

Interoperability in Health Information Systems

Report
Specialization Project
TDT4501

Kenneth Børtveit

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Abstract

Chapter 1

Introduction

1.1 Research Questions

What kind of tools and method of approach is necessary for optimeizing interoperability in developing countries?

1.1.1 Interoperability

Interoperatability between computing components may be generally defined as the ability to exchange information and mutually to use the information which has been exchanged [6].

This report will focus on the challenges of interoperateability in the general electronic government into a more specific case based scenario. The aim is to identify common challenges when trying to make the exchange of data between computer systems automated and accessable. The end result should be that the user of one system should be able to use data from external systems as if it were he's own.

Part I

Litterature

Chapter 2

Interoperatability

Chapter 3

Datawarehouse

Chapter 4

Integration

Chapter 5

Transition Strategy

5.1 System Migration [2] [8]

5.1.1 Initiation

Who is the initiators and how does this impact the choice of system.

5.1.2 Implementation

What characterizes a successful implementation

5.1.3 Cut-Over

Evolutionary vs. Revolutionary

5.1.4 Migration Methods

The Big Bang

Forward Migration

Backwords Migration

The Chicken Little Strategy

The Butterfly Methodology

Part II

Empirical

Chapter 6

Context

In the center of Africa we find the country known as Rwanda. A very small country, only $26338km^2$. This would be about 7% of Norway. Their population is estimated to be around 12 million which makes it about 420 people per square kilometer. Rwanda is made up of 5 provinces, east, west, north, south and Kigali. Each province is again divided into districts and there is a total of 30 districts. Under districts there is a total of 416 sectors[1]. It lies in the center of Africa with Uganda at the north, Tanzania to the east, Burundi at the south and the Democratic Republic of Congo in the west. Because of its location it works perfect as a gateway to all countries in Africa. And because of the stable environment comparing to the neighboring countries it is even more attractive for foreigners doing business in Africa making it the ‘Singapore of Africa’.

Rwanda has a goal of transforming to a knowledge based economy with Information and Communication Technology as their field of knowledge. This means basically that they want to offer ICT services for other kind of resources. They want to be the regional center for the training of top quality ICT professionals. This will hopefully in turn create wealth, jobs and entrepreneurs. From their perspective they have some competitive advantages in order to achieve this which include:

- Cheap labor compared to other countries in the Region
- Young and dynamic workforce (98% of the population is under 50 years and 43% is under 16 years)
- Most favorable business environment in the Region (8th best place to do business in the world 2012)
- Low levels of corruption - Zero tolerance (Transparency international Bribery index 2012 ranked Rwanda as least bribery prone in the EAC)
- World class ICT infrastructure
- Strong & visionary leadership
- Bi-lingual business environment (French and English)

[2]

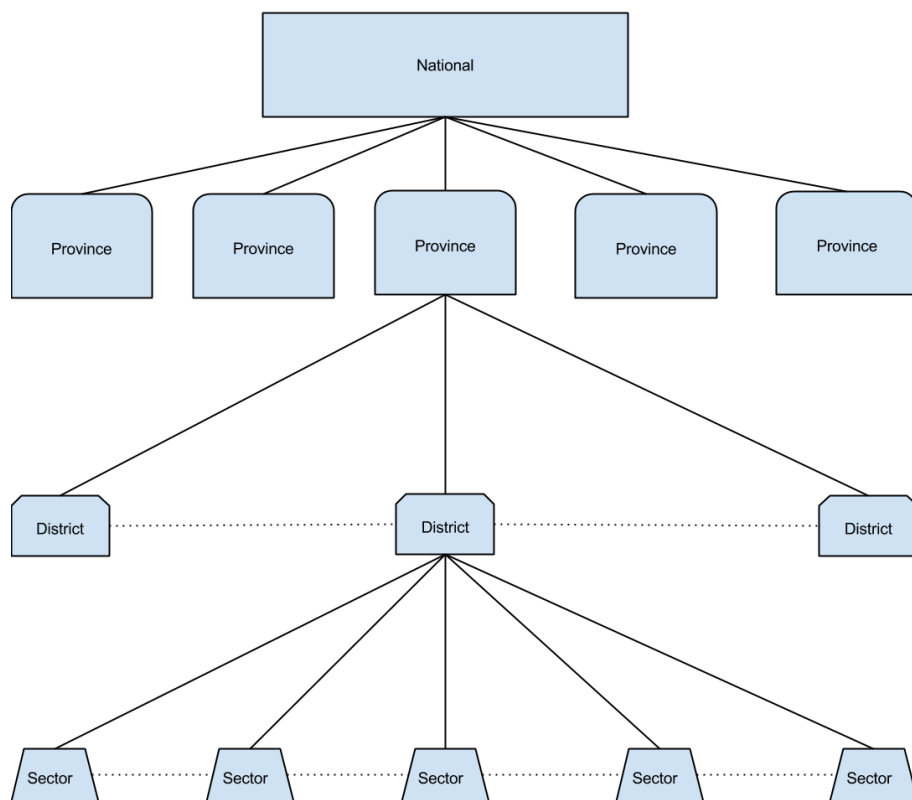


Figure 6.1: Rwanda Administrative Division

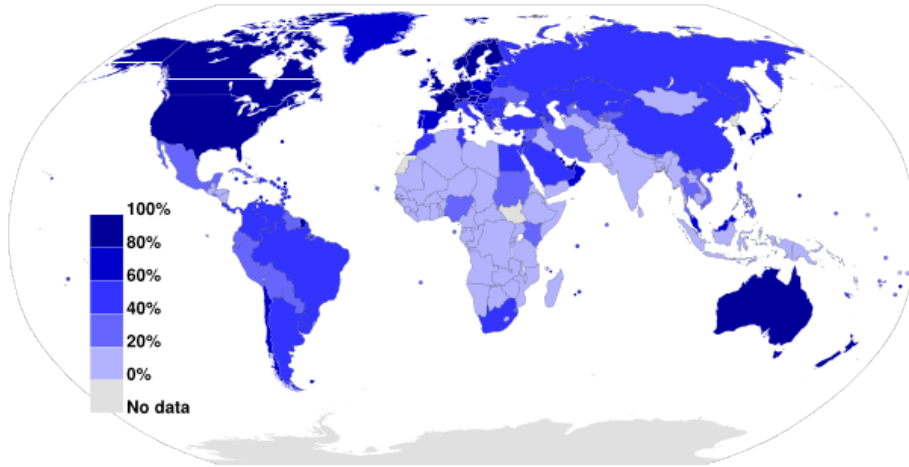


Figure 6.2: Global Internet Penetration in 2012 [3]

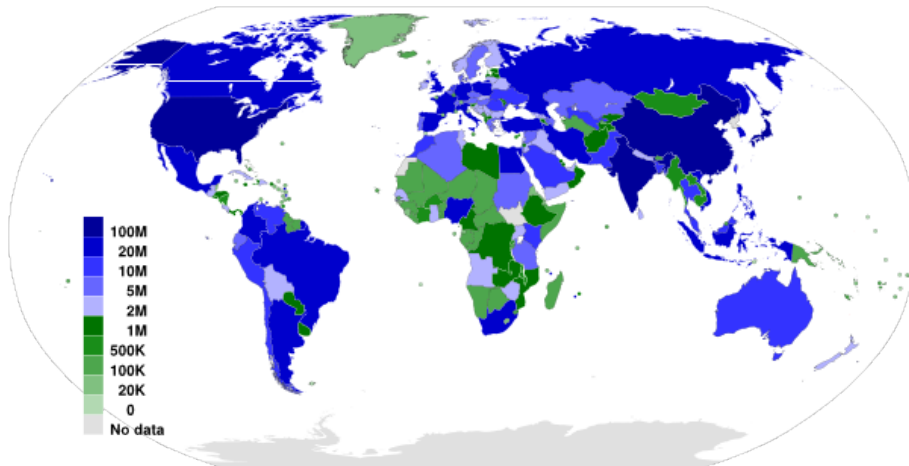


Figure 6.3: Global Internet Users in 2012 [3]

