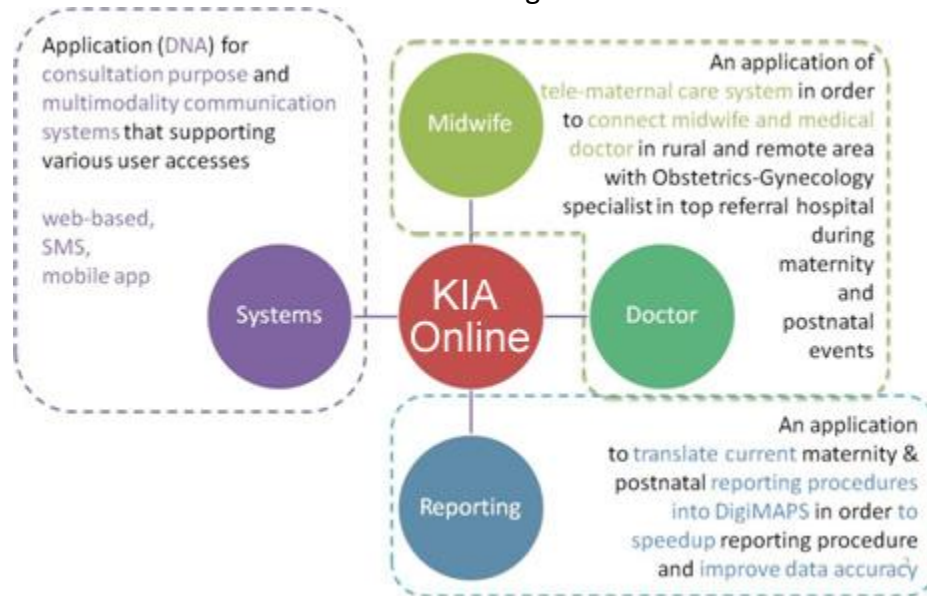


Figure 17 KIA Online Architecture

3.2.7.1. Logical representation of KIA Online

Logical representation of software of KIA Online system elaborates relationship between actors and system. The relationship will be stated in a use case diagram. The use case diagram should provide good coverage of user requirement. The actor of the system as stated on table 13.

Table 13. Actors of KIA Online

No	Actor	Description
1.	Administrator	User with Super user roles which gain access to system . Responsible on operation, back up, security and maintenance of system.
2.	Midwife	User with medical data entry and data read roles.
3	Doctor	Expert user with medical data entry, data read, data analysis role

Actor is representing people, system, external entity or stakeholders who provide input or get output from the system.

Use case diagram of the system reveal both interaction between actor and the system. The use case was built to describe what the system do and get the name for it. Every use case was drawn in horizontal ellipse symbol; interaction with actor was symbolized into open arrow (Figure 18).

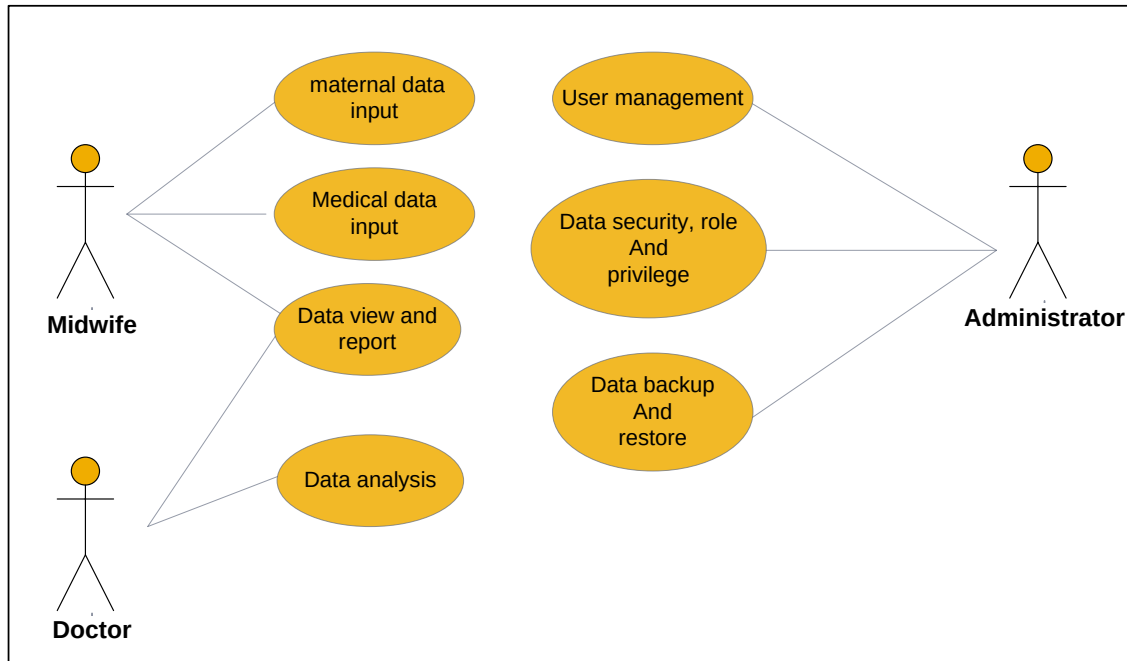


Figure 18. Use Case Diagram of KIA Online

Detail elaboration of use case reveal detail features that will accommodate into the system as seen on table 14.

Table 14. Use case detail elaboration

Code	Name	Description
UC_010	Maternal data input	Basic system's capabilities related to data input provided by actor through classified process by using printed form or electronic devices. Main actor of this use case is mid wife who receive hand written report from medical volunteer.
UC_020	Medical data input	Basic System's capabilities related to data collections of patient, diseases, medicine or other issues that need to be confirmed by expert.
UC_030	Data view and report	Basic capabilities of the system which include data presentation feature, report generation, data indexing, data cataloging, etc.
UC_040	Data analysis	Basic capabilities of the system that include: data inspecting, data cleaning, transforming into another format, and data modeling with the goal of highlighting useful information for actors.
UC_050	User management	Is an authentication feature that provides administrators with the ability to identify and control the state of user logged into the system.
UC_060	Data security,	Ensure data privacy and compliance with data loss or

	role and privilege	exploitation prevention method. Protect the data from insider threats, data stealing, malware and unauthorized user.
UC_070	Data backup and restore	Basic capabilities of the system of copying files or databases so that they will be preserved in case of equipment failure or other catastrophe. The opponent capabilities of the system is data restore, basic capabilities that involves copying backup files from secondary storage to the disk.

The use cases diagram transformed into class information that define interaction in terms of public methods. The next step is composing several diagrams such as: interface diagram, object programming library and interface collaboration diagram. Skeleton code of software system should be composed based on the three diagrams.

3.2.7.2. Scope of KIA Online design

The scope of design of KIA Online is stated below.

1. Improve services for maternal and medical data capture
Reduce data bias or lost since hand written data transformed into digital data. Reduce time to retype the data and compose it into report.
2. Better performance of health service in backward regions
Several meanings of better performance compare to condition without the system such as: faster data transfer, better appearance of data, better managed information, etc
3. Efficient User Interface
One of the scope of the proposed system is to provide a user friendly User Interface, enable user to work on clicks and make the data transfer possible with the various communication devices.
4. More information for better decision or action to the suitable environment.

3.2.7.3. Entity Relationship Diagram

Entity Relationship (ER) Diagram of the system describes relational data storage of the system in data table form. The physical model of data table is normally forward engineered to instantiate the structural metadata into a database management system as relational database objects such as tables, views, store procedure, and database constraints. The ER diagram is also normally used to design modifications to the system relational database objects and to maintain the structural metadata of the database. ER diagram of maternal and post natal care system as seen on Figure 19.

