MOH/RAN/69.13 (GU)

MINISTRY OF
HEALTH MALAYSIA

MALAYSIAN HEALTH DATA WAREHOUSE (MyHDW) 2011-2013

HEALTH INFORMATICS CENTER
PLANNING DIVISION
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CONTENT

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ISBN : 978 - 967 - 0399 - 67 - 6

Printed by:
D'FA PRINT SDN BERHAD
No16, Jalan P10/21, Selaman Light Industrial Park,
43650, Bandar Baru Bangi, Selangor
T : 03-8926 3808 F : 03-8926 3830
www.dfaprint.com

FOREWORD

The Ministry of Health (MoH) has started working on the Malaysian Health Data Warehouse (MyHDW) project since 2010. This project is envisioned to meet the diverse needs of timely health information provision and management, and acts as a platform for the standardization and integration of health data from a variety of sources. This allows for a trusted source of truth within a jurisdiction to be established which can be leveraged to better manage the health system, provide surveillance information and in addition provides a valuable source of data for research.

The actual implementation of the various health programmes within the Ministry and their success depend on the rigourity of the planning processes and the quality of plans. In turn, this is highly dependent on the comprehensiveness and accuracy of information available for use at all levels, which can be provided by MyHDW.

In our pursuant to provide the best care possible to the Malaysian population, it is my hope that valuable information shared in this compilation of reports will provide a better understanding of the MyHDW project and also the various endeavours that the Ministry has undertaken.

I would like to extend my most sincere appreciation to everyone who has been involved and contributed in this project since Day 1. Their commitment and contribution towards the planning of this project will improve the Malaysian healthcare delivery system. Lastly, it is my sincere hope that MyHDW will be a reality in the near future.

DATUK DR. NOOR HISHAM B. ABDULLAH
DIRECTOR GENERAL OF HEALTH, MALAYSIA

INTRODUCTION

EVOLUTION OF HEALTH INFORMATICS IN MALAYSIA

EVOLUTION OF HEALTH INFORMATICS IN MALAYSIA

Pre-independence

During the British civil administration days (1874-1947), health information and events were recorded and documented by the medical department. Sanitary inspectors and public health nurses carried out collection of data for the public health activities in the course of their work. In the hospitals, static dispensaries and institutions for special diseases, data collection was carried out by the hospital assistants and nurses.

The Annual State Health Situations Assessment Reports were given to the Medical Department Headquarters (one for the Straits Settlement States and the other for the Federated Malay States) to prepare an annual report on the health situation of the country as a whole. Between 1948 to 1962, the gathering of health information rested with the Medical Services under the Ministry of Social Welfare.

Post-independence

In 1963, with the formation of Malaysia, the Ministry of Health and Social Welfare were merged to become the Ministry of Health. The responsibility for health information collection continued to be undertaken by the Medical Services Division. By the second half of the 1960s, this function was taken over by the Medical Records and Health Statistics Unit set up in the Planning and Development Division. The Unit functioned as a data coordination unit for the Ministry of Health.

In 1972, an Operation Research Unit (ORU) was set up. The primary function of this unit was to monitor the development of the National Health Information System (NHIS). The Ministry sought assistance from the World Health Organization (WHO) in 1975 to study and recommend improvements to the existing Health Information System and resulted in a comprehensive information system through a National Health Management Information System Development Project (NHMISDP). In November 1978, the Chief Secretary to the Government directed to all Ministries and Government Departments to set up a Documentation System Unit to ensure proper documentations of data which are comprehensive and up-to-date.

The Information and Documentation (IDS) Unit was established in Ministry of Health in 1981, replacing the Medical Records and Health Statistics Unit and the Operations Research Unit. In time, the role of IDS expanded beyond Health Statistics reporting and Health Information Management Systems (HIMS) monitoring. IDS also carried the responsibility of ensuring the proper methodology in acquiring quality health data, perform statistical analysis, identify new Health Indicators and health information, and disseminate these information on behalf of MoH. The information must be produced on a reliable, responsive and timely fashion. Whilst all this, IDS also faced a challenge of non-interoperability of various Health Information Systems within the Ministry, a worldwide problem due to nonconformance to Health Informatics Standards.

To address these issues, IDS proposed the formation of Health Informatics Centre (HIC), approved in 2007, to carry out three (3) major functions namely data management, publication and dissemination, and development of Health Informatics Standards. IDS produced the Health Information Management Systems (HIMS) Blueprint where the plan to set up a national health data warehouse was deliberated. This plan was aligned with the MoH ICT Strategic Planning 2011-2015.

Recent years

HIC actively pursued the above objective in 2011, and formally named the project as Malaysian Health Data Warehouse (MyHDW). The first document was produced in collaboration with an international consultant appointed by WHO. The same consultant was later appointed by MoH for series of consultations in 2012 and 2013, to assist MoH in the works to support the planning, successful development and evolution of MyHDW. Each sessions output was detailed in documentations, which are compiled in this publication.

It is the Ministry's sincere hope that the documents contained within this publication will be our reference and guidelines in MyHDW development. In the future, MyHDW will then be "a trusted source of truth of comprehensive health data structured for query and analysis." The high quality information produced will benefit MoH in making well-informed decisions and planning in Malaysia's health sector.

HEALTH INFORMATICS CENTRE
2013

MALAYSIAN HEALTH DATA WAREHOUSE

GUIDELINES AND BLUEPRINT

May 2011

OBJECTIVE

This document outlines guidelines and an initiation plan for the effective development of a Malaysian Health Information Data Warehouse (MyHDW). In terms of scope this report will provide a blueprint for the effective development and sustainment of MyHDW. This system has the potential to supply key data and information for the optimal running of the health system, health surveillance and research.

APPROACH

Drawing on successful international experiences with the development of national health information data warehouse's and analysis and reporting systems to guide and inform the initiation, development and evolution of MyHDW, the following steps contributed to the creation of this report:

- Visit by Mark Fuller to Malaysia in March/April 2011 for 2 weeks to investigate current environment and to determine a blueprint for the initiation and evolution of a national health information data warehouse to support effective management of the health system, surveillance and research needs. Mr. Fuller currently heads the development of a national health data warehouse program for Canada
- Review current environment material for example Life Time Health Plan, Telemedicine Flagship Application, Telemedicine Blueprint, HIMS Blueprint etc.
- Interviews and workshop sessions with appropriate stakeholders both from business and technical groups to determine current environment and future requirements for:
    - Data and Information products (Reports, Analytical tools, Health Indicators, Key Performance Indicators etc.)
    - Data acquisitions systems (Electronic Medical Records (EMR), Electronic Health Records (EHR) and Clinical Administrative systems etc.
    - Architecture, data and terminology standards – Current and desired
    - Information and Data Governance
    - Critical Success Factors
    - Manpower, organization and resource considerations
    - Technology

  The above exercise concluded with a three day workshop in Kuala Lumpur in April 2011 with key stakeholders with findings and recommendations presented to a panel of senior members of the Ministry of Health. *See Appendix 2 for details of workshop participants.*