6.1 Ditch

6.1.1 1994 Geneside

6.2 Information Technology focus in Rwanda

Rwanda has an internet penetration of 7% in 2012. In Africa there is internet penetration is 15.6% and for the world it is 34.3% (See 6.2). The neighbouring countries, Uganda has 2.6%, Tanzania 12.0%, Burundi 1.7% and the Democratic Republic of Congo with 1.2%[4]. Rwanda grew from 1% to 7% from 2000 to the end of 2011[2]. More interesting is the mobile broadband development in Rwanda. The subscriber base accounts for 48.1% of the population and the network coverage accounts for 99.79% of the country. The government of Rwanda has made the decision to become an ICT hub in Africa. Therefore alot of re-

sources and attention is focused on developing knowledge in the field of ICT. They are in 2012 ranked among the top 6 developing countries when it comes to dynamic performance in ICT development[5].

6.2.1 The ICT park project

As of January 2013 the Rwandan government is planning to set up an ICT park through the Rwanda Development Board. This park will host technological training, industries research and development. The ICT park will support the growth of the following clusters:

- Energy
- Internet, multimedia and mobile telecommunication
- Knowledge
- E-Government
- Financial
- ICT Service and export

[2]

6.3 Health Information System Programme

6.3.1 About

The Health Information Systems Programme (HISP) is a global network established, managed and coordinated by the Department of Informatics at the University of Oslo. They design, implement and sustain Health Information Systems by a participatory approach[8]. This means including the local users when developing the system in hopes of a more sustainable and successful project. The system developed aims for supporting health care delivery and information flows in selected health facilities, districts and provinces.

Vision

To strengthen the development and use of integrated health information systems within a public health inspired framework in India and the South Asian region[9].

Mission

To enable networks of collaborative action with like-minded actors who aspire to the ideology of open source software, open standards and decentralized decision-making to create complementary strengths in providing integrated and public health friendly health information systems[9].

6.3.2 History

In the 1970 and 80's the HISP approach to action research and system design was influenced by a number of union based action research projects in Scandinavia. The focus were on empowering workers who were affected or threatened by new technology. Methods may have changed over time, but the philosophy remains the same. Explore ways in wich disadvantaged people could appropriate ICT's for their own empowerment. Original key member of the HISP team had background as social political activists in the anti-apartheid struggle and other social movements. DHIS, organized within the HISP network, was actually born out of the political processes following the fall of apartheid[7]. The fall of apartheid had a strong influence on the design of DHIS. During apartheid and until 1994 there were 14 departments of health in South Africa. Baccuse of this fragmentation it was alot of different procedures, collection tools and data defenitions. In order to take this into account, DHIS became very flexible and one can easaly see how this has effected the design. This might be the reason why DHIS so easaly could be used in other countries.

6.3.3 Portefolio

6.3.4 District Health Information System

The latest version as writing is DHIS version 2.13. DHIS2 is now used by 30 countries across the globe and even more organizations. DHIS2 is a tool for governments and health organizations to manage their operations more effectively, monitor processes and improve communication. DHIS2 is mainly a tool for managing aggregate data. It will let you visualize large amounts of data in a GIS implementation, a pivot table and in charts. These data representations can then be shared with other user registred in the same DHIS2 instance. Probably the most powerful feature would be GIS. This feature shows selected data on map based on province, district etc. The regions on the map can then be colored based on the data. If one has data for the hole country one can in seconds get a accurate impression of the current health status. DHIS2 runs on server wich is connected to a database. As long as this server is connected to the internet anyone that also has access to the internet can connect and use DHIS2.

GIS

The GIS that is integrated in DHIS2 is relatively easy to use. One selects what kind of regions that are of interest and apply the correct data that should be visualized, see figure 6.4. Heres a list of some of the functionality that the GIS offers:

- Thematic mapping of areas and points.
- Visualize catchment areas of facilities.
- View facilites based on classifications.
- Overlay multiple layers and use googlemaps as a background layer.

[10]

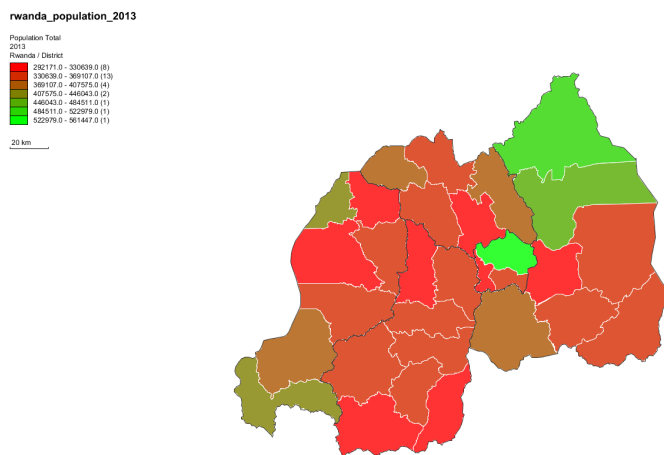


Figure 6.4: A population count using GIS in DHIS2

Charts

The charts are a little bit trickier. In short the series is the y-axis and Category is the x-axis. Displaying data as a chart is alright once you get what the words mean. Figure 6.5 shows an example counting population by district. Types of charts supported include:

- Column
- Line
- Pie
- Stacked Column
- Area

[10]

Pivot Table

A pivot table is a data summarization tool. It generally sorts data and show them in categorized table. The DHIS2 pivot table let's you analyse data along all data dimensions and arrange these on columns, rows and filters, see 6.6.

Dashboard and social features

One can send messages and share all data visualizations with users registered on the DHIS2 instance. Interpretations of the visualizations can be commented and viewed by all other users. This way DHIS2 let's users experienced in the field help others interpretate the data while they are looking at it. Also one can store charts, maps and pivot table at a dashboard so they can easily be referenced later.