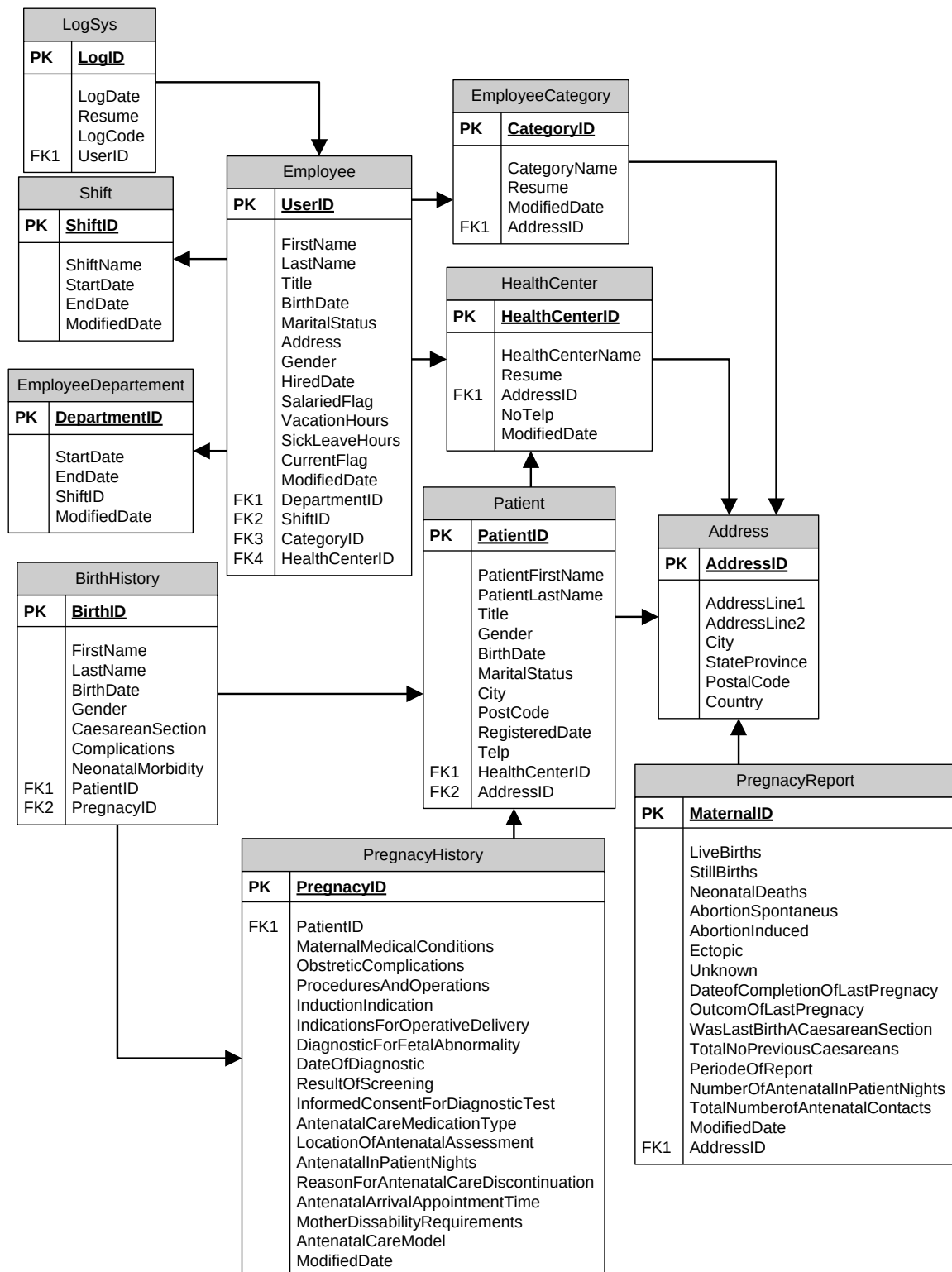


Figure 19. ER Diagram of KIA Online

The first stage of information system design of the system uses these diagram during the requirements analysis to describe information needs or the type of information that is to

be stored in a database. The data modeling technique can be used to describe any ontology (i.e. an overview and classifications of used terms and their relationships) for a certain area of interest.

3.2.7.4. Graphical User Interface (GUI) of KIA Online

The Graphical User Interface (GUI) of KIA Online as seen on figure xxx. In order to provide the best view for common personal computer screen, the GUI resolution has setted for 800 x 600 or 1024 x 768 pixel with color quality 16-32 bit. The layout of the GUI KIA Online has been designed to comply the situation of minimum and maximum appearance of common internet browser.

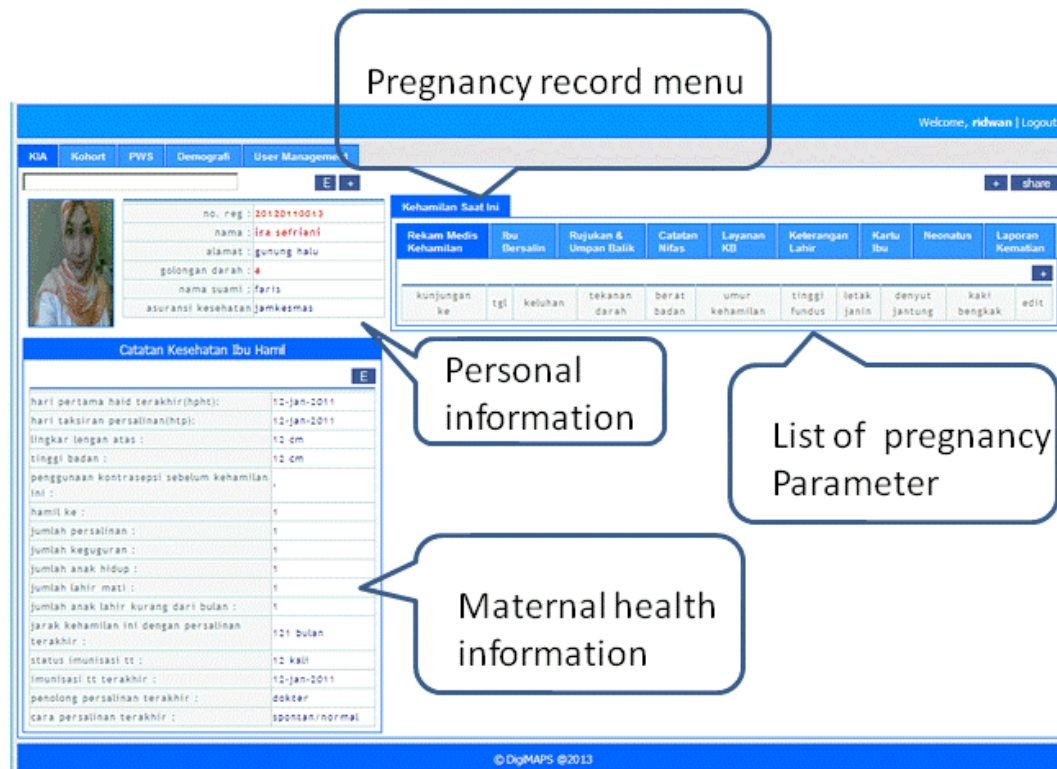


Figure 20. Main page of KIA Online

The KIA Online has developed by using common markup and scripting language such as : HyperText Markup Language (HTML), PHP Hypertext Preprocessor, Cascading Style Sheet (CSS) and jQuery.

To deal with minimum specification of appearance on the client side of computer, several consideration has made and implemented for the KIA Online as described below :

1. Separated placement of Java Script, CSS and action script against the main page of GUI KIA Online to reduce the total size of page should be loaded on the client screen. The modification for the files will be held easily, any replacement of the file can be done with minimum risk of imcompatibility since each file can be debug partially.

2. Enhance browser capability with primed cache management. In the situation where floating information sent from network is minimum, the minimum floating information has been common way of non multimedia page application, in that situation the primed cache management is right thing that can be done.

3.2.8. PWS – KIA

The additional module of KIA Online has made to meet the requirement of reporting. The PWS (Pengawasan Wilayah Setempat or Local Area Monitoring) is the formatted table for maternal and post natal reporting. Back to the situation when the data has extracted from KIA book manually, it was taking more than two weeks for each midwife to compose complete of monthly PWS. Another problem would be come since the road infrastructure in the worst condition, it would be more than 4 hours to sent the document from Gunung Halu to the Head Office in Bandung Barat.