CONTEXT AND BACKGROUND

Malaysia faces challenges in the sustainment of a responsive health system where there are ever increasing expectations from its citizens, changing trends in disease patterns and socio-demography, a need for greater integration, accessibility and affordability and a requirement for increasing efficiencies. Within this milieu of a combined publically funded and private system, new programs such as 1Care aim to address these challenges. Furthermore with the increase in the utilization of evidence based decision making and performance measurement, greater financial and resource planning will further require good access and availability to trusted health data and information. It is proposed that MyHDW will provide a solution for this need in terms of:

- Addressing an increasing demand for access to data and information
- Providing access to information and data that is accurate, timely and trusted
- Presenting an integrated consolidated view of health information
- Effectively delivering Key Performance Indicators (KPIs) and Performance Measurement metrics
- Cost effectiveness

To meet the diverse needs of timely health information provision and management such as above, many jurisdictions internationally have employed the use of a Health Information Data Warehouse (sometimes known as a Clinical Data Warehouse –CDW) to act as a platform for the standardization and integration of health data from a variety of sources for example; Electronic Medical Records, Electronic Health Records, Clinical Administrative Systems. This allows for a trusted source of truth within a jurisdiction to be established which can be leveraged to better manage the health system, provide surveillance information and in addition provides a valuable source of data for research. *See Appendix 1 for an overview of Malaysia's Health System*.

1Care is the restructured integrated health system that is responsive and provides choice of quality health care, ensuring universal coverage for the health care needs of the population based on solidarity and equity. This national healthcare reform addresses three areas: service delivery reforms, organizational reforms and financing reforms.

HEALTH INFORMATION DATA WAREHOUSE

While the term data warehousing is associated with a set of technology methods and techniques associated with building reporting and analysis systems, it recently has come to embrace broader approaches to the effective provisioning of information and includes factors such as governance, quality assurance, requirements gathering, privacy, security and consent and so on. **Clinical Data Warehouse (CDW)** is synonymous with Health Information Data Warehouse. The ISO definition is as follows:

'grouping of data accessible by a single data management system, possibly of diverse sources, pertaining to a health system or sub-system and enabling secondary data analysis for questions relevant to understanding the functioning of that health system, and hence supporting proper maintenance and improvement of that health system'

It is recommended that reference be made to the following ISO reports for a good overview and guidelines regarding Health Information Data Warehousing:

- Deployment of a clinical data warehouse - ISO/TS 29585
- Good principles and practices for a clinical data warehouse – ISO TR 22221

In addition the following report on Health Indicators provides an internationally accepted approach on this topic and is recommended supplementary background reading.

- Health indicators conceptual framework – ISO TS 21667

INTERNATIONAL DEPLOYMENTS OF HEALTH DATA WAREHOUSE

A number of jurisdictions internationally have adopted a health information data warehouse concept or similar. In addition some of these jurisdictions have considered alignment between primary use systems such as EHR's (LHR) and downstream secondary usage systems.

International examples include:

- UK – National Program for IT/Secondary Usage Services
- Canada – Canadian Institute for Health Information/Canada Health Infoway
- Spain - NHS
- Denmark
- Australia- NEHTA
- USA – Kaiser Permanente
- USA – US Veteran Health Administration

From this international experience the following are some high level strategies that have been found to be helpful in effectively delivering good quality, relevant and trusted information:

- An integrated and holistic strategy for both primary and secondary use has proved successful. This needs to be supported by political will at all levels of government, national and regional.
- Effective and overarching governance must be in place to coordinate all e-health related activities. Ideally this should report into the highest levels of government or their representatives. National and regional activities must also be aligned and should involve all key stakeholders.
- There needs to be agreement or consensus on standards and other requirements. A national health informatics standards body is required.
- A national infrastructure that supports data sharing has found to be most cost effective.
- Particularly ensure that data provider's input and requirements are incorporate into data usage and system design
- An endorsed and well thought through communication strategies with all relevant stakeholders
- Legislative and legal frameworks are needed to allow sharing of data; this includes a clear approach to consent and privacy.

CHALLENGES AND GAP ANALYSIS

A consolidated view of the Malaysian Health System based on high quality data available at the right time is required to allow for evidence based planning and accurate projection and forecasting so that good decisions can be made, within a climate of a changing health landscape (disease patterns, resource allocation, demands, delivery challenges, etc.) Based on interviews and workshop sessions it would appear that the current environment falls short of this requirement as detailed below. MyHDW is proposed as a solution. Currently in terms of readiness for the initiation, development and sustainment of this concept the following gaps have been identified along with recommendations to ameliorate these:

Gaps/Readiness	Recommendations
Limited information and data governance mechanisms	Establish information governance structure led by the National Health Informatics Council, Responsible for ratification of: • Data standards - structure and content • Health Indicator methodologies • Access to data • Privacy and security standards • Legislation and policies in line with 1Care
Non-compliance to Health Informatics Standards	Strengthen policies on Health Informatics Standards to ensure proper development, adoption, promotion and compliance of appropriate standards
Limited data architecture, with various data sources, legacy systems, redundancies and duplication. No evidence of an overarching information requirement aligned with priorities	Development of health information model, national reference data model and data dictionary Review & make appropriate changes to reduce burden & duplication
Limited data collection abilities	Concentrate on priority areas, which need to be subjected to review and prioritization, including KPIs, finance etc. Develop incentive mechanisms for private and government facilities, which include reward & enforcement to promote "buy-in"
Existence of various levels of data, completeness and data quality	Develop and disseminate guidelines on data quality Consider applying validation rules at the point of data acquisition
Limited funding	Allocation of funds for programs and initiative associated with the MyHDW blueprint overleaf.
Limited technology and tools	Standardize and invest in quality tools for data loading, reporting and data analysis

Lack of human resource, skills and capacity	Invest in increased analytical and technical capacity to leverage, develop and maintain MyHDW
Policies will be required to support MyHDW	Align to government and MOH policies (e.g. ICT Security Policy etc.) Who and when the data going to be used – who is responsible? Private Health Care Facilities and Services Act, 1998: to be reviewed for data sharing and data reporting to enable MyHDW and 1Care. Implementation model possibilities: MOH MAMPU – as part of National Data Ware House initiatives ETP/Private Sector – to take up the project Hybrid Model

MALAYSIAN HEALTH DATA WAREHOUSE MYHDW - WORKING DEFINITION AND CHARACTERISTICS

Based on industry standards, international experiences, consultant advice and workshops in KL April 2011, the following is a working definition for a Malaysian Health Data Warehouse MyHDW:

'A trusted source of truth of comprehensive healthcare data structured for query and analysis purposes'.

MyHDW will have the following characteristics:

- A dedicated system that is optimized for analysis and reporting
- Data is integrated, interoperable and comprehensive
- Build based on national health informatics standards
- Employs an overarching healthcare system governance
- Information available in 'right time'
- Employs the notion of 'build once use many' with the objective of reducing the burden of data collection and processing – This implies where possible aligning primary and secondary usage consideration
- Can support many reporting and analysis tools and interfaces
- Data Quality is of the highest level and will be supported through appropriate methods, tools and techniques
- Implements secure and privacy sensitive access
- Evolution is aligned and prioritized in accordance with key programs, initiates and information needs
- Support the development and sustainment of MyHDW through the creation of centers of excellence of skilled internal resources and through best practices and learning's from international experiences

REFERENCE MODEL

The following schematic represents the flow of data from source to presentation of information to an end user. Holistically this represents the concept of the Health Information Data Warehouse and each of its major components. MyHDW is a national deployment of this concept. For a more detailed explanation of each component represented please refer to the ISO material referenced.