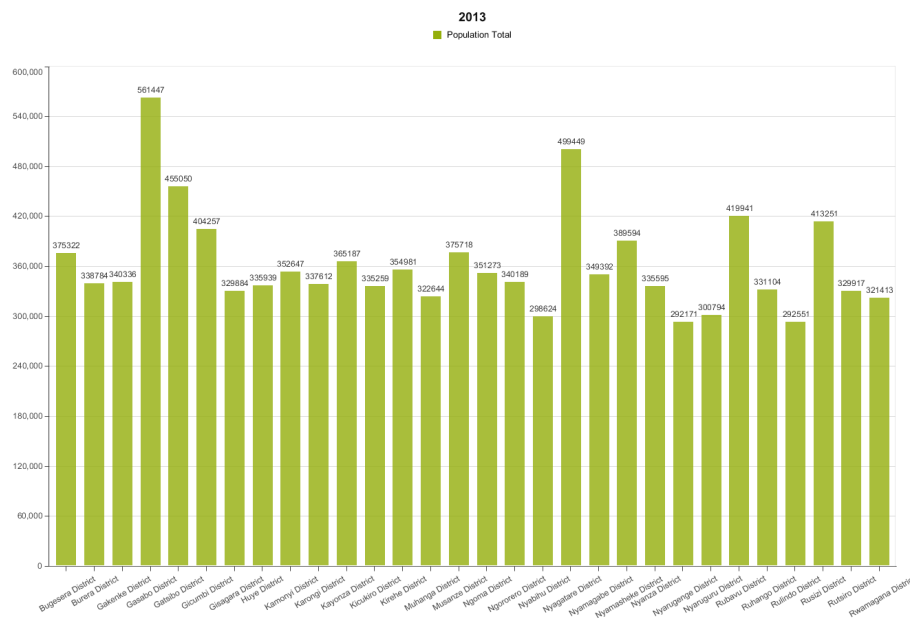


Figure 6.5: A population count using a chart in DHIS2

		Rural												Urban											
		April 2012	May 2012	June 2012	July 2012	August 2012	September 2012	October 2012	November 2012	December 2012	January 2013	February 2013	March 2013	April 2012	May 2012	June 2012	July 2012	August 2012	September 2012	October 2012					
BCG doses given	CHC	1 371	1 444	1 603	1 371	1 482	1 379	1 058	1 047	854	1 563	1 454	1 371	15 997	3 625	3 980	4 293	3 936	3 375	3 750					
	CHP	1 531	1 542	1 685	1 482	1 597	1 472	1 145	1 135	829	1 617	1 418	1 531	16 984	1 925	2 314	2 394	2 130	2 089	2 207					
	Clinic	331	369	408	270	347	397	244	173	209	477	340	331	3 896	1 116	1 196	1 251	1 245	851	1 069					
	Hospital	33	44	34	20	169	32	41	40	130	44	38	33	658	773	790	629	528	588	473					
	MCHP	2 522	2 694	2 786	2 477	2 489	2 691	2 012	1 723	1 641	2 518	2 374	2 522	28 649	5 050	6 333	6 182	5 924	5 290	5 637					
Fully immunized child	CHC	905	998	950	929	1 703	1 161	1 417	1 399	643	895	968	905	12 873	2 807	3 022	2 737	2 466	2 757	3 095					
	CHP	1 255	1 281	1 192	1 162	1 237	1 274	1 014	1 003	847	1 231	1 124	1 255	13 875	1 874	2 057	1 799	1 747	1 968	2 079					
	Clinic	331	178	189	163	250	210	176	206	179	217	181	331	2 611	641	721	456	674	639	647					
	Hospital	8	10	5	18	27	18	30	26	26	12	14	8	202	339	287	193	152	276	248					
	MCHP	1 998	2 225	2 139	2 095	2 188	2 562	1 683	1 475	1 581	1 876	2 161	1 998	23 981	5 018	5 943	4 971	5 134	5 298	5 223					
IPT 1st dose given at PHU	CHC	4 497	4 692	4 475	4 367	4 505	4 255	3 420	4 109	3 276	4 231	4 448	4 497	53 542	10 679	12 030	10 196	10 173	10 398	11 262					
	CHP	1 436	2 194	1 519	1 169	955	1 359	1 326	1 270	1 118	1 551	1 200	1 436	16 533	3 135	3 697	3 853	2 949	3 459	3 354					
	CHP	1 104	1 733	1 445	1 234	1 232	1 103	2 009	1 104	1 409	1 485	1 009	1 104	15 971	2 201	3 724	3 112	2 768	3 008	2 346					
	Clinic	222	281	312	309	109	135	240	156	257	245	196	222	2 684	435	541	524	513	360	435					
	MCHP	1 400	76							152		36		404	765	1 081	219	5 904	824	193					
IPT 1st dose given by TBA	CHC	2 299	3 204	2 459	2 428	1 802	1 994	2 190	1 814	2 185	2 580	2 420	2 299	27 674	5 408	10 033	7 395	5 602	5 932	6 064					
	CHP	5 061	7 412	5 735	5 280	4 174	4 991	5 785	4 944	5 121	5 861	4 861	5 061	63 266	11 942	24 076	15 073	17 736	13 483	12 823					
	CHC	68	50	72	108	37	161	112	141	287	76	82	68	1 262	516	314	487	370	288	525					
	CHP	125	196	220	143	88	176	124	236	120	66	64	125	1 683	530	347	496	603	522	592					
	MCHP	11	3	23			6		10				11	64	16	22	20	87	50	62					
	Clinic																			30					
	MCHP	255	290	394	509	415	791	520	632	552	369	295	255	5 277	1 109	1 427	1 358	1 133	1 045	1 565					

Figure 6.6: An example of a pivot table in DHIS2[10]

Individual Records

DHIS2 was mainly intended for aggregated data that could not related to anyone person. The need for a system which can track individuals is a requirement that most users of a health care system would want. Therefore the DHIS2 tracker was developed. It let's you sign up people for programs and track them through the process. Also send out reminders so that patients come to their scheduled checkups. One problem with the individual records is that it does not work as a patient record system. Such a system is that it requires a level of confidentiality that DHIS2 currently is not supporting. Also a patient record system needs all health facilities to be users of the same system if it is going to be of any use.

Data entry and validation

DHIS2 let's users entry data even if their not online. This feature is crucial for countries with unreliable connection to the internet. For developing countries with regular power cuts, one can understand why this is. Data entry is done with prepared forms and then uploaded to the server which is running the DHIS2 instance. The forms are highly customizable due to the varying requirements from users. Also there is the possibility to validate the input. For an example shouldn't there be more people under five years than people in the same region, just to give an example. The data entry can be done in alot of different ways. One example is through SMS. In indusdy countries this may sound odd at first, but in developing countries health facilities might not have access to computers. This is the simplest form of data entry, even though it might require some coding of data representations. Since DHIS2 is accessible from any device with a browser the range of devices that can be used for data entry goes from a mobile phone that supports SMS to a sophisticated computer.

6.4 Healthcare

6.4.1 History

6.4.2 Structure

6.4.3 Financial

6.4.4 Ranking and the rest of the world

Two approaches. Participatory or export service.

6.4.5 Health Information Systems in Rwanda

The government instance that has the responsibility to maintain and manage health information data is the Ministry of Health. Here there is a team that maintains the Health Management Information System. The HMIS is built on open source District Health Informaiton System 2. The health ministry has made some modifications so that there is in fact 4 instances of DHIS2 running for different purposes. Besides the HMIS there are alot of systems that runs and has critical tasks that is not yet supported solely by DHIS2, see 6.7. These systems has varying tasks, but are all in some way related to HMIS. Sharing

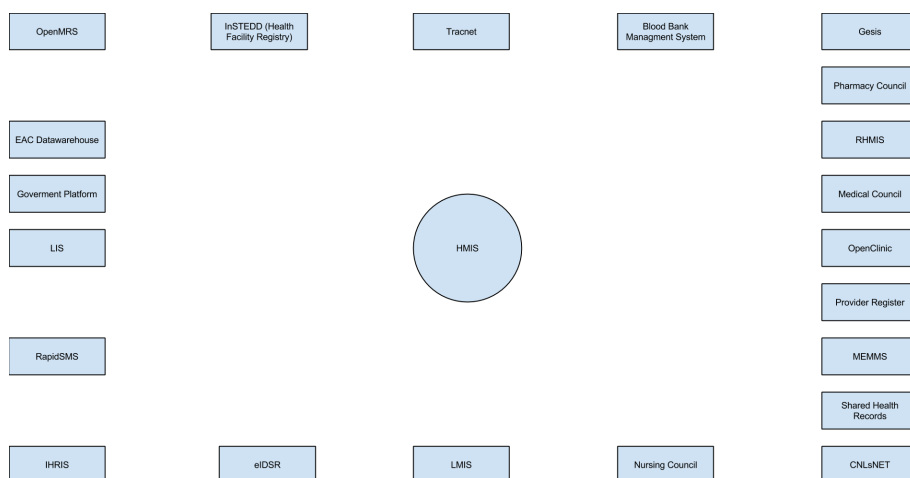


Figure 6.7: Systems Currently in Use 2013

data between these systems is crucial for maintaining an overview of the health status in all of Rwanda.