Since KIA Online has implemented on Gunung Halu, the PWS formatted table has been generated automatically by PWS- KIA Online module directly. The PWS module has been summarized the electronic data from KIA Online, it reduce miscalculation of data, data inconsistency as well as the effort for extraction.

The PWS module has been implemented as part of KIA Online, the appearance of the PWS module as seen on the figure 21.

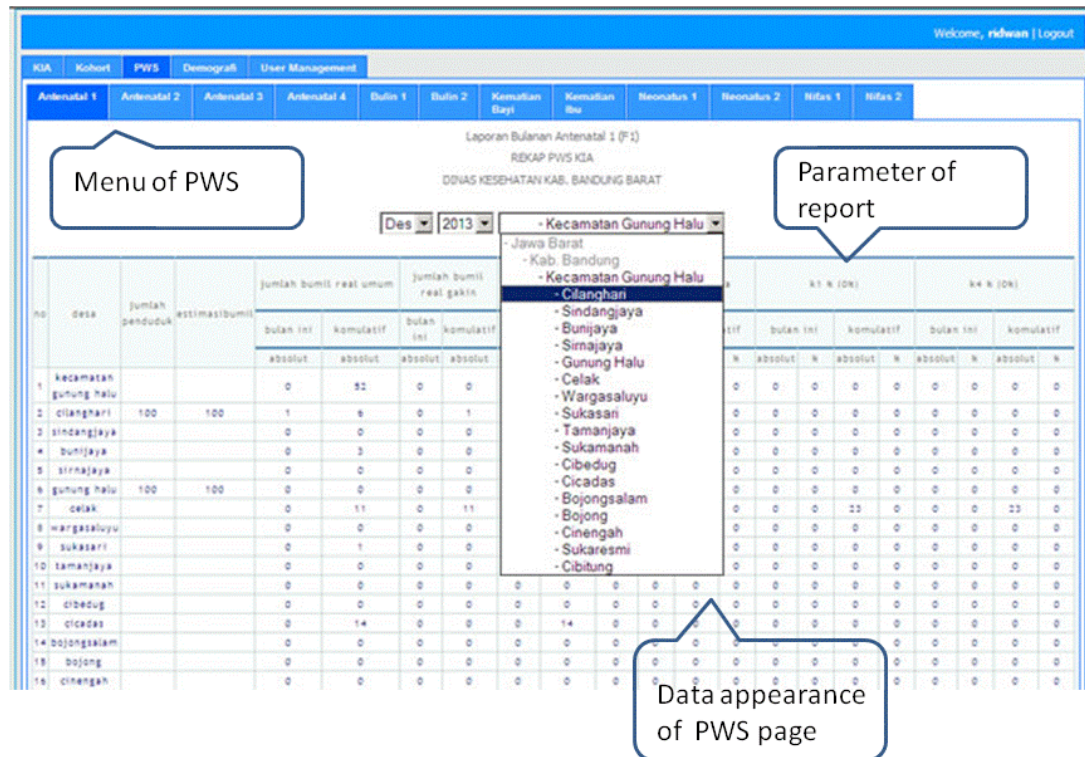


Figure 21. PWS page on KIA Online

And then the PWS page can be shown onto client browser just in time with no distance limitation or road infrastructure issue.

3.2.9. Tele Obgyn

The real and biggest problem of Gunung Halu is worst road infrastructure. Information and communication technology has been utilized to reduce the impact of the situation. The simplest game to deal with the situation was providing audio visual communication for midwife, volunteer and doctor on Gunung Halu.

A module of audio visual communication system has been implemented onto personal gadget and personal computer of midwife, volunteer and doctor. Several surveys has made to obtain the best situation and scenario for audio visual communication from Community Health Center (Puskesmas) to Hasan Sadikin Hospital on Bandung, or even from midwife house to Bandung.

As mentioned on the Verification and Testing 1st/2 nd Phase Trial, the network access devices have been installed to leverage the visibility of audio visual communication such as Tele Obgyn module.

The appearance of Tele Obgyn module as seen on figure 22 below.



Figure 22. Module of Tele Obgyn has been implemented On Gunung Halu



Figure 23. First explanation of Tele Obgyn for Midwife

4 Summary of the Project Activities

4.1 General Project Activities

All researchers involved in this project, both researchers from Indonesia and Japan, actively supported all project activities. Some activities were virtually held via email, via telephone line and other activities required a physical attendance of the researchers (exchange of researchers).

In general, all main activities of the project complied with the initial planning. Although Some activities required an adjustment to accommodate the progress of DigiMAPS dissemination and challenge in the field trial. The project ends twelve months (March 2014) after the APT grand received.

The detailed description about project activities is summarized in the following table 15.

Table 15. Summary of Project Activities

ID	Task Name	Start	Finish	Location	G
1	Digitalization Maternal	14 January 2013	18 February 2014		
2	Kick off project	14 January 2013	14 January 2013	BANDUNG	
3	Project planning	05 February 2013	11 February 2013	BANDUNG/JAKARTA	
4	Site survey	27 February 2013	21 March 2013	GUNUNG HALU	
5	Workshop of Maternal Health & Post Natal care	25 March 2013	02 April 2013	BANDUNG	
6	Ideation/Idea validation	09 April 2013	02 May 2013	GN HALU	
7	System Requirement	03 May 2013	30 May 2013		
8	Device design	03 May 2013	30 May 2013	BANDUNG	
9	Software design	03 May 2013	23 May 2013	BANDUNG	
10	Network & Communication Design	03 May 2013	30 May 2013	BANDUNG	
11	System development	24 May 2013	28 August 2013		
12	Device manufacture & packaging	31 May 2013	08 August 2013	BANDUNG	
13	Software development	24 May 2013	08 August 2013	BANDUNG	
14	Installation & Integration	09 August 2013	28 August 2013	BANDUNG	
15	research on Community Health Center	31 May 2013	25 June 2013		
16	observation to user at location	31 May 2013	13 June 2013	GUNUNG HALU	
17	discussion & review	17 June 2013	25 June 2013	BANDUNG	
18	First use	01 July 2013	26 September 2013		
19	documentation	01 July 2013	16 July 2013	BANDUNG	
20	first use/stabilization	26 August 2013	12 September 2013	BANDUNG	
21	first use evaluation	13 September 2013	26 September 2013	BANDUNG	
22	Discussion with Japanese Expert	10 October 2013	20 October 2013		
23	Meeting With President of UEC Tokyo	10 October 2013	20 October 2013	TOKYO/JAPAN	
24	Meeting with Prof. Toshizumi Ohta	10 October 2013	20 October 2013	TOKYO/JAPAN	
25	Meeting with BHN	10 October 2013	20 October 2013	TOKYO/JAPAN	
26	Field trial	19 November 2013	11 December 2013		
27	KIA Online /PWS trial	19 November 2013	28 November 2013	GUNUNG HALU	
28	Teleconsultation trial	19 November 2013	28 November 2013	GUNUNG HALU	
29	Product Validation	29 November 2013	11 December 2013	BANDUNG	
30	Project Dissemination	10 October 2013	10 January 2014		
31	Int'l publication on IsfTech 18th. Takamatsu	10 October 2013	20 October 2013	TAKAMATSU/JAPAN	
32	Maternal & Prenatal care workshop. Bangka	12 December 2013	16 December 2013	BANGKA	
33	Maternal & Prenatal Care Workshop	12 December 2013	12 December 2013	BANDUNG	
34	Int'l publicatin on The 7th Asia Telemedicine Seminar.	06 January 2014	10 January 2014	BANGKOK/THAI	
35	reporting	10 February 2014	18 February 2014		
36	final & accounting report	10 February 2014	14 February 2014	BANDUNG	
37	project closing	17 February 2014	18 February 2014	BANDUNG	

4.2 Exchange Activities

4.2.1 Exchange Activity in Indonesia

Exchange activity for this Digimaps project was held in Indonesia and hosted by TELKOM-RDC from March 2013 to March 2014. Some activities that is done during the visit:

4.2.1.1. Kick-off Meeting

This meeting was held in RDC-TELKOM, Bandung and attended by 7 Indonesian researchers. Japanese researcher gave their comments and discussion via email and yahoo messenger.