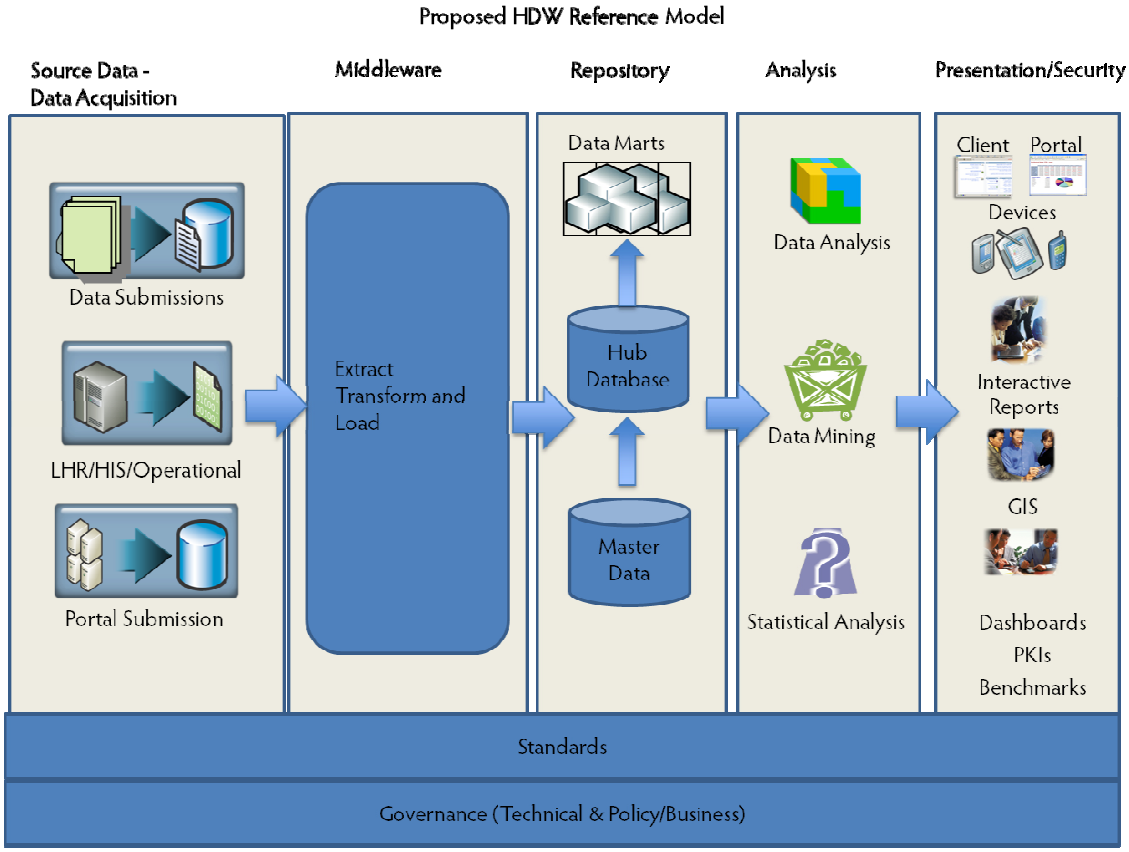


Figure 1

CATEGORIES OF USE AND POTENTIAL DATA SOURCES

The following diagram represents categories of usage and candidate data sources of MyHDW. These categories and data sources provide an implementation framework for MyHDW. Actual implementation may be partial driven by the source systems and data that actually exist, as well as prioritization of investments. Further this framework itself may appropriately evolve with time.

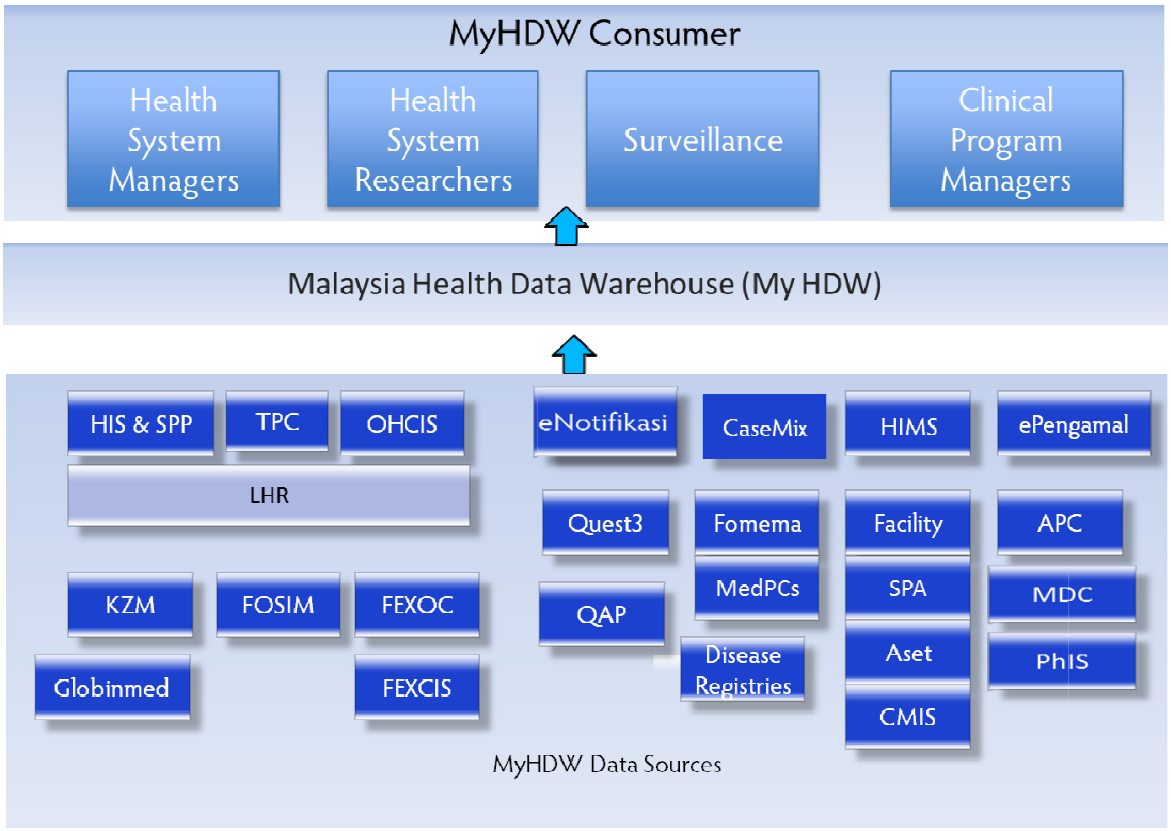


Figure 2

SECONDARY USE DATA/MYHDW TYPES OF CONSUMER

In terms of providing trusted information it is recommended that data is collected as a byproduct of providing care, thus ensuring efficient collection, accuracy and completeness. Data collected as part of providing care is sometime known as 'Primary Use' and its downstream usage for other purposes 'Secondary Use' or in some jurisdictions such as Canada 'Health System Use'. Extraction, standardization

and integrating this data, supplemented by additional collection if necessary compose the Health Information Data Warehouse and it is from this source that key reporting indicators can be drawn. The following are categories of secondary use data and how they are used:

Category	Description	How Used
Health System Management	Improve the efficiency and effectiveness of the health system	Cost management Strategy, planning and policy development Resource allocation, priority-setting and funding Resource utilization System performance reporting
Research	Insights in regards to improved medical treatments and programs of care, and better understand the performance of the system and health of the population	Clinical research studies Comparative effectiveness and evaluation Retrospective analysis of policies, initiatives and interventions Population research Modeling and simulation
Surveillance	Provide data on certain disease/events which leads to preventive and control activities Evaluation of public health programs/practices Alert on potential outbreaks/risks	Disease Surveillance Public health education Public health reporting
Clinical Program Management	Improve delivery of clinical care and evidence-based best-practice	Quality control and improvement Disease management Patient safety initiatives Monitoring access to care

BENEFITS

Building on the categories of use, the potential benefits of MyHDW are multifaceted and far reaching. The collection, management and use of health information is vital to continued efforts to improve the quality and efficiency of Malaysia's health system. This ultimately will allow health leaders to better be able to measure performance to ensure quality care is being delivered resulting in improved health outcomes, that LHR investments will achieve value for money and that healthcare spending can be linked to measureable outcomes.

MyHDW key benefits include:

- High quality, trusted source of information to allow the effective management of the health system.
- Good access to data in a secure and privacy sensitive manner.
- Data is linkable and comprehensive allowing questions across the continuum of care.
- Is integral to key health system management initiatives e.g. KPI's, 1Care, HIMS etc.
- Support research and surveillance requirements
- Output provisioned at a variety of levels and through different tools and interfaces.
- Increased analytical productivity and efficiency.

BLUEPRINT OVERVIEW

The following outlines the key steps for evolving MyHDW for 2011-2014. Clearly initiatives for 2013 and 2014 should be considered tentative pending further analysis closer to the time. The key assumptions associated with this blueprint are that the budget proposed is accepted, that there is sponsorship of MyHDW at the highest level, strong governance established as suggested and HIC is the main custodian of this initiative. Note task 11-3 (MyHDW Portfolio Plan) below will more comprehensively document and plan the exact content of the MyHDW portfolio for 2011-2014. It is recommended that this detailed planning step consider as possible an approach of a limited number of tightly focused deliverables to ensure a realistic and achievable plan.

Ref	Initiative/Task	Notes	2011	2012	2013	2014
11-1	Create Business Case present to ICT SC		●			
11-2	Establish National Health Informatics Council		●			
11-3	Develop 3 Year Strategy and Portfolio Plans	1. eHealth strategy report 2. MyHDW Portfolio Plan	●			
11-4	Develop Infrastructure Plan	Technology, Tools, Infrastructure Plan	●			
11-5	Gap Analysis between HIS and SMRP/Discharge summary data sets. [1]	Gap analysis to determine if HIS can be used for SMRP/Discharge collections	●			
11-6	Recruit and train core teams - Analysts and IT resources	15 x IT 15 x Analytical/Stats/Research See Appendix 3 for IT resources	●	●		
11-7	Reference Data Model and Data Dictionary	Establish national data standards (structure) – Data Model and Data Dictionary	●	●	●	
11-8	Develop Health Information Model/Framework	Overarching map of key questions that need to be answered to support priority KPI's, 1Care and HIMS and what products and data are required to answer them.	●			
11-9	Communication Plan	Communication material, roadshow etc. to communicate the MyHDW concept to key stakeholders	●			
12-1	Procure and setup technical infrastructure			●		
12-2	Establish enhanced analytical and technical capacity/capability in HIC and IT			●		
12-3	Build 2 x HIMS databases 'Data Marts' within MyHDW	Establish 2 x Data Marts and Reporting Products – Likely candidate would be: -Inpatient discharges, integrated with Case Mix. -Support to 1Care needs -To be determine based on further analysis		●		

[1] Could include Primary Health Care Systems e.g. TPC and OHCIS

Ref	Initiative/Task	Notes	2011	2012	2013	2014
12-4	Renal & Cancer Registries	If possible house 2 x registries ideally Renal and Cancer within the MyHDW infrastructure. These would be separate from MyHDW but could leverage the same technology and services		●	●	
12-5	Establish Master Data Program – Develop Facility and Professionals Master data	Establish program/function in HIC to develop and maintain master or reference data. Initial master data candidates are Facility and Professionals		●	●	●
12-6	Strategy, planning and policy development, System performance reporting	Report and Information products development for these areas. TBC		●		
12-7	Systems Running - Establish Operations and Support Services	Establish group to maintain and support what has been built		●	●	●
13-1	Add 2-3 Data Marts to MyHDW	Establish 2-3 x additional Data Marts and Reporting Products – Likely candidates would be: Communicable Diseases, Primary Care, Pharmacy -To be determine based on further analysis			●	
13-3	Add Public health surveillance data/functionality	Addition of Public Health Surveillance data/function TBC			●	
13-4	Patient safety initiatives, Monitoring access to care	Develop new reports for Patient safety initiatives, Monitoring access to care			●	
14-1	Add 2-3 Data Marts to MyHDW	New Data Marts To be determine after further analysis				●
14-2	Other Registries	To be determine after further analysis				●
14-3	LHR	Begin to utilize LHR data feeds as possible. Further analysis needed				●
14-4	Clinical research studies, Disease and wellness program	Develop new reporting products for these areas				●

It is recommended that each task/step above is more fully defined in the Portfolio plan (11-3) and that each task is assigned to a specific group or individual to take accountability.

COST ESTIMATES

The following are the cost estimates for the proposed plan based on interim cost estimates developed during the workshop sessions. Please note there is wide latitude in software and hardware costs. The higher values represent the usage of 'best of breed technology'. This strategy can be extremely effective in increasing productivity as well as improving the quality of products. That said, further analysis is needed to determine which procurement strategy should be adopted. Task 11-1 will further develop outline costs as part of a broader business case for MyHDW. It is suggested that the median total value be used for planning assumptions at this stage.

	2011	2012	2013	2014
Capital				
Hardware	50K	310K – 810K	41K – 91K	61K – 137K
Software	200K	615K – 4115K	123K – 823K	123K – 823K
Facilities, Services, Operations	1.0M	1.55M – 1.60M	1.04M – 1.09M	788K – 838K
Staff/Compensation/Expenses				
IT/Technical Staff (15)	800K	1.65M – 2.10M	1.65M – 2.10M	1.65M – 2.10M
Analytical Staff (15 Statistician & Researchers)	150K (3)	750K	750K	750K
Professional Services/Consulting	300K	500K	500K	500K
TOTAL	**2.5M**	**5.3M – 9.9M**	**4.1M – 5.4M**	**3.9M – 5.1M**

CONCLUSION

It is recommend that the initial three tasks in the Blueprint be undertaken immediately to launch this initiative, specifically:

- 11-1 - Create the Business Case and present it to ICT Steering Committee. It is vital that the value and need for MyHDW is clearly detailed to the key stakeholders, along with an associated investment profile presented through a well articulated Business Case.