6.4.6 DHIS2 enters Rwanda

Chapter 7

Method

7.1 Shoice of Method

7.2 Data Collection

7.3 Reflection & Data Analysis

7.3.1 7 Principles for Conduction and Evaluating

Chapter 8

Case

8.1 Information Systems in Rwanda

8.1.1 Current situation

8.1.2 Health Management Information System

8.1.3 DHIX

Apache Camel

8.1.4 Malaria Surveliance

Sentinel Surveliance

Active Surveliance

8.1.5 Voxivia

Part III

Discussion

Chapter 9

Conclusion

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Appendix A

Journal

A.1 Day 1

Date:	07.10.2013
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A.1.1 Traveling

Bus

I started out with waking up at 05:00am. Usually I get my salary from Peppes at the 7th each month, but this time there was a delay. So waking up, I was broke. No money for the Planebus. I tried to get some money from the local gas station with my mastercard with no luck. With only 3minutes until my bus was leaving i hoped that the bus driver would accept my mastercard. He did. Either way i was in luck, just before I was going to pay i checked my balance and my salary was in.

Trondheim Airport

No problem here. Talked a little with my mom, said goodbye and registrered. Plane ride was good.

Oslo Airport

Met up with Simen. There was some problems with he's visa. One cannot leave Norway and have a visa that expires before your return date. He had fortunately bought a flex ticket so he could just change the dates, and then change them back when he arrives Kigali and prolonges his visa. Then it was off to Istanbul. Flight was ok, good movies.

Istanbul

A little short on time. Didn't find the directions to our gate at first. The signs were properly hidden. After a little exploring we found it. Next stop, Kigali. The flight seemed a little longer, but it was cured by 'free cell' and 'soduko'.

Kigali

At last, after about 18 hours from Trondheim, I was here. The guy that checked out our visa seemed a little sceptical, asked me one more time of my purpose of visit. I just explained that we had an internship with the Management Sciences for Health and it was ok. Felix picked us up and drove us to our house, 21KK Avenue, Niboye Road. Awsome house! Randy's old place. We could stay here for free out October. Took a beer with Felix and went to bed.

A.2 Day 2

Date:	08.10.2013
-------	------------

A.2.1 Meeting with Randy

Breakfast

Got off to a bad start today. Woke up 10:05AM and we were expecting Randy at 10:00AM. No worries though, he wasn't there yet. Took a shower. Simen sat outside talking to our day-time guard, Peter. I took some breakfast, bread with jelly, a tomato and a banana. The bananas here are very small. Anyways, Randy came in the middle of breakfast and we talked some.

Bank

Then we drove out to the bank. About a 5 minute drive I think. We took out 100 000RFR, this should cover us for about 2 weeks Randy said. About 1000NOK. Then we had to get our SIM-cards.

MTN

Pretty straight forward. We registred our passports and got our sim cards with unlimited data usage.

Lunch

We got liuch at a chiniese resturant. The food was not very great, but better than airplane food I think. Strong chilli. We got chicken, goat and some vegetables. Simen and Randy were so kind and decided that for me.... We then got to talk about the project. In general I think we got 3 options. Malarya registration by phone, system migration from Voxivia and a bigger project that involved several Systems and a Data warehouse. The systems included HMS, Inidicator Remarks and health finances. The data warehouse should also be able to pull data from several instances. We did not land on a specific one and we were presented with some other options as well. The project that involved several instances had alot of subproject bound to it. Andrew is the system wizard, Eric the doctor that likes his ways and Beth is a eager IT-person. Randy talked a little about another survey that he thought was better than DHIS2. We should gather some recomendations here I think.

The Office

Then we went down to the office where we will probably work. Our space consists of 4 cubicals that we share with 2 others. It was not far from the ministry of health.

Back Home

Randy had to go to a meeting so we called it a day. We were invited to join a training program on thursday later this week. Meeting up with Randy 08:30AM tomorrow.

A.3 Day 3

Date:	09.10.2013
-------	------------

A.3.1 First day at the office

We were down from our house to the ministry of health by Randy today. 08:30AM. Early day. Randy had some meetings and we've got the opportunity to check our emails and catch up on some reading. I found some new articles today that talked a little about how there is a gap between some countries in the IT world. Talked a little with Simen about trying to share our perspectives to get the best from both worlds.

A.3.2 DHIS2 Intro

After a while Randy was finished with his meetings. Andrew, the system wizard, came and said hello. He is joining us tomorrow for some DHIS2 training. We were introduced to a lot this session. Mostly about how they were using DHIS2 today. DHIS2 is not the only program they use. The functionality that are needed, but not supported by DHIS2, are hacked into their day-to-day work with some scripts made up by different people. I think their data is pushed to the server monthly.

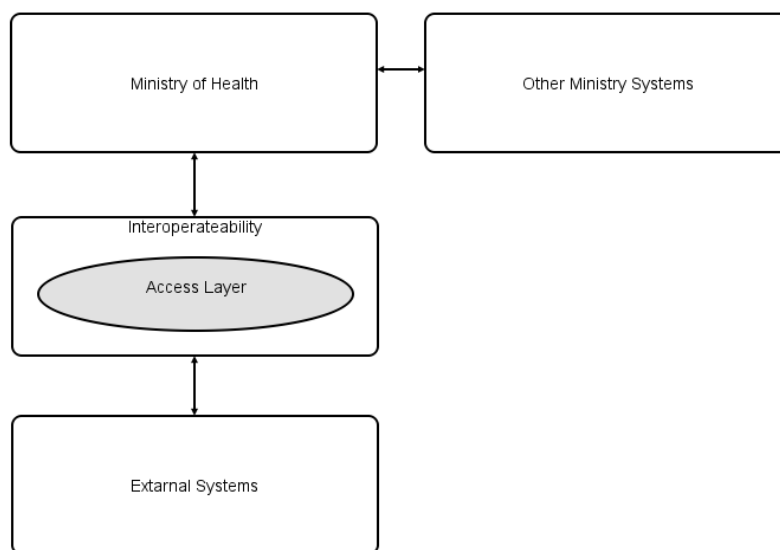
Here are some changes that Randy suggested.

- Wanted to make some good validation rules, but lacked people with experience in the field to make them properly.
- After the usercount got high, the favorites got very messy and unorganized.
- Would like to share tables, diagrammes and maps with individuals and make only a selected few public.
- Some labels on the map, didn't quite get that one.
- They would like to choose what type of facilities that would be viewed in GIS. This would be a great improvement.
- They had some language barriers. Would like some improvements there. Didn't get the details.

- Problem with reports being loaded from NGINX cache, they were not updated after changes if it already was in NGINX cache.

I was wondering how he trusted the data. It turned out that sometimes the data wasn't accurate. This was tested by some people motivated by a Performance Based Finance system. The health facilities down here get some funding based on their registration count. Some cases are worth more than others. Like, don't actually know the numbers, but let's say 1000RWF for registering a pregnant woman. So to prevent health facilities from cheating the authorities take some samples in order to check if the inputted data is correct. Randy would like some more competence on iReport. Should check that out later. FOSAID is the identification number used through all the databases. This identifies the facility. This number is also used by external systems. I think I should get a better understanding of Pivot tables. They are quite popular here. Camel is used to make an access level from the MOH to external systems.

He also gave us an overview of how everything should be linked together in the future.