4.2.1.2. Project planning

Defining vision and mission statement of the project with all activities that would be achieved. Defining project output and clear statement of milestones, as well as person in charge in every activity.

4.2.1.3. Ideation

The ideation activities has been conducted to find out the most painfull problem of the user and identify the valid solution can be made to overcome the problem. During the ideation session, the team arranged focus group discussion with the midwife in the health center on Gunung Halu. Several meeting has conducted with the midwife, volunteer and doctor during May to June 2013. Spesific topic of direct interview has created and asked to them during the ideation.



Figure 24. On site ideation in order to capture the real issues and problem



Figure 25. Direct interview has conducted with midwife and doctor

Several intensive interviews with Health Service of West Bandung also arranged in order to compare the problems has founded.



Figure 26. Visit to Health Service of West Bandung

Since several problems has founded, the collaborative discussion has arranged with Japanese Expert to define the ICT related solution that could be declared as for the solution.

4.2.1.4. System requirement analysis

The system requirement analysis has created as result of ideation activities. All team already captured the data from intensive interview has made several days before, the most paintfull problem has defined. To validate the suitable solution against to the most painfull problem of the user, the team has been used the Lean Innovation Management to identify two things of user and problem. The Lean Innovation Management described in Annex-2. In the situation where the problem as well as the solution were unknown, the lean innovation process has been become the most effective way to validate both of them.



Figure 27. Small working group on design and analysis activity

4.2.1.5. System planning and design

Defining and assessing some tool/equipment would be used for development and trial. Identifying the suitable method of data measurement on field trial. The procurement has been done in Bandung, and some of the tools have been used for the development of the system.

In this phase, the minimum viable product (MVP) has identified based on the several assumptions that capture during the ideation and system requirement analysis phase. Several basic features and capabilities has defined to overcome the problem

Two critical conditions identified from the problems : the existence of obstetry gyneacology (obgyn) expert it must be, time accurate of report that should be provide by healt service office in order to provide valid and suitable health programme monthly. The MVP of technology will be identified to deal with the critical conditions, the technology will be utilized to create maximum appearance of obgyn in rural location, as well as the technology will be optimized to create more efficient methode and faster way to deliver data from midwife to health service office. Detail MVP will be tranformed into features and system capabilities. To deal with the conditions and problems, DigiMAPS team have initiated a solution to reduce the risk of obgyn absence on emergency cases, to obtain fast and valid report through easiest and otomatic process of reporting from widwife to health service office.

The first solution will be revealed into Tele obgyn solution and second solution will be fitted into KIA Online and PWS-KIA Online.

4.2.1.6. Equipment procurement process

In order to meet technical specification of the DigiMAPS system, some devices was ordered and tested before the field trial. Equipment procurement process was arranged in self procurement that comply with Telkom procurement procedures.

4.2.1.7. Research on Community Health Center

That was time for get out of the building and go to representative location. That was the time to validate the assumptions and solutions has provided to deal with situation.



Figure 28. Team member on their task of validation during July 2013

It need several days on locations to test and obtain the suitable solution for each problem. Each assumption has validated and measured to ensure the data has captured during the test. For almost two weeks during the fasting month on 2013 (July 2013), the parameters of test has tested and validated.

4.2.1.8. Exchange researchers (discussion with Japanese expert)

During October 10 - 20, 2013 the Indonesians researchers have visited Japan to do exchange activity for this APT project. The activity was hosted by the University of Electro Communications (UEC) and Basic Human Need (BHN). The summary of this exchange activities are as follow :

Discuss about the findings, validated proposed solution and enhancement of the system with Prof. Toshizumi Ohta and Dr. Hirohiko Suwa. In this discussion, the team received many advices to improve the implementation of Digimaps system.

The team also arranged a meeting with president of UEC, Prof. Makoto Kajitani, to report the progress of the project and next activity of the implementation.



Figure 29. Indonesian Researchers has accepted by Prof. Makoto Kajitani

Another meeting also has arranged with Basic Human Need (BHN) institution on its headquarter on NTT Ueno Bldg.5-24-11 Ueno, Taito-ku, Tokyo.

The discussion has focused on basic idea of the Digimaps project and the possibility of implementations in the next near future.



Figure 30. Indonesian Researcher on their visit to BHN

It was a valuable meeting with BHN, since they have experiences of APT J3 implementation on several countries. The BHN shared their capabilities and experiences to Indonesian researchers.

4.2.1.9. Field trial and workshop

The trial was arranged in order to test the functional solution and user experience, and the workshop was arranged to leverage the product knowledge to the midwife, volunteer and doctor on the Gunung Halu. The field trial and workshop has held during the beginning of Dec 2013.



Figure 31. The situation of field trial and workshop

It was the first time for user to see the appearance of applications, either web or application for smartphone. All team has taken in charge on technical explanation of solutions. The midwife and doctor has setted for using KIA Online, Tele Obgyn and PWS-KIA application.

4.2.1.10. Project dissemination

The project dissemination has arranged for several objectives, eg: raise awareness in the medical practitioner and government, generate understanding and obtain the support of medical practitioner according the project, bring about a change in attitudes and ways of thinking for targeted user.

Detailed event has targeted for project dissemination as explained in the Chapter 6.

4.2.1.11. User experience test

The User Experience (UX) test was held to capture the opinions of users by using offline survey to clasified respondents. The objective of the survey is to capture the acceptance level of users to KIA Online application. The users has devided into two categories, eg: medical praticioner and non medical praticioner. The detailed result of the UX test as elaborate on Annex 3.

4.2.1.12. Project closing

All activities of the project would be summarized into project report that will be delivered on project closing phase.

4.2.2 Exchange Activities in Tokyo – Japan

From Oct 10, 2013 until Oct 22, 2013, Indonesian researchers have visited Japan to do exchange activity for this APT project. The activities were International Conference and Seminar on Takamatsu Prefecture, and meeting hosted by The University of Electro-Communications (UEC). The summary of this exchange activities are as follow:

4.2.2.1. Conference and Seminar

During exchange activities in Japan, the team member had also joined on two conferences has conducted on Takamatsu Prefecture, Japan, eg: the 18th ISfTeH International Conference, Japanese Telemedicine and Telecare Association. Detailed explanation as seen on chapter 6.

4.2.2.2. In the UEC – Japan

- a. Discuss about enhancement of the system with Prof. Toshizumi Ohta and his team. In the discussion team received many advices to improve the implementation of Digimaps system, especially for non-technical things such as product validation process, effective measurement and evaluation the impact of the system's implementation, some features and ICT need to be focused for main problem solving. Deep discussion has been conducted in order to defined objective, methodology of problem solving, and main purpose of technolog.
- b. Have a meeting with president of UEC, Prof. Makoto Kajitani, to report the progress of the project and next activity of the implementation.
- c. Finalizing the final design document of the system and processing the data collection during the trial in Indonesia.

During Japanese institution visit and exchange experience, the Digimaps team briefly obtained many information regarding telemedicine and telecare system already developed and operated, the information has been elaborated and implemented for the same situation on Digimaps trial location.

5 Project Deliverables/Outputs

5.1 DigiMAPS as Solution for Maternal and Baby Newborn

The whole system of DigiMAPS comprise of communication solution and application solution. Both of the solution has designed to answer the main problem of people of digital device. Digimaps already tested and tried on Gunung Halu during end of 2013.

5.2 KIA Online Application

KIA (Kesehatan Ibu dan Anak or Maternal Health Record) is a book for maternal health recording, it has been published by Ministry of Health of Republic of Indonesia. It was composed on 1997, in collaboration between Ministry of Health of Republic of Indonesia with Japan International Cooperation Agency. KIA book still has been delivered to the mother to capture medical record during her pregnancy till the children get five years old. KIA online is an online version of KIA book, it has developed for web and smart phone based application. The user interface for both web and smart phone application as seen on figure

KIA Online has developed from the scratch to capture many aspect of the information according maternal health service, maternal –child nursing as well as mother child relation. In the real condition, all aspect of the information has been captured in the KIA book record. KIA Online has developed onto 2 technology platforms, web based and android based technology. Web based application is covered almost items in the KIA data flow as seen on figure 32.