- 11-2 - Establish the National Health Informatics Council – the workshop discussions emphasized the strong need for this council. This group should probably be re-formed and its Terms of Reference reviewed if necessary.

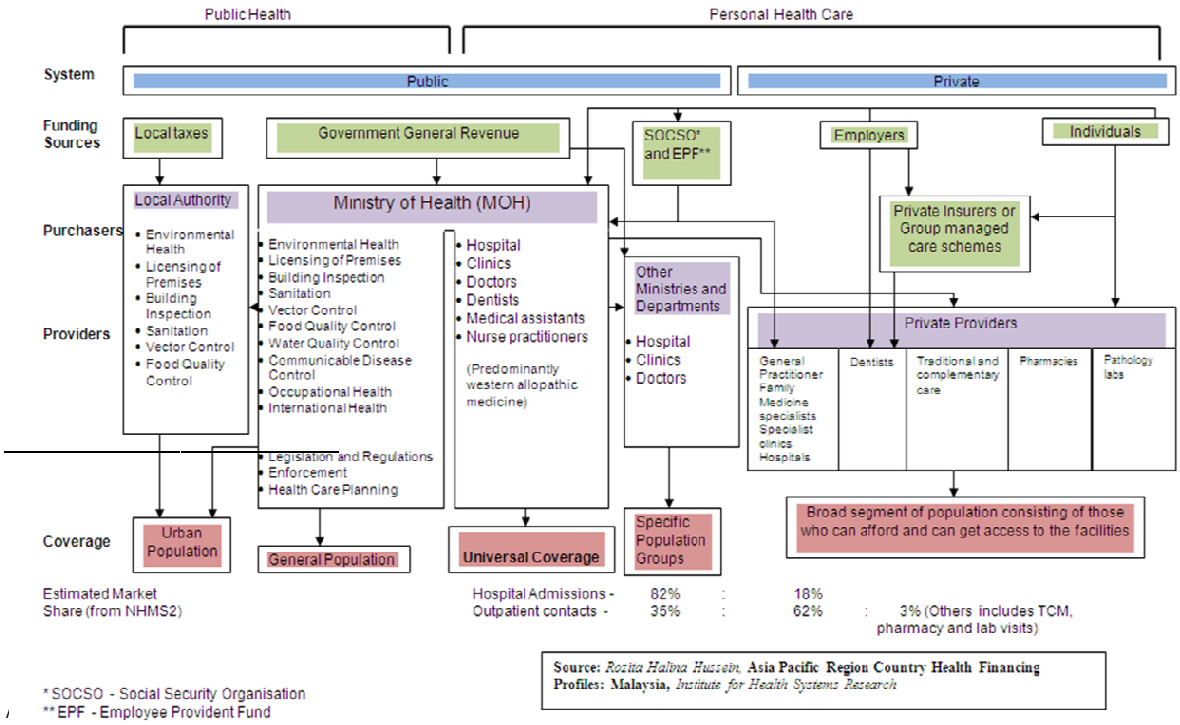
- 11-3 -Develop a 3 Year Strategy and associated Portfolio Plans. This task should be undertaken following the successful review of the MyHDW business case by the ICT Steering Committee. This plan should place particular emphasis on fiscal year 2012 and include a gated process at the end of each year to review the exact deliverables in subsequent years.

It is encouraged that a highly focused plan be delivered and that care is taken not to over-extend the scope of MyHDW in the first year. A high degree of expertise will be required to successfully develop and scope this plan and it is recommended that a strong and experienced team is assigned to this work. The two critical steps for the remainder of fiscal 2011 are building the capacity and ensuring the appropriate alignment to the broader eHealth strategy.

APPENDICES

APPENDIX 1 OVERVIEW OF THE MALAYSIAN HEALTHCARE SYSTEM

Overview of Current Malaysian Health System



APPENDIX 2 – WORKSHOP PARTICIPANTS

GROUP 1 : SYSTEM MANAGEMENT		
No	**Name/Division**	**Duty**
1.	Dr. Azrin Zubir Consultant Meridien Project Management Pt. Ltd.	Facilitator
2.	Dr. Fazilah Shaik Allaudin Selayang Hospital	Facilitator
3.	Dr. Christina Rundi Disease Control Division (Malaria)	Group Leader
4.	Dr. Fathullah Iqbal Ab Rahim Health Informatics Centre	Secretariat
5.	Dr. Fauziah Zainal Ehsan Family Health Development Division	Secretary
6.	Dr. Rohana Ismail Family Health Development Division	
7.	Muznita Mahmood Human Resource Division	
8.	Nur Azlina Abdul Aziz Nutrition Division	
9.	Zanariah Zaini Health Education Division	
10.	Md Amidon Ag Danot Health Education Division	
11.	Sevanthainathan A/L C. Sundram Traditional & Complimentary Medicine Division	
12.	Asmah Ismail Allied Health Science Division	
13.	Norzitah Abu Khair Food Safety & Quality Division	
14.	Noorsiah Hassan Basri National Health Financing	
15.	Dr. Cheng Lai Choo Oral Health Division	
16.	Dr. Suzana Mohd Hashim Disease Control Division (TB/Leprosy)	
17.	Tan Yoke Hwa Allied Health Science Division	
18.	Mariam Bintarty Rushdi Pharmacy Division	

GROUP 2 : ICT AND STANDARDS		
No	**Name/Division**	**Duty**
1.	Dr. Dzaharudin Mansor National Technology Officer, Microsoft Malaysia	Facilitator
2.	Dr. Azrulreezal Azanne Abdul Wahab Health Informatics Centre	Secretariat
3.	Dr. Amiruddin Hisan Telehealth Division	Group Leader
4.	Jaafar Ahmad Information Management Division (BPM)	
5.	Jamalul Rijal Abd Aziz Health Informatics Centre	
6.	Idham Halimi Idris Financial Division	
7.	Rahayu Shafie Family Health Development Division	
8.	Nor Faziella Nat Jemi Medical Devices Control Division	
9.	Kee Chia Choon Disease Control Division	
10.	Mohd Zamri Selamat Information Management Division (BPM)	
11.	Rosnita Abdul Kahar Food Safety & Quality Division	
12.	Abzarul Azli Abdullah Information Management Division (BPM)	

GROUP 3 : STRATEGY ASSOCIATED WITH DATA & INTEGRATION		
No	**Name/Division**	**Duty**
1.	Noriati Baharum MAMPU	Facilitator
2.	Dr. Ilias Adam Yee Health Informatics Centre	Secretariat
3.	Dr. Fekriah Mohd Yatim Oral Health Division	Group Leader
4.	Dr. Muhammad Najib Adnan Consultant, Emergency & Trauma Department, HRPB	
5.	Dr. Azlee Ayub Bintulu Hospital	
6.	Asri Hashim Food Safety & Quality Division	
7.	Mohd Radzi Ab Aziz Pharmacy Division	
8.	Farina Zulkernain Allied Health Science Division	
9.	Dr. Fatimah Othman Consultant Radiologist, Putrajaya Hospital	
10.	Fathkiah Hj Khalil Pharmacy Division	
11.	Dr. Sabariah Faizah Jamaluddin Consultant, Emergency & Trauma Department, Sg. Buloh Hospital	
12.	Dr. Lim Yam Ngo Consultant Pediatrician, Kuala Lumpur Hospital	
13.	Martha James Jimponey Engineering Division	
14.	Junidah Raib Nutrition Division	