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I then wondered how they could trust the open source code to do its job. Is there some testing that ensures that DHIS2 is working as it should? To me this seems like life or death for some people. When funding is based on registration of data. Is this the only option that MSH have? What other options did they consider before DHIS2? And what was the primary factor for choosing DHIS2. Open source? Proprietary software alternatives? I know I would be very sceptical to a software that did not guarantee customer support.

A.3.3 Lunch

During lunch we got some food from a burger diner. Good food, bad smell around the toilet. Randy just had a baby that is 4 months old with his second wife from Rwanda. She had family in Trondheim and visited them not too long ago.

A.3.4 Install Rwanda DHIS2

When we got back we installed all the necessary software. We got our own copy of the database so that we could work locally on our machines.

1. JDK
2. Postgres
3. Ireport
4. Tomcat
5. odbc
6. restore database
7. edit hibernate.properties

I think I should get more comfortable with environment variables in Windows. I should get back to my todo list for sure.

A.3.5 Dinner

After work we ate at an Italian restaurant. A little bit pricey. Should probably find some cheaper alternatives. We are getting picked up at 07:30AM tomorrow, so I should probably get some sleep now. Good NIGHT!

A.4 Day 4

| Date: | 10.10.1987 |

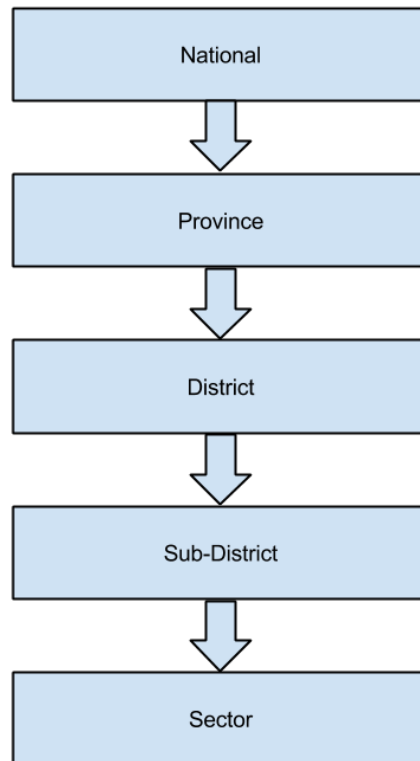
A.4.1 1st session: Review of training

The datamanagers from different facilities reviewed their previous training. See email from Gloria for more information. Where's the map? (Because they removed it.)

Insert chart list maybe too long.

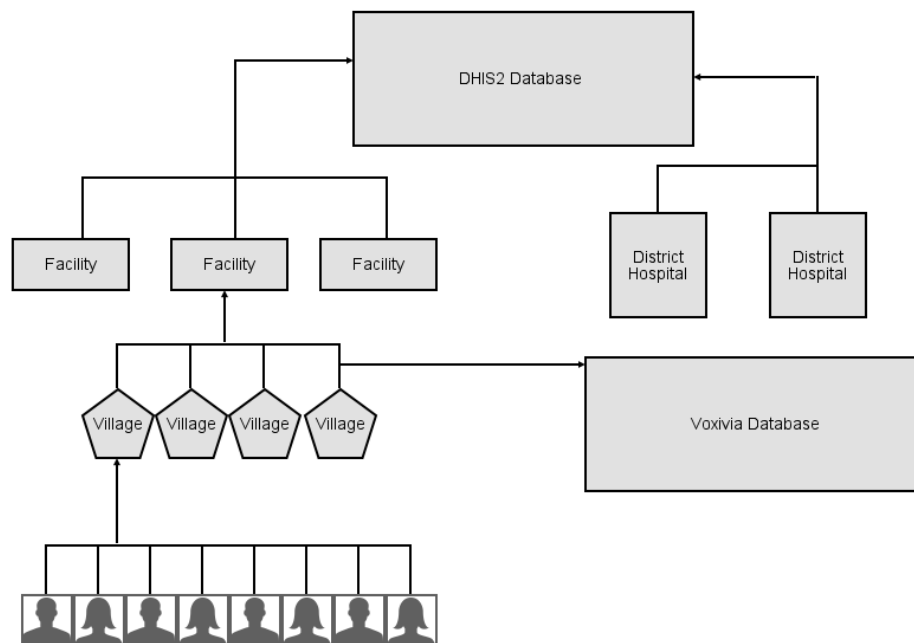
Why is the top border gone in GIS? (Problem solved)

Wheres the back button? (Found it!)



A.4.2 Meeting

We talked a little bit here in order to get a better understanding of how they used the DHIS2. The consisted of me, Simen, Gloria, Adolf and three other data managers. It was a little difficult at first, but after a while I think we've got a pretty good understanding of it. They use DHIS2 for data analyses and for reporting data. Reporting data is done by the data manager at each health facility. Data analysing is used by monitoring and evaluation officer and head of community officers for decision making and strategic planning.



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The collecting of data starts in paper form. They are then gathered at each facility for reporting in the DHIS2 database. They have a separate reporting system with voxivia. They still use this because they allow for more detailed information. If they use DHIS2 they have to track the reporting to the paper-based forms in order to get the ground details. Adolf mentioned that he would like a way to combine the data from the tracker and the aggregated data. This was a nice feature that they would like.

A.4.3 Dinner

Dinner was awesome!

A.4.4 Second Session

We then had a look at their presentations. We only stayed for one presentation. Then it was photo's. Thumbs up Simen!

A.5 Day 5

Date:	11.10.2013
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A.5.1 MSC Office

We set up at the Management Sciences of Health office. We met alot of new people. Mircel, I don't really know what he does yet. Think it was finance. Felix, good to meet him again. Bob the american. Cedrick and Emmir. Cedrick is a little shorter than Emir. And some other people.

A.5.2 After Brunch

After Randy's meeting we talked a little more about the projects that are relevant. The malaria surveliance and the interoperateability. I want the Malaria Surveliance. This would give us a concret assignment and a 'know when its done' thing. The interoperateability would probably give us the best learning experience. Because it challenges me to think at computer systems at a higher level. I will send an email to Eric and discuss it further. I have a feeling I wont enjoy the best choice. Nappolina is the project manager.

A.5.3 Conference room

Randy gave us a briefing about the 2 remaining projects. This was alot of information to take in.

Malaria Active Surveliance

The want to copy an existing report to a web based solution. Where this should be, I do not know.

- HTML
- DHIS2
- Mobile SMS
- App

This was an extensive report. Randy proposed that we should mayby trim down the report a little. I think we've got the report on an email.

Sentinal Surveliance

This system is awsome. It's purpose is to collect weather and malaria data in order to see if theres an corelation between the two. They are going from 11 to 16 sentinels nationally.

Ineroperateability

Then got of to discuss the interoperateability project. For starters Randy wanted to make a report based on some choosen indicators. The task goes something like this.