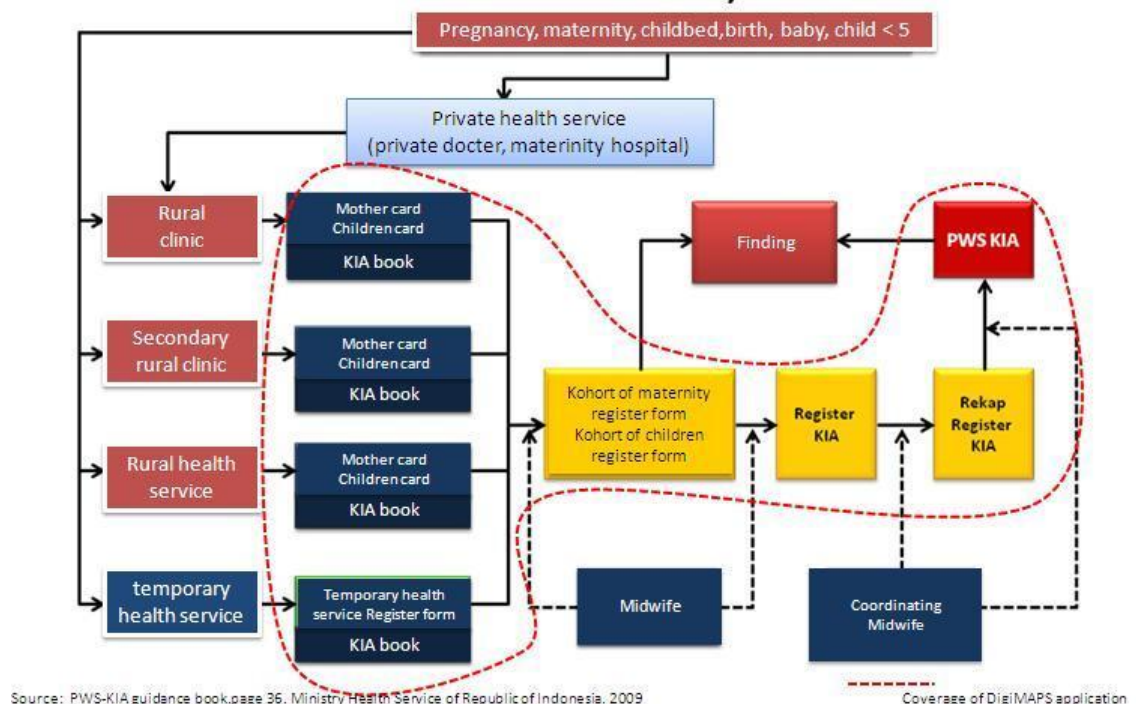


Figure 32. The situation of field trial and workshop

In the web based application, the appearance has been separated into 3 menus are: KIA, Kohort and PWS (pengawasan wilayah setempat or local area monitoring graph). The KIA Online can be accessed through intranet network.

In order to deliver the user experience of online digital system for midwife, several rural health services will be joined into intranet loop of trial. The loop also connected to health office on West Bandung municipality.

5.3 User Acceptance DigiMAPS Service

This study aims to verify what the initial behavior of midwives towards the use of Online System for Mother and Children Health Record system and whether their continue utilization will lead their intention to adopt this system in the future. In a period of 3 months, 5 volunteer midwives will monitor each up to 10 expectant mothers and their new born babies in Gunung Halu, West Java - Indonesia.

A Technology Acceptance Model (TAM) questionnaire was supplied to them before and after using the system and analyzed the significant improvements in opinion between them. An additional survey was performed to analyze the usability of the system to understand midwife experiences using the system. Improvement between the pre and post iterations of the TAM questionnaire and result of usability testing of application will contribute to design the best interface for this system and facilitate conditions to integrate the system into the midwife's daily routine.

KIA Online has two main objective, the first one is to report on time every month beginning in stages and the second one is to provide validation and analysis of data at district and city level. Thus, KIA Online is expected could be used by all medical personnel (midwives) in the area.

In order to know the user acceptance, the team do a qualitative analysis with 8 respondents which used two methodology:

- a. User Experience; to observe people using the product to discover errors and areas of improvement and measuring how well test subjects respond in four areas: efficiency, accuracy, recall, and emotional response.
- b. Technology Acceptance Model; seek to know the initial perception of the applications that have been made, and the more likely to be adopted.

The result can be shown in table 16.

Table 16. User Acceptance of KIA Online

Respondent	Attribute			ICT Level		UX Level	TAM	
	Age	Sex	Category	Device	Internet	Usability	Easy to Use	Usefulness
Ai Santi	25	F	Midwife					
Yauhana	22	F						
Yosima	29	F						
Lilis	41	F						
Aditya	29	M	Office Worker					
Hanny	23	F						
Dewi	21	F						
Qonita	22	F						

5.4 Enhancement of Human Resource Competencies

All researchers involved in this project have obtained some advantages to improve their technical capabilities and project experiences, especially in scope of monitoring and reporting for maternal and baby newborn. To achieve the simply deployment device, technical competency in reporting systems in the rural area we should contact directly to the midwife and volunteer who works in collecting data from the mother and newborn.

The response of medical personnel while using DigiMAPS user interface were significantly quick and user friendly in the simulation. The users were easy understandable when the first time facing KIA Online user interface, especially for Tele Obgyn.

6 Workshop & Dissemination

6.1 Asia Pacific Advanced Network, Bangkok Thailand

After the project we have disseminated our results to the international meeting, in International Telemedicine Conference in Takamatsu and ASEAN ICT Meeting in Tokyo Japan. Bangkok it is also presented in Asia Pacific Advanced Network Meeting in Bangkok, as shown in the picture below.



Figure 33. DigiMAPS has presented in the Seminar on Bangkok, Thailand

6.2 International Conference Telemedicine Takamatsu and ASEAN meeting in Teleconference, Tokyo, Japan

In Japan, the Ministry of Internal Affairs and Communications took the lead, and it has carried out the model projects for promoting the solution through utilization of ICT. In this Symposium, the participants acquire through lectures, observations and explanations on the latest trends in E-Applications for Overcoming Digital Divide in medical cares, etc. specialized knowledge that will contribute to their future planning of ICT policies. In Japan, there are many examples of the E-Applications for many fields even in rural areas. Typical examples of the applications are selected for this Symposium.

The visit to Kagawa University in Takamatsu City in Kagawa Prefecture to observe the applications in medical field is one of the main subjects. The interesting applications are the network of perinatal telemedicine, teleconference system include an electronic medical record, the apoplexy cooperation path, recuperation-at-home support which utilized the medical network. We also International Conference on collaboration with telemedicine in Takamatsu city.

The Objectives of this Symposium is to enable the participants, by experiencing the forefront of infrastructure and operational technology of the one of the most advanced countries of the E-Applications for Medical fields. Through lectures and observations, to become aware of the necessity to apply and utilize the methods of the mentioned E-Applications in participants' own countries and to become able to turn the knowledge acquired in advantage when the participants plan and prepare applications in their own countries are expected.

In addition, the Symposium does not only limit the flow of information given in one direction from lecturers to the participants, but also encourages the interactive flow of information by presentations and discussions regarding the present state and future plans of E-Applications in participants' own countries among participants themselves and with the Japanese specialists, exchanging and sharing the knowledge and information mutually, enabling the participants to feed them back to the planning of ICT in participants' own countries, as showing on below pictures.



Figure 34. DigiMAPS has presented in the IsfTeH 18th, Takamatsu, Japan

6.3 Workshop in Bangka Belitung Islands Province Indonesia

In order to be implemented in other area, we also proposed this project in Bangka Belitung Province which consists of many small islands. During the time, we made a

workshop in front of the doctors and nurses about the use of ICT in maternal and prenatal care as well, as shown on the figure 35.