GROUP 4 : RESEARCH & ANALYSIS		
No	**Name/Division**	**Duty**
1.	Dr. Lailanor Ibrahim Kuala Lumpur Hospital	Facilitator
2.	Dr. 'Ismat Mohd Sulaiman Health Informatics Centre	Secretariat
3.	Dr. Muhammad Fadhli Mohd Yusoff Institut kesihatan umum (IKU)	Secretary
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5.	Dr. Ravichandram Jeganathan Consultant Obstetrics & Gynaecologist Sultanah Aminah Hospital	
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8.	Dr. Sivasakthi V Consultant Anaesthesiologist Kuala Lumpur Hospital	
9.	Dr. Wan Mohd Zamri Wan Nawawi Consultant Forensic Pathologist Medical Forensic Institute	
10.	Dato' Dr. Suarn Singh Jasmit Singh Consultant Psychiatrist Hospital Bahagia Ulu Kinta	
11.	Dr. Tahir Aris IKU	
12.	Mohd Nasir Mohd Noor Institute of Medical Research (Epidemiology Division)	
13.	Dr. Amal Nasir Mustafa Institute of Medical Research	
14.	Dr. Noel Thomas Ross Consultant Physician Kuala Lumpur Hospital	
15.	Dr. Wan Hamilton Wan Hassan Consultant Obstetrics & Gynaecologist Serdang Hospital	
16.	Dr. Roshida Hassan National Blood Bank	

APPENDIX 3 – IT RESOURCE PLANNING SHEET

	[3]Year 0 Estimate (minimal infrastructure)	Year 1 (On-Premise, best cost)	Year 1 (Best of breed)	Year 1 Cloud (Estimate) - best cost	Year 2 (On-Premise, best cost)	Year 2 (Best of breed)	Year 2 Cloud (Estimate) - best cost	Year 3 (On-Premise, best cost)	Year 3 (Best of breed)	Year 3 Cloud (Estimate) - best cost
DB Server HW		120,000	120,000	0						
DB - staging, development UAT additional 1. Backup server.		120,000	120,000	40,000						
Enterprise storage, Fiber channel.		100,000	100,000	0						
Backup storage		100,000	100,000							
BI Server HW		50,000	50,000	50,000						
BI – testing		50,000	50,000	50,000						
ETL/Middleware	50,000	50,000	50,000	0						
Statistical desktops		120,000	120,000	120,000						
Installation/Service		100,000	100,000	50,000						
Expert Consulting	100,000	100,000	100,000	100,000						
HW Maintenance/yr					91,000	91,000	41,000	136,500	136,500	61,500
Software Licenses										
DB	192,000	200,000	800,000	384,000			384,000			384,000
BI + development	7,680	100,000	1,500,000	7,680			7,680			7,680
ETL/Middleware/Development		0	1,500,000	0						

[3] Workshop technology worksheet from ICT and Standards group based on 3 scenarios – 'minimal', 'cloud', 'best of breed'

Statistics (Desktop, SPSS)		300,000	300,000	300,000						
Backup agent		15,000	15,000	15,000						
Software Maintenance/yr					123,000	823,000	141,336	123,000	823,000	141,336
Facilities/yr										
2 Racks		100,000	100,000	50,000	100,000	100,000	50,000	100,000	100,000	50,000
12 x Office space		100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Miscellaneous	100,000	100,000	100,000	100,000	50,000	50,000	50,000	50,000	50,000	50,000
Personnel/yr										
DBA (2)		300,000	300,000	150,000	300,000	300,000	150,000	300,000	300,000	150,000
BI Administrator (internal)		150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
BI Developers (2)		200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
SAS Admin		150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
ETL Admin		150,000	150,000	0	150,000	150,000	0	150,000	150,000	0
ETL Developer (trainable x 3)	100,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
DW Architect (acquire)	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Data modeler (acquire)	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Systems/Biz Analyst **(internal)**		150,000	150,000	0	150,000	150,000	0	150,000	150,000	0
Project Manager/Lead **(internal)**	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Contract budget	800,000	1,200,000	1,200,000	1,200,000	840,000	840,000	840,000	588,000	588,000	588,000
	2,049,680	5,125,000	8,625,000	4,216,680	3,404,000	4,104,000	3,264,016	3,197,500	3,897,500	3,032,516
3 year total		**11,726,500**	**16,626,500**	**10,513,212**						
HW Cost	50,000	810,000	810,000	310,000	91,000	91,000	41,000	136,500	136,500	61,500
Software	199,680	615,000	4,115,000	706,680	123,000	823,000	533,016	123,000	823,000	533,016
Others (Staff, space, operations)	1,800,000	3,700,000	3,700,000	3,200,000	3,190,000	3,190,000	2,690,000	2,938,000	2,938,000	2,438,000

APPENDIX 4 SUMMARY OF SYSTEMS CURRENTLY IN PLACE (AND IN DEVELOPMENT) WITHIN THE MINISTRY OF HEALTH, MALAYSIA

System Name	D'base	Process Tool	Data Type	Collection	Output
Health Informatics Centre (HIC)					
Health Information Management System (HIMS) 10 subsystems (dataset). GIS in development	Excel	SPSS - KIV SAS			AR, HF, HI
Medical Care Information System (SMRP) Inpatient, Outpatient, Daycare, Clinical Support	Access MySQL		Granular outpt - summary	electronic	AR
Family Health Information System	Excel		summary	electronic	AR
Family Planning Information System	Excel		summary	electronic	AR
Blood Transfusion System	Excel		summary	electronic	AR
Private Hospital Information System	Excel		summary	electronic	AR
Dental Information System	Excel		summary	electronic	AR
Rural Water Information System	Excel		summary	electronic	AR
International Entry Point System	Excel		summary	electronic	AR
Food Safety Information Management System (see below)	**In development**				AR
Facility and Services Information System	Access		summary	manual	AR
Clinical Research Centre (CRC)					
Patient registries. Each RM100K (initiate) & RM50-70K/year (maintenance). Database used for research (>30 registries) 60% data underused		SPSS & STATA	granular		
Institute of Health System Research (IHSR). Governance: QA Program of the Medical Development Division					
Secretariat of the National Institutes of Health (NIHSec)					
NMRR. Database for research documents. Governs all research using MOH facilities or using MOH staff				Web-based	
Oral Health Division (operating budget 2-3% of total budget)					
Dental Practitioners Information Management System (DPIMS). Manages dental practitioners, (registration and licensing)	**In development**				
Oral Health Clinical Information System (OHCIS). Manages dental health records. Pilot in 11 hospitals & clinics	MSSQL		Granular	electronic	
Dental practitioner Information Management System (DPIMS)	MSSQL		Granular	Web-based	
Pharmaceutical Services Division					
Pharmacy Information System (PhIS) (Dev. cost RM6K). Management of expenditure & enforcement, not the dispensing, Quest 3	**In development**				
Non-communicable Disease Section of Disease Control Division (DCD)					