1. Load data from dictionary
2. Choose indicators

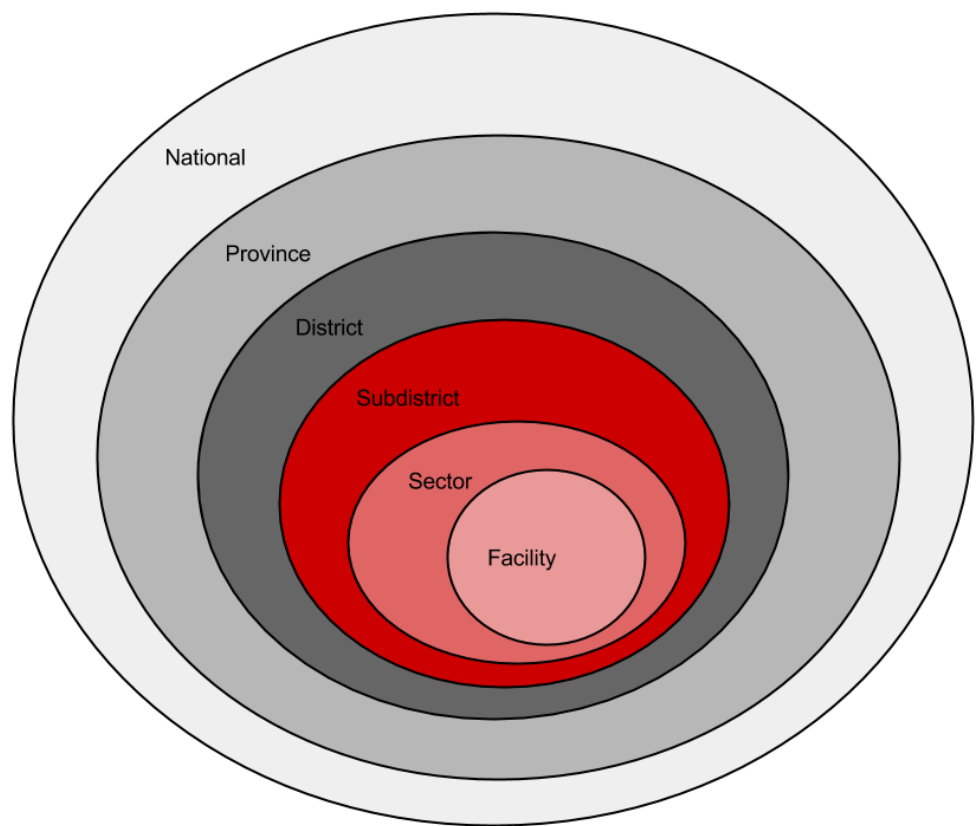


Figure A.1: Rwanda Map Hierarchy in DHIS2

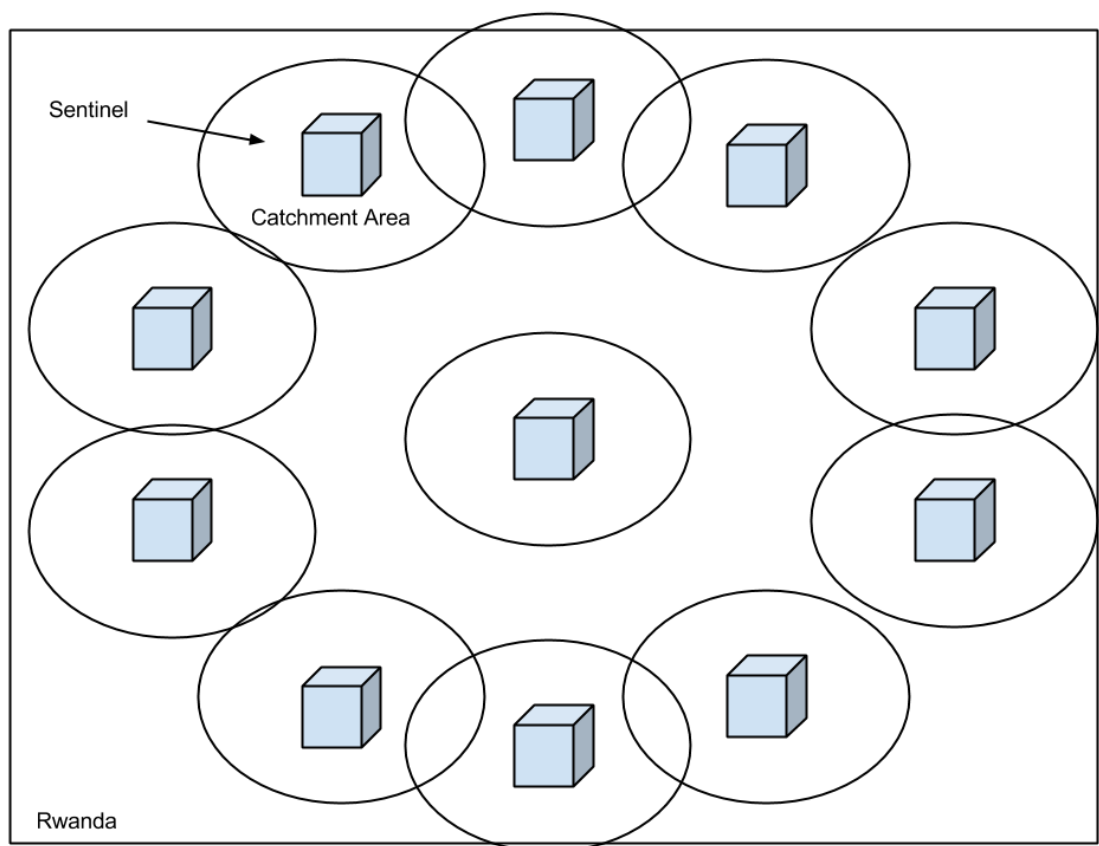


Figure A.2: Sentinel Surveillance

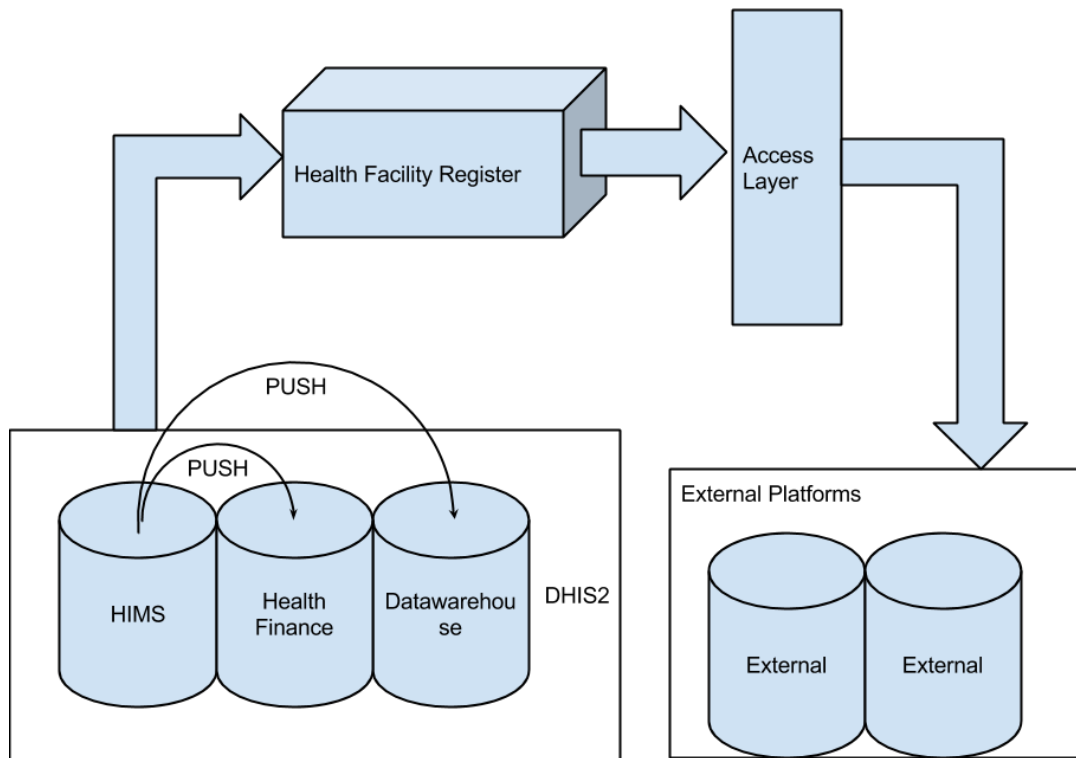


Figure A.3: System Architecture

3. Choose metadata/attributes
4. Produce report (Maybe with a preferred layout)

He then explained how he wanted the entire system to work. The result would be something like this. I think I should read up on SQL. It seems that this would be relevant. For the last part he talked about how he would like to synchronize changes made to certain data element groups, cross instances of DHIS2. This in the case of adding elements. Would he like the same thing for indicators, I do not know.