Figure 35. Maternal and prenatal care workshop, Bangka

7 Impacts of the DigiMAPS Project

1. Digitalization of maternal and postnatal care reporting systems (DigiMAPS) that supported by TELKOM Infrastructure has contributed for the people in the rural area especially for the monitoring and reporting systems of maternal and baby newborn
2. Enhancing the utility of broadband connectivity model to support DigiMAPS access in rural and remote area
3. Development instant communication service for maternal and postnatal telemedicine system has been used to make a quick reporting systems so that hopefully it may cause the quick response from the obstetrician and stakeholders in case of maternal and baby newborn problem.
4. This project also has made a comprehensive study report of applicability of this system including coverage characteristics, performance, application, deployment issues and use case scenarios.
5. Introducing the system to local government, paramedics and midwives
6. Dissemination information and research outcome to health and ICT community align with EMAS programs, Family Planning Coordinating Agency (BKKBN) and Ministry of Health.

8 Project Sustainability

In order to ensure the continuity of the project, all team members have considered continuing the research of Digimaps system. Some efforts to ensure the sustainability of the implementation of Digimaps system are:

1. Improvement of the Digimaps system based on the trial measurement; such as enhance the stability of the platform, improvement of the antenna and securing the communication part to avoid fraud.
2. Implement application that is needed most for disaster victims, for example victim management, video streaming application and voice over IP. These applications should be light and very easy to use.

9 Lesson Learned

Some lessons learned from this project are as follow:

1. The implementation of IT is very important for human being, not only for people live in the city, but also in the rural area. And we realized that the distribution of IT knowledge is not equal in every area. Because of that, IT related project should be developed gradually in more rural areas to avoid isolation area.
2. Collaboration among researchers from some different locations can be effectively accomplished electronically via both Internet and telecommunication facilities.

3. Intensive coordination between team members, non-government organization and also people is very needed to make sure that the implementation of the system is running well.
4. The problems/limitations of this limited DigiMAPS trial may be in the area of:
5. Blank spot communication signal that covered by mountainous area that has not have communication facilities.

10 Future Plan

1. All team members consider to do further research regarding mother and baby newborn monitoring to decrease morbidity and mortality as mentioned in MDGs programs as well as the communication system, that can give more stable solution for monitoring and give a quick response for the mother and baby.
2. In future implementation team agree to collaborate with non-government organization that has task as volunteer in monitoring or reporting for mother and baby report. In this collaboration, DigiMAPS will be used as a main solution to solve communication problem between field midwife, central health service and the Ministry of Health.
3. This model of DigiMAPS is the first research in this area, thus team consider to publish the result in the national and international forum, to get the input to enhance the system and also get opportunity for wide implementation.

ANNEX-1

In order to capture the real problem of midwife, volunteer and doctor on Gunung Halu, on site discussion was held on May 23, 2013 at Community Health Center of Gunung Halu. From them it has been captured the variety of problem that related to mother mortality issues. Problem tree identification as seen on figure 36.

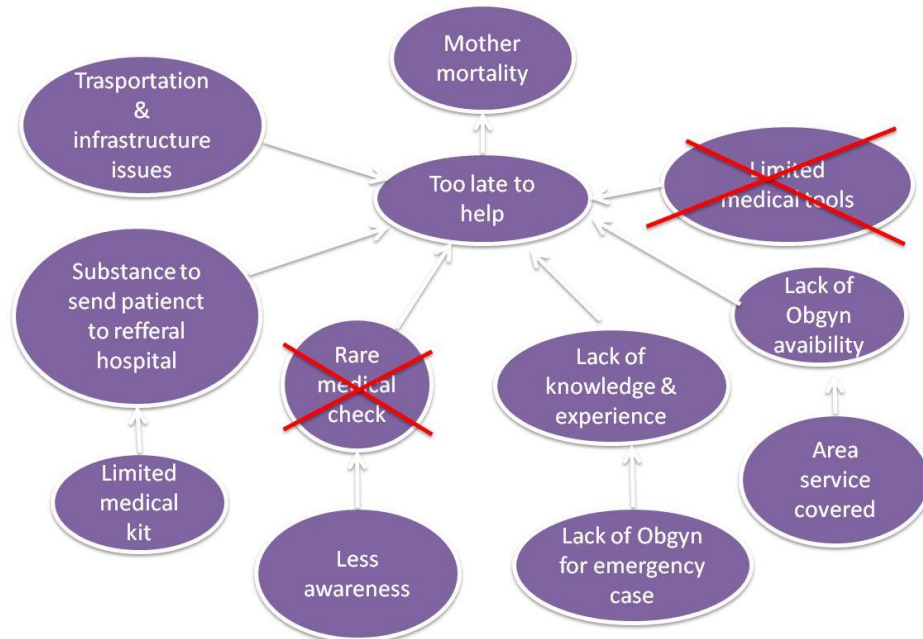


Figure 36. Problem Tree Identification

Kind of problem category was identified into problem tree, problem validation was made as a part of the result of discussion with midwife, volunteer and doctor. It wasn't a easy way to capture the most painfull problem and figure out the solution of it, since the problems have been generated from linked aspect. Information technology solution will be implemented to reduce gap between process of health data capture.

Discussion between DIGIMAPS team with health service staff has conducted to ensure the business process of health services. In the discussion conducted on May 24, the business process of health service revealed as well as the right and responsibility of person in charge of the process. From the second discussion conducted on June 3, more detail process has elaborated by health service office staff. New insight of problem definition and solution comes from interative and intesive interaction with the all team. Health related data flow and information have been transfered manually, latency and data corrupt have been potentially happened during the process. The manual process data transfer has been repeated periodically on every first week of month. Time accurate report has been become the priority objective that should be meet for health service staff . The right and suitable health programme come from the data of report submitted by midwife. As painfull problem capture, the planned solution to overcome the problem has created.

ANNEX-2

LEAN INNOVATION PROCESS OF DIGIMAPS

The Lean Innovation Process is a formal method of problem finding before defining a solution. The method has been adopted by Telkom Indonesia since beginning of 2013 for new product and service creation.