MyHDW Guidelines and Blueprint May 2011

System Name	D'base	Process Tool	Data Type	Collection	Output
National Cancer Registry (voluntary)Cancer information with clinical purposes.70% coverage of all cases ~ 20K records/year			Granular	electronic + Manual	
National Diabetes Registry (not a form of EMR). Epidemiological data at population level & QA Program. Capacity 350K	mohnet		Granular	Web-based	
Communicable Disease Section of Disease Control Division (DCD) eNotification(surveillance – realtime)					
eNotifikasi	mohnet				
Family Health Development Division					
Teleprimary Care (TPC).Since 2005, 7 states (10% of MOH clinics). capacity ~4M/yr. Primary care & linked to specialists clinics. total ~40M			Granular		
Mortality Reporting (Maternal and < 5 y.o)				Manual	
Health Education System (Activity report)				Manual	
Food Safety & Quality Division (FSQD) (Final stage of development)					
Food Safety Information System (FOSIM) . Cost ~RM 1.2M Domestic (realtime analysis), export and import components	mohnet			Web based	
Medical Practice Division Private Medical Practice Section (CKAPS)					
Private healthcare facilities, currently registration only					
Secretariat for Professional Boards (Medical & Optical Councils, Medical Assistants, Nursing & Allied Health Boards)					
For registration & licensing purposes			Granular	Manual	
Medical Development Division					
Case-Mix system (DRGs) Pilot 6 hospitals- (outsourced). Needs clinical & resource-based info for resource utilization assessment					
Health Technology Assessment	Excel			Manual	
Quality Unit - National Indicators Approach (NIA) & KPIs	Excel			Both	
Telehealth Division					
Teleconsultation (TC) (Cost ~ RM200K per site) Hospitals without specialists for specialist consultation. 43 TC centers 4 disciplines					
Virtual Library (A portal to access scientific materials/publications)					
Lifetime Health Record (LHR):(myHIX). Initial budget ~RM 60M. RM30M/3 yrs. Planned - 1997, deferred to 2013. Prototype 2008.	SQL	no data model	.	Central repository	
MyHealth Portal- Health information to the public & future LHR integration				Pts enter	
Traditional & Complimentary Medicine Division (T&CM)					
ePengamal (voluntary practitioner registration only currently)			Granular	electronic	
Engineering Services					
Radiography Radiation Surveillance					
National Drinking Water Surveillance Program			summary	electronic	
Nutrition Division					
KZM Registry	**In development**				

System Name	D'base	Process Tool	Data Type	Collection	Output
Information Management Division					
Sistem Pengurusan Pesakit (HIS – developed in house). A Clinical Information System in 5 hospitals					
Medical Devices Division - Registration & licensing of medical devices. Certificates for overseas marketing					
Sistem Pendaftaran Sukarela untuk Syarikat Peralatan Perubatan (MeDVER),Medical Devices Centralized Online Application System (MedCAST).	~ 1000+ entry			Voluntary electronic	

MALAYSIAN HEALTH DATA WAREHOUSE

PORTFOLIO PLAN (PHASE 1)- INITIATION: INFRASTRUCTURE, RESOURCES AND INITIAL DELIVERABLES FOR 2013

MAY 2012

OBJECTIVE

The purpose of this report is to provide an outline of the steps required to initiate the Malaysian Health Data Warehouse (MyHDW). The report will provide an outline of the start-up plan and will encompassing infrastructure, resource planning and initial deliverables. The document will also review the objectives of our consultant, Mr. Mark Fuller, for Session 1, 2012. These are:

- to consolidate a detailed initiation plan for the MyHDW start-up;
- to recommend and plan an approach to the development and maintenance of Malaysia Reference Data Model that will ensure semantic interoperability;
- to make recommendations on the technology options for MyHDW, and
- to make recommendations on providing the best means for MyHDW users to generate statistical reports.

CONTEXT

This document will cover the start-up plan for Phase 1 of the Portfolio plan as detailed in *MyHDW Guidelines and Blueprint* initiative task 11-3 (2): MyHDW Portfolio Plan and 11-4: Develop Infrastructure Plan. A comprehensive three-year portfolio plan that will include Phase 2 will be produced in subsequent reports.

APPROACH

Successful international experience provides the basis for developing a national health information data warehouse, as well as analysis and reporting systems. The following steps contributed to the creation of this report:

- Visit by Mark Fuller to Malaysia in May/June 2012 for 2 weeks to investigate the current environment and readiness in initiating MyHDW, and to delineate the MyHDW portfolio plan, with particular emphasis on fiscal year 2013.
- Courtesy call and discussion with high-level health managers intended to determine the key requirements and driving factors behind the development of a national health data warehouse. *See Appendix 1 for details on meetings held.*
- Interview sessions with appropriate stakeholders, both from business and technical groups, and visits to healthcare facilities and government bodies to determine the current environment and future requirements for:
    1. The Health Information Management System and information products (Reports, Analytical tools, Health Indicators, Key Performance Indicators, etc.),
    2. Architecture, data and terminology standards - Current and desired,

3. Information and Data Governance,
4. Manpower, organization and resource considerations, and
5. The technology available internally, locally, and by vendor.

- Explore locally available technology and services through a Continuous Medical Education/Continuous Technical Education (CME/CTE) session by vendors, ending with a panel discussion by stakeholders and consumers to answer key concerns, requirements, technology options and general feedback.

A three-day workshop with key stakeholders and private sector representatives was held. Findings and recommendations intended to underline the portfolio plan, with specific emphasis on resources and technology options, were presented to a panel of senior members of the ministry. *See Appendix 2 for details of workshop participants.*

BACKGROUND

In Malaysia, there is an increasing demand for evidence-based decision making and performance measurement, as well as greater financial and resource planning. This will require improved access to and availability of accurate and timely health data and information. The need for a national health data warehouse to answer to this demand became apparent with the publication of *Malaysian Health Data Warehouse: Guidelines and Blueprint*, May 2011 prepared by Mr. Mark Fuller.

In this document Mr. Fuller proposed MyHDW as the best solution. Specifically, the MyHDW will:

- address an increasing demand for access to data and information;
- provide access to information and data that is accurate, timely and trusted;
- present an integrated and consolidated view of health information;
- effectively deliver Key Performance Indicators (KPIs) and Performance Measurement metrics, and
- be cost effective.

Aligned with initiatives and tasks outlined in the blueprint, further work was undertaken by the Health Informatics Centre (HIC), the custodian of this initiative. First, the proposed MyHDW business case was presented to the ICT Steering Committee in October 2011, and its concept approved. This was followed by the establishment of National Health Informatics Council in November 2011. This laid the foundation and provided governance for health informatics standards at the national level. These two initiatives can be referenced in the Section Heading Blueprint Revisited, Initiative/task 11-1 and 11-2.

In addition, between May 2011 and May 2012, HIC established the following important tools and mechanisms to ensure good governance and compliance to international standards. HIC was allocated a budget in February 2012 under the MyHDW project that allowed these actions to be taken.

NATIONAL HEALTH DATA DICTIONARY (NHDD)

Consensus to approve the initial documents of previous NHDD was achieved after a three-day workshop in April 2012. These documents will be brought to the next National Health Informatics Council meeting for endorsement.

SYSTEMIZED NOMENCLATURE OF MEDICINE - CLINICAL TERMS (SNOMED CT)

A proposal for acquiring a SNOMED CT National License was approved by the ICT Steering Committee on 28th February 2012. Work on procurement of the license is still in progress.

10TH MALAYSIA PLAN - THIRD ROLLING PLAN (2013-2015)

Following the directive from the Director General of Health Malaysia, MyHDW has been enlisted as top priority under the Research and Clinical Support Programme, Ministry of Health Malaysia. The decision by Economic Planning Unit (EPU) to approve the budget is pending.

PATIENT REGISTRIES

Another directive from the Director General, Patient Registries has been transferred to HIC. Previously, this was under the ownership and governance of Clinical Research Centre Malaysia. It will oversee the governance of the data for clinical research and public health management.

CME/CTE SESSIONS

HIC conducted several CME/CTE sessions and site visits to review locally available technology and services in an effort to boost momentum and enhance personnel education. It was attended by stakeholders from within Ministry of Health, private health sectors and vendors.

MyHDW – PRIMARY CHARACTERISTICS

MyHDW is an enterprise wide analytical environment employing industry standard data warehousing concepts applied to support Malaysian health information provision. The Blueprint defines this as:

'A trusted source of truth of comprehensive healthcare data structured for query and analysis purposes'.

MyHDW will have the following characteristics:

1. A dedicated system that is optimized for analysis and reporting,
2. Data is integrated, interoperable and comprehensive,
3. Build based on national health informatics standards,
4. Employs an overarching healthcare system governance,
5. Information is available in 'right time',
6. Employs the notion of 'build once use many' with the objective of reducing the burden of data collection and processing. This implies that where possible, aligning primary and secondary usage considerations,
7. Can support many reporting and analysis tools and interfaces,
8. Data Quality is of the highest level and will be supported through appropriate methods, tools and techniques,
9. Implements secure and privacy sensitive access,
10. Evolution is aligned and prioritized in accordance with key programs, initiates and information needs,
11. Support the development and sustainment of MyHDW through the creation of centers of excellence staffed by highly skilled internal resources and through best practices and learnings from international experiences, and
12. Intended for Secondary Usage of health data[1] not for Primary Usage (direct provision of patient care).

[1] A major confusion regarding the concept of MyHDW usage was discovered during this visit i.e. the terms Primary and Secondary Usage. In reference to *MyHDW Guidelines and Blueprint*, in many instance the data collected for MyHDW is a byproduct of providing care for the purpose of managing the health system.

REFERENCE MODEL

Drawing from the initial reference model in *MyHDW Guidelines and Blueprint*, Figure 1 (below) represents the updated data flow from source to the presentation of the information to an end user. Holistically, this represents the refined concept of MyHDW and each of its major components with emphasis on Start-up Phase 1. The Start-up Phase 1 for MyHDW is the national deployment of this concept from end to end. We propose that a single, mature system should be chosen for implementation.

CATEGORIES OF USE AND POTENTIAL DATA SOURCES

Figure 2 represents the functional categories of consumers and the candidate data sources. The original framework has been restructured, and may evolve further with time and additional data sources. Highlighted is the proposed data source for Start-up Phase 1, specifically, the *Sistem Maklumat Rawatan Perubatan* - SMRP (Medical Care Information Sub-system) under the Health Information Management System (HIMS). Additional data sources may be used following the success of the initial implementation. *See Appendix 3 for details on categories of consumers and how they are used.*

FIGURE 1: EVOLUTION OF MYHDW REFERENCE MODEL DIAGRAM

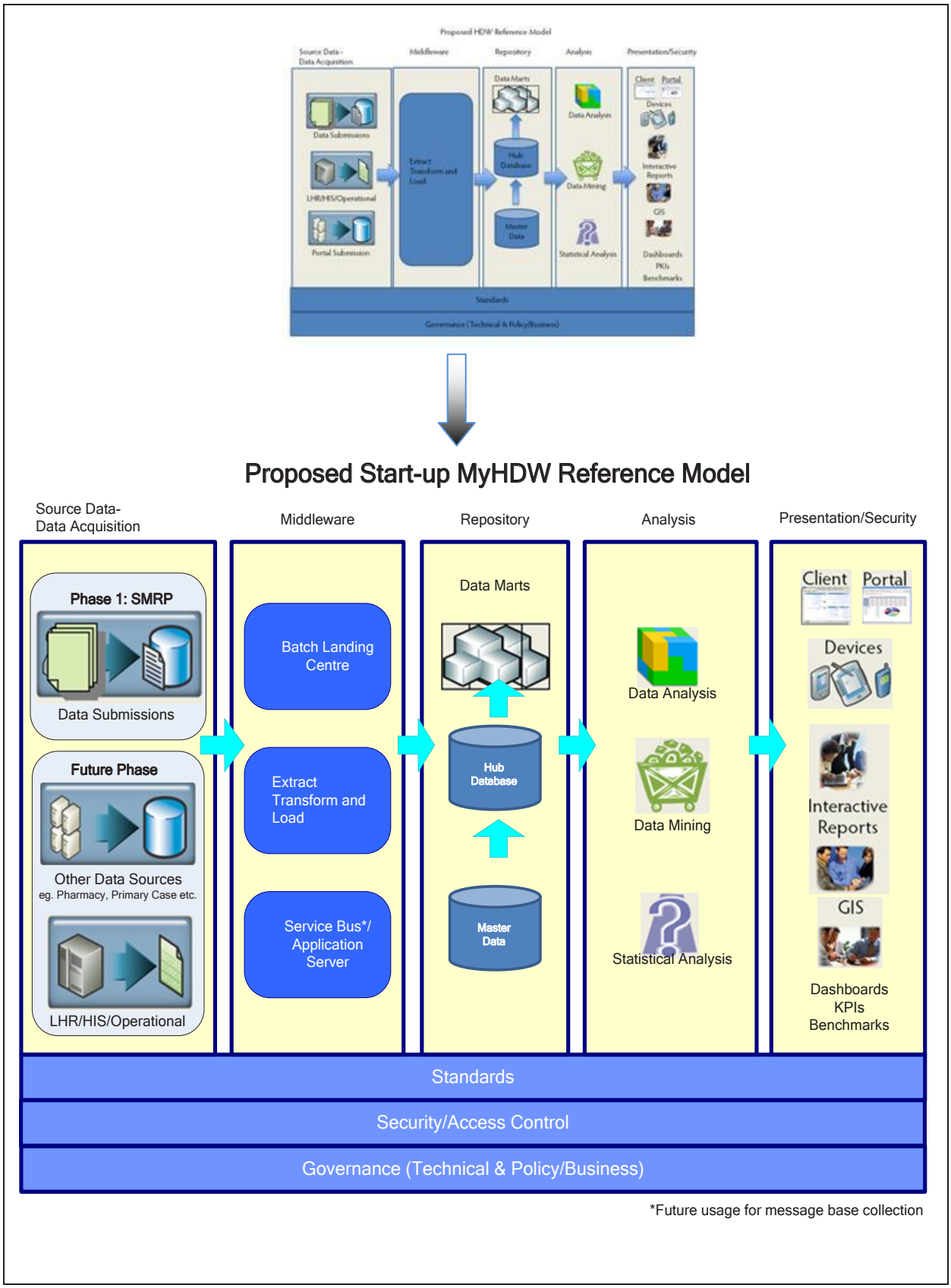