A.5.4 Dinner at Randy's

A.6 Day 6

Date:	12.10.2013
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A.6.1 HASH

A.6.2 Papairus

A.7 Day 7

Date:	13.10.2013
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A.7.1 Spaghetti Dinner

A.8 Day 8

Date:	14.10.2013
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A.8.1 Zero Values

Today we got working on fixing a database that had accedently deleted some 0's. Randy want to delete all zeroes from a specific date and then insert the ones from the last week or so. I thought this should be done directly with the database. This worked fine, but resulted in dates being placed instead of a NULL. I think this is very wrong. Should probably mention that we had a problem with the dataset. The booleans and the dates where not always present. This caused POSTGRESQL to stop when we tried to import the data. So Randy filled in all the empty values. This resulted in the same way as the other way.

A.9 Day 9

Date:	15.10.2013
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A.9.1 Before lunch

We've just had a solution. We first import the data that should be updated. Then we import data with the right zeros. We then select the records that should be updated and do so. NP I think..... I think the only troubling part is learning how to use SQL and the operating system. On thing should be mentioned before I forget. There is some efficency issues I think. I do think that it would be better if they learn a little more LINUX since they have the server.

A.9.2 After lunch

We have a solution for the database problem. We need to test it in order to be sure. Bah, lot of work. Anyways, this is important. So, moving on. We think we could implement the data entry report in DHIS2. This is fairly easy. We found a bug in the program. After creating the data elements and indicators and adding them to a dataset. We then bound them to an organisation unit, but the set would not show up. After deleting the set and re-insert them, DHIS2 would suddenly find them. Kinda important I think. That's about it.

A.9.3 House hunting

We've went to a couple of places for Simen's last days. I should probably look for a hotel or so for the last days here. I will talk with Randy tomorrow. Scary shit the last place we were at. Simen did not think so much about it. The first place we went to was great though. Awesome, I would prefer to live there when I come back again after Christmas.

A.10 Day 10

Date:	16.10.2013
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A.10.1 Staff meeting

We had a staff meeting today. Topics of the day was.

1. HMIS portal. Andrew got assigned to this. I really don't know what kind of portal this is. Maybe a website for the public?
2. Clean up DHIS2. Since everybody had received training in how to use the DHIS2 there been a lot of analytics that has been made. This resulted in making browsing very unorganized. Gloria got the assignment of cleaning this up and making a naming convention.
3. New systems to the DHIS2.
 - TRACNET. Don't know its purpose yet.
 - CNLS. Don't know its purpose yet.
4. Annual report. I was wondering what this report should contain. Are they using DHIS2 in order to make this?
5. NIKE foundation. I didn't mention this, but I think there should be some research about what they are doing since the guy at the 'good house' was saying that they were doing a lot of similar things. My first idea was that we should share databases. But who knows, maybe there is some competition going on here.
6. SMS module. I really didn't get what this was really about. There is an easy way to do the data entry in DHIS2, but there were some interest in the group of having an alert system based on some thresholds. I was thinking this should be done with an app.
7. DQA. This is an abbreviation for Data Quality Assessment. The main problem was that they would like to compare their data with samples from the field. DHIS2 does not support this functionality very well. This is a possible task. Something was mentioned about a report card that is being developed or been developed, but I didn't quite follow.
8. Then it was the Resource mapper. This relates to the overall architecture and the interoperability thing. Gloria, Randy and Bob are working on this.

9. The group is planning a training early this November. Should be thinking about growing a mustache. Anyways, the group is going to be trained in iReport and HTML report. Randy is putting this together.
10. We should upload some database files to the Gorilla server. Gesis HC and Gesis DH. Eventually putting them in the DatawareHouse.
11. At the end of the meeting it was mentioned that some of the members should think about their contracts. Are they looking for other jobs? Got me thinking about if they had secure jobs. What is their situation there?

A.11 Day 11

Date:	17.10.1987
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A.11.1 Setting up for Development

There's a slow internet connection here. This is something that significantly slows down the process in general. I download in general about 50kB/s tops. Upload seems to be the same. The eclipse set-up seems to work fine. Got some errors with the maven plugin for eclipse. So I decided to run maven outside eclipse and then import it in. We use bazaar as version control. I had a unicode problem when trying to push our branch to the server.

A.11.2 Meeting with Edith

Time: 02:00PM, I got a meeting with Edith later to discuss setting up an SMPP account with MTN (the local teleoperator). Hopefully will get to the bottom of this. A previous master student, 'Magnus', tried to set this up, but he was met with indecision I think. We agreed that Edith should make arrangements for a SMPP Gateway. How I'm really not sure. Hope that it will get done.

A.12 Day 12

Date:	18.10.2013
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A.12.1 Continuing setting up IDE

We will use Eclipse. Everything should be ready. I encountered a problem building the project with Maven. There were some test's that would produce some errors. When we skipped the test's, everything seems to work. We agreed with Randy that we will work on Interoperability. Also agreed with Eric that this is what we shall be working on. Hopefully we'll start on Monday.

A.13 Day 13

Date:	19.10.2013
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A.13.1 House hunt finished

Simen decided to move in the house next to the MTN center.

A.13.2 2nd Hash

A.14 Day 14

Date:	20.10.2013
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A.14.1 Showing Felix the House

This day we showed Felix where Simen will live for the remaining 2 months. Felix had also made arrangements for me to live at a hotell for the last 2 days.

A.14.2 Massage

A.14.3 Eating

Biggest meal I've ever had.

A.15 Day 15

Date:	21.10.2013
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A.15.1 Getting in touch with the Health Facility Registry

Gloria is going to send me an email about this system. We will try to make the interoperability thing work. As of now we got many things going on at the same time. Honestly I don't know what we should be working on.

1. Interoperability project.
 - (a) Get current status from Bob.
 - (b) How often should the HMIS database update HFR?
 - (c) The data that should update HFR.
 - i. Where are they?
2. Malaria Active Surveillance.
 - (a) Implement SMS gateway.
 - (b) Find out what happened to the Sentinel Project.
3. Import additional datasets and plan launch of National Data Warehouse and web portal.
 - (a) Don't really know what this is..

A.16 Day 16

Date:	22.10.2013
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A.16.1 Back at the office

Got really sick yesterday. I think it was food poisoning. Now I'm back almost well again. I hope that we can focus on the interoperability project from now on. Simen suggested that we should make some interviews and I think that is a good idea. We are going to get a briefing from Randy 10:30AM.

A.16.2 Meeting with Randy

We discussed the core issues of trying to synchronize their data. First of all it should be mentioned that the main issue here is to understand the problem. The problem being that they want to sync datavalues. The rest is for the moment irrelevant. Datavalues is found in a table in the database. The table itself is called datavalue. Each record is identified by a primary key. In this instance this is a combination of id's.

1. dataelementid
2. periodid
3. sourceid
4. categoryoptioncomboid

The problem here is that these identifiers will not be the same in other instances of DHIS2. So in order to copy this data from one database to another we will have to find a way to compare the datavalues and decide if two values are the same or not. So actually there might be a datavalue that is the same, but with different identifiers. For the dataelementid there is a code that we could use that will be the same in all instances, but is this only for DHIS2 here in Rwanda? For the periodid we will have to compare start dates and period type. The sourceid is the organizationunit. There is a code here that I hope is the same as the FOSA ID. And what exactly is the categoryoptioncomboid? In any case we should be able to make codes for all the categoryoptioncombos as well.