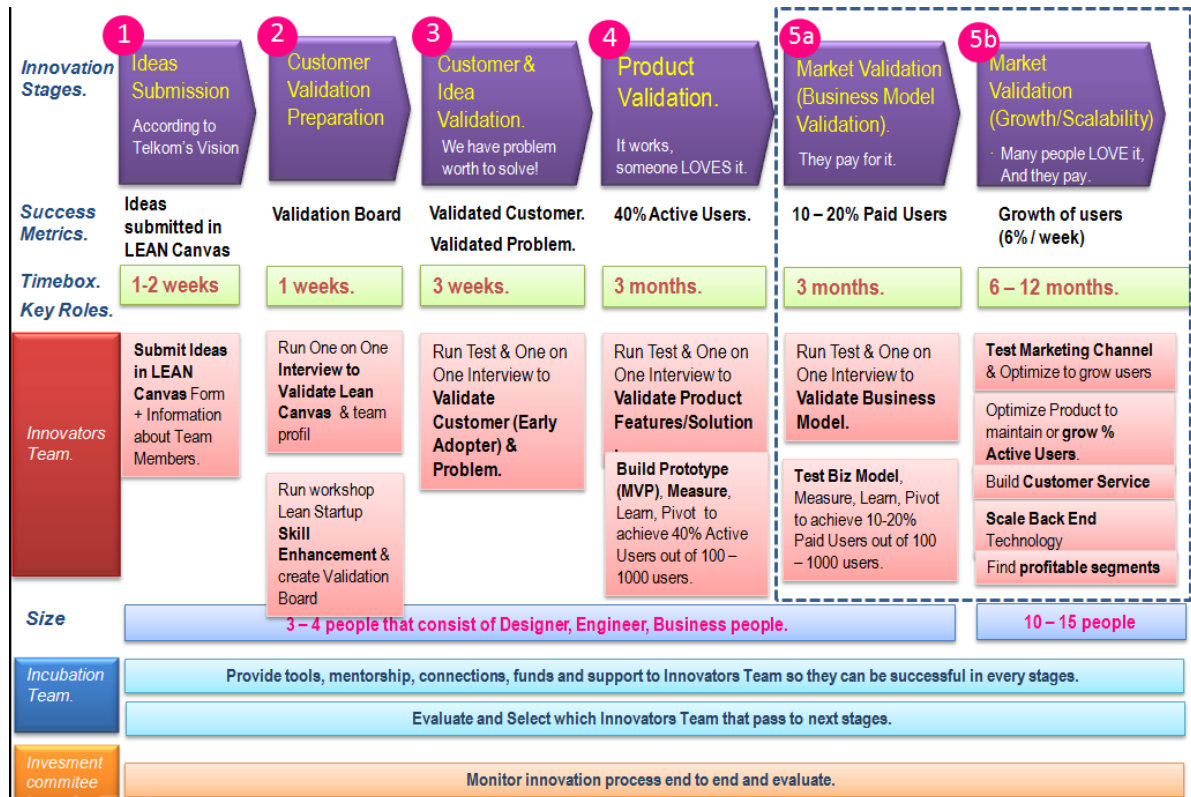
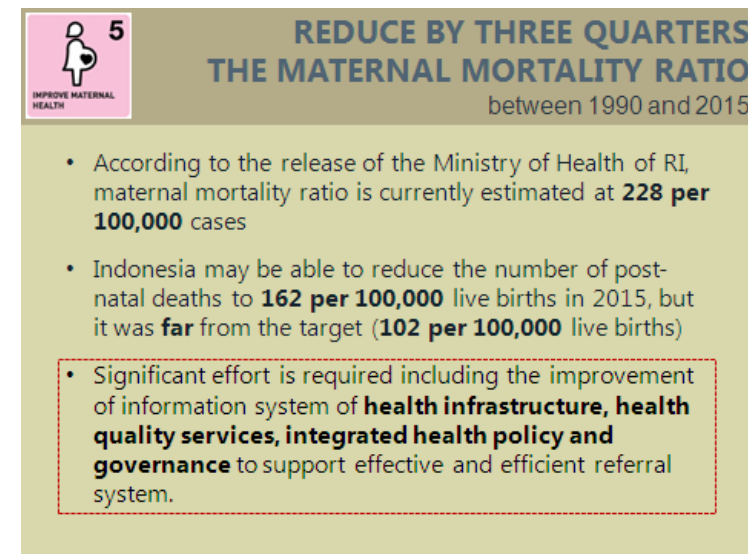
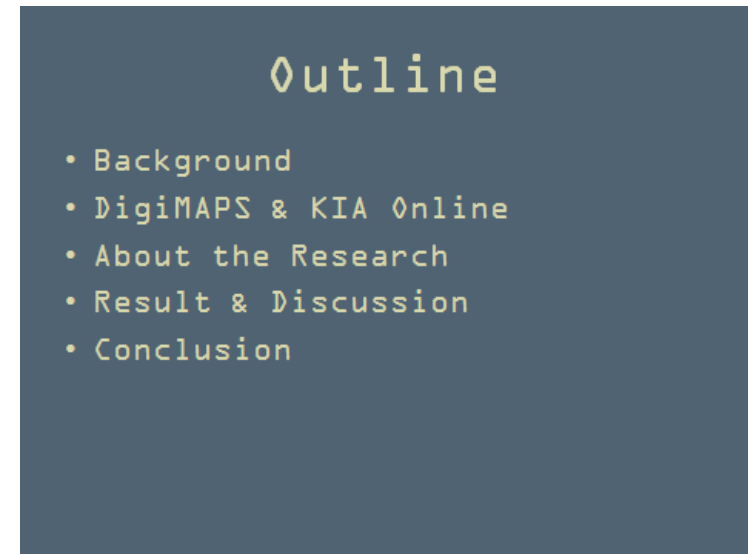
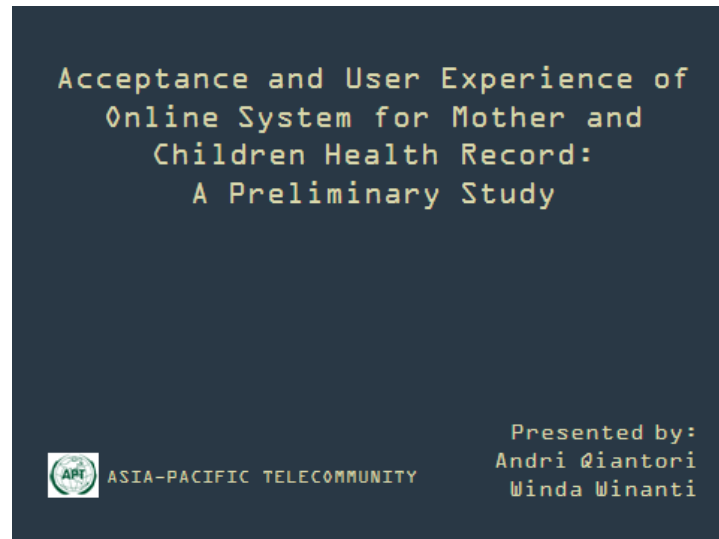
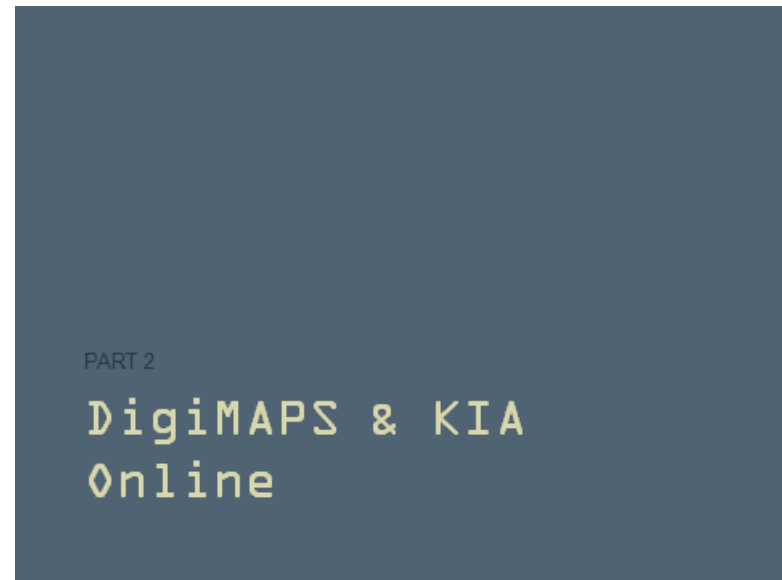
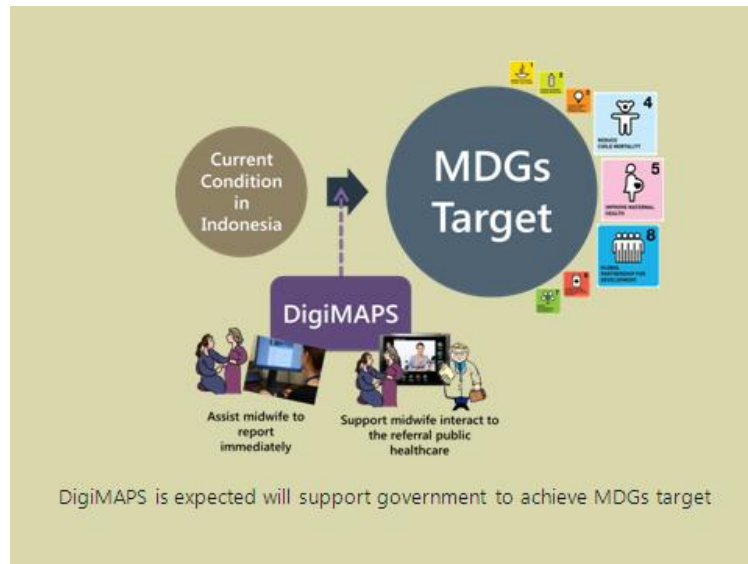


Figure 37. Lean Innovation Process of DigiMaps

ANNEX-3





DigiMAPS

is a new **maternal and postnatal care reporting and tele-maternity care systems** by using any kind of telecommunication modalities while the communications infrastructure is not available



Assist midwife to report immediately



Support midwife interact to the referral public healthcare

KIA Online

Before



Midwife



KIA (Medical Record) Book



Report for Health Department

After



Midwife



KIA Online



Report for Health Department

KIA Online Features



Medical Record



Pregnancy Record



Progress of Patient



Birth Certificate



Post-Natal Record

Since limited medical personnel in remote area, KIA Online is expected could be operated by **all kind of user.**

Whether
KIA Online have the
same acceptable
level of midwife
and non-midwife?

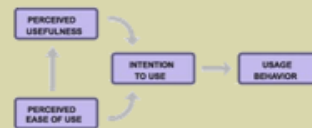
Methodology

Use Technology Acceptance Model

Pre-test Questionnaire

Objective

- to know the initial perception of the applications that have been made, and the more likely to be adopted



- Since the number of respondents only slightly, the qualitative analysis is conducted with 8 respondents for both UX+TAM.
- Location: Gunung Halu, West Java

PART 3

About the Research

West Java is the most
severe area in Indonesia

Maternal Mortality Proportion by Province, 2010

Trends in number of maternal and infant mortality rates in West Java increased.

In 2010 it was discovered almost 800 cases of maternal deaths and almost 5000 cases of neonatal death.

In 2011 increased to more than 5000 neonatal deaths.

Glimpse of Gunung Halu



Located in West Java province, 4 hours by public transportation from West Java Capital City



Total area 12.801.4Ha



Altitude of 800-1200 m above sea level,
Temperature 28° - 31° C



Population 72.313, Villages: 9



Agriculture population: fields and livestock

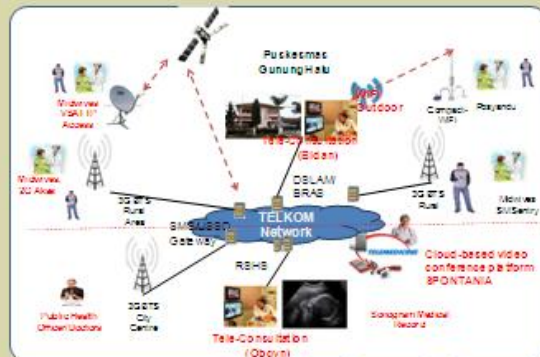


Glimpse of Gunung Halu Health Facility

- 1 Health Center
- 2 Doctors, **No ObGyn Specialist!**
- 15 Midwives
- 13 Paramedics
- 39 Traditional midwives



DigiMAPS Multimodal Communication



DigiMAPS Application



Basic Concept

- Public broadband IP communication networks
- If not available, then setup WiFi and/or VSAT IP
- Support multi-devices, multi-operating-system & multi-screen
- Cloud computing (SaaS) approach for DigiMAPS application (Tele-Obgyn and KIA Online)

Pro

- Less capex
- Managed services: Dinkes and KBB do not require to have IT specialist

Cons

- Data privacy (confidentiality) and security
- New Business models

Result & Discussion

Midwife and Doctor

Ai
Santi

Female
25 years old
Midwife

Unfamiliar for
the 1st time,
confusing

Often forget to
press the + button
to add data

Long process,
much faster if
written

Difficult to focus
when using
applications



Yauhana

Female, 22 years old, Midwife

Difficult to find
the patient data

"E" button, is it
for edit the
data? Or what?

How to add
data? I'm
confused

Looks
complicated, not
as easy as
manual



1 year
experience with
KIA

Use only 1
ICT device

Yosima

Female, 29 years old, Doctor

Not clear where to
use the search
feature

Buttons aren't clear.
"E" for what?
"+" for what?

Simple, just
have to select



Active ICT and
internet user

Lilis
Female
41 years old
Midwife



Takes a long time, I prefer to write it manually

Better used by someone other than the midwife; assistant for example

The buttons are hard to understand

Internet service in office often has problem

Difficult to get GSM signal

Non-Midwife (Office Worker)

Aditya
Male, 29 years old, Office Worker



The buttons aren't describe the function. +? E?

Simple process in application

What should I fill? I don't understand the terms

Use technology and internet everyday

Hanny
Female, 23 years old, Secretary



Use basic level of technology and internet everyday

Easy process in using application

The buttons don't describe its function

A lot of self exploration in using application

Do not understand the medical terms

Confused what should be the contents of the data

Dewi
Female
21 years old
Project Assistant

Use website everyday

A lot of self exploration in using application

Easy process in using application

The "+" button, for what? And the "E" button?

Do not understand the medical terms

What should I fill in the form?



Medical Worker

Donita
Female, 22 years old
Office Worker

Confused what should be the contents of the data

The buttons don't describe its function

Easy process in using application

Do not understand the medical terms

Using a wide range of technology and internet facilities

A lot of self exploration in using application



Mrs. A
24 years old, medical worker

- Update medical record RS Hermina to DINKES every one month.
- Update many record to form reporting procedure
- Must go to Health Department to report every one month

Mr. B
25 years old, medical worker

- Learn Hospital informationsystems (HIS) with UU Republik Indonesia No. 44 - 2009 about hospital version VI
- Use technology and internet everyday
- Interest to make KIAonline

Mr. C
37 years old, medical worker

- Active technology and using internet
- Not interest to try KIAonline
- Still using oldest device (hand talk) in activity everyday

Mr. D
38 years old, medical worker

- Make big device technology
- Interest to make KIAonline, and learn part KIA7 years
- Problem search record for internal & external

Respondent	Attribute			ICT Level		UX Level	TAM	
	Age	Sex	Category	Device	Internet	Usability	Easy to Use	Usefulness
Ai Santi	25	F	Midwife	●	●	●	●	●
Yauhana	22	F		●	●	●	●	●
Yosima	29	F		●	●	●	●	●
Lilis	41	F		●	●	●	●	●
Aditya	29	M	Non Midwife (Office Worker)	●	●	●	●	●
Hanny	23	F		●	●	●	●	●
Dewi	21	F		●	●	●	●	●
Qonita	22	F		●	●	●	●	●

• UX - There is a difference in the level of usability between midwives and non-midwives.
 • TAM reference method can not be good enough to find the application can be accepted or not. Measurement should be done after the system used in the day-to-day activities.
 • Does the Internet influence the literacy level of usability? This should be investigated further.

Respondent	Attribute			ICT Level		UX Level	TAM	
	Age	Sex	Category	Device	Internet	Usability	Easy to Use	Usefulness
Ai Santi	25	F	Midwife	●	●	●	●	●
Yauhana	22	F		●	●	●	●	●
Yosima	29	F		●	●	●	●	●
Lilis	41	F		●	●	●	●	●
Aditya	29	M	Non Midwife (Office Worker)	●	●	●	●	●
Hanny	23	F		●	●	●	●	●
Dewi	21	F		●	●	●	●	●
Qonita	22	F		●	●	●	●	●

Midwife's Acceptability
 ≠
 Non-Midwife's Acceptability

KIA Online have
 DIFFERENT ACCEPTABLE
 LEVEL of Midwife and Non-Midwife

• UX - There is a difference in the level of usability between midwives and non-midwives.
 • TAM reference method can not be good enough to find the application can be accepted or not. Measurement should be done after the system used in the day-to-day activities.
 • Does the Internet influence the literacy level of usability? This should be investigated further.

Discussion

- Midwives have been using simple booklet
→ Process data input in KIA Online is considered **complicated**
- Non-midwives are more familiar in using ICT tools, compared to Midwives
- Research Weakness
 - Few data → impossible for generalization

Conclusion

KIA Online have
DIFFERENT ACCEPTABLE
LEVEL of Midwife and
Non-Midwife

Future Works

1. Fix the application. Differentiate UI for Midwife and Non-Midwife
2. TAM and UX re-examination