A.16.3 After lunch

Should really find some proper food down here. The trick now is to make all the necessary codes. These codes have to be the same for all instances of DHIS2. How are we going to facilitate this? The thing that is causing all the complexity is that they want independent databases. These databases don't sync completely. I don't know why they want it this way. Thing is, how is access to all data a bad thing? Are there some security issues here? Randy told me that the different departments don't want other departments changing their data. So it's about wanting control of their own data I think. More openness could cause a drop in the data quality. Delay...delay...delay. Simen suggested that this would be a good thing in a different case. The regional database need data from only a selected data elements. This is in fact the same problem we're dealing with here. Another issue that comes to mind is testing! We will have to make tests that ensures our solution.

A.17 Day 17

Date: 23.10.2013

A.17.1 Starting on the interoperate ability project

We discussed what the requirements for our case should be. Randy wants to be able to transfer data groups from one DHIS2 instance to another. We started to make some ideas and landed on making a web app. There were several good options.

Android App

This one we disqualified pretty early on. I think it was because it is kind of separate from DHIS2.

Web App

We thought this would be a good idea. This can easily be integrated later on as a DHIS2 app and then run as a part of DHIS2.

DHIS2 App

The app framework is was not great for our purposes so we could not use it yet.

A.18 Day 18

Date: 24.10.2013

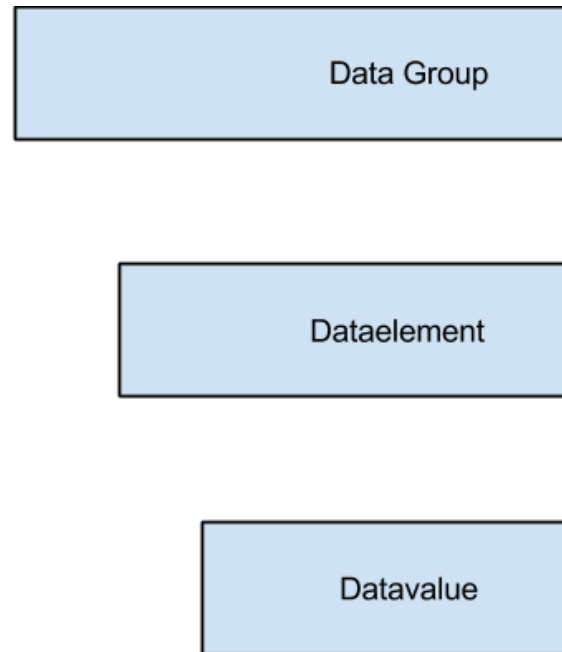
A.18.1 Presented our idea to Randy

Our idea was to make a webapp that will cover Randys requirements.

The image shows two screenshots of a web application. The left screenshot is titled "DHIS INTER DATABASE DATA TRANSFER" and features a "Database Manager" section with "Add Database" and "Add Group" buttons. It includes two identical forms for selecting "From database" and "Dataelement Group", and a "To database" section with a "Transfer" button and a progress bar. The right screenshot is titled "Database Manag" and shows input fields for "IP/Domain", "DB Name", and "US", along with an "Add" button and a loading spinner. Below these is a table of "Existing databases" with two columns, "Head 1" and "Head 2", containing cells 1 through 11.

Head 1	Head 2
Cell 1	Cell 2
Cell 4	Cell 5
Cell 7	Cell 8
Cell 10	Cell 11

I started programming the GUI while Simen took care of the database. Here the complications startet. We need a way to push datagroups into the other DHIS2 instance. The web API does not support this. So in order to do this we have to



directly access the database. ””

The datagroup consists of several dataelements and a dataelement consists of a datavalue in DHIS2. In the database it is a different story. There are a lot of dependencies. So just pushing everything in would not work. A problem is that groups, dataelements and datavalues may be there already. Also there is no way that the data is from one DHIS2 instance can identify the same data in another DHIS2 instance. We then thought of a way to handle this. Make codes that are equal cross instances and this way make comparison possible. Dependencies in the database made this not so straight forward. There is a lot of dependencies in the target database that needs to be updated when introducing new dataelements. I think this was solvable with a recursive algorithm. Simen did not like this. It seems that poking around in a database is not very popular.

A.19 Day 19

Date:	25.10.2013
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A.19.1 Starting today's work

Today we had a heated discussion regarding how to proceed. I still think that we should proceed, but in a slightly different manner. Simen thinks that users should be able to make the dataelements manually. I think it should be automated. We are now back on a research face where we explore different options. Olav is working on something similar and Bob has suggested that we should maybe collaborate with him.

A.20 Day 20

Date:	26
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A.20.1 Safari

Got up really early this morning. 4AM. Saw many animals this day. Awsome!

A.20.2 Movie

Me and Simen watched Akira. Still a wierd movie. Ends with the birth of a universe and the kids in it a part of it.

A.21 Day 21

Date:	27.10.2013
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A.21.1 Android Development

I began training for Android development today. Should make this and web sites a daily practice.

A.21.2 Town

Went to the city center today. Got a bad price on the taxi. I wasn't willing to walk away, really I should do better. Anyway, bought some cool stuff for the family. Should get some more for Jan, Victoria, Cecilie and Susanne. First thing I did alone down here. Should get better at that. Do stuff on my own.

A.22 Day 22

Date:	28.10.2013
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A.22.1 Data Flow Diagram

I decided to make a Data Flow Diagram today. This will give me an overview of the system as a whole. I found out today that the DDDT web application we wanted to make was already taken care of. So now I am kind of on square one. I will try to get an overview of the whole system, one for how the system is today and then one for how the system should look like. I've decided to use Yourdon & Coad notation. See article. This will allow us to map the intire system down to psudeocode and all the way up to context view.

A.23 Day 23

Date:	29.10.2013
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A.23.1 HMIS Staff meeting

We dicussed several things. Was kind of hard to pay attention since I was about to say something in front of the whole group and I was very nurveous. At least I got the information needed in order to continue mapping all the systems. Edith should be able to provide the necessary information about the external entities.

Agenda

- DHIS2 Version 2.13 Demo
- Indicator list to load into datawarehouse
- DHIS2 Transitions
- Training plans
- Mapping of all DHIS2 interoperatability requirements

A.23.2 Malarya Surveliance

This meeting generally was about outside my current scope. It is really hard to pay attention when there is so much I cant relate to. We got a copy for the reporting of malarya cases. We discussed how we should proceed. A task that could be relevant for me is implementing the sms reporting service. I should also look at the tracker in DHIS2, so I am aware of it's functionality.

A.23.3 Meeting with Jean Paul

Jean Paul is a representant from IHRIS. He gave us some information abour how IHRIS is sending data to the dataware house. I were after very specific information so the meeting didnt take long. After talking about that I tried to understand IHRIS future plans. Seems like they also want to exchange data with some external entities. This led me to the fact that there are even more entities that would like to participating in data exchange.

A.23.4 Skype with Bob

After a long conversation with Bob(Jo) from Dublin I realized that again we were victims of rework. Bob had already made the necessary code for updating the Resource Mapper. This is awsome. Saves us from alot of work. I begin to notice that awareness is key to avoid rework, but it is very difficult. Staying updated on everybody's work is almost a full time job. Maybe it should be. It looks like Bob want me and Simen to make to make a GUI based on he's script/application. In the future maybe this application could make data exchange possible between all the different systems. By the way. Bob wants the application to be built on Apache Camel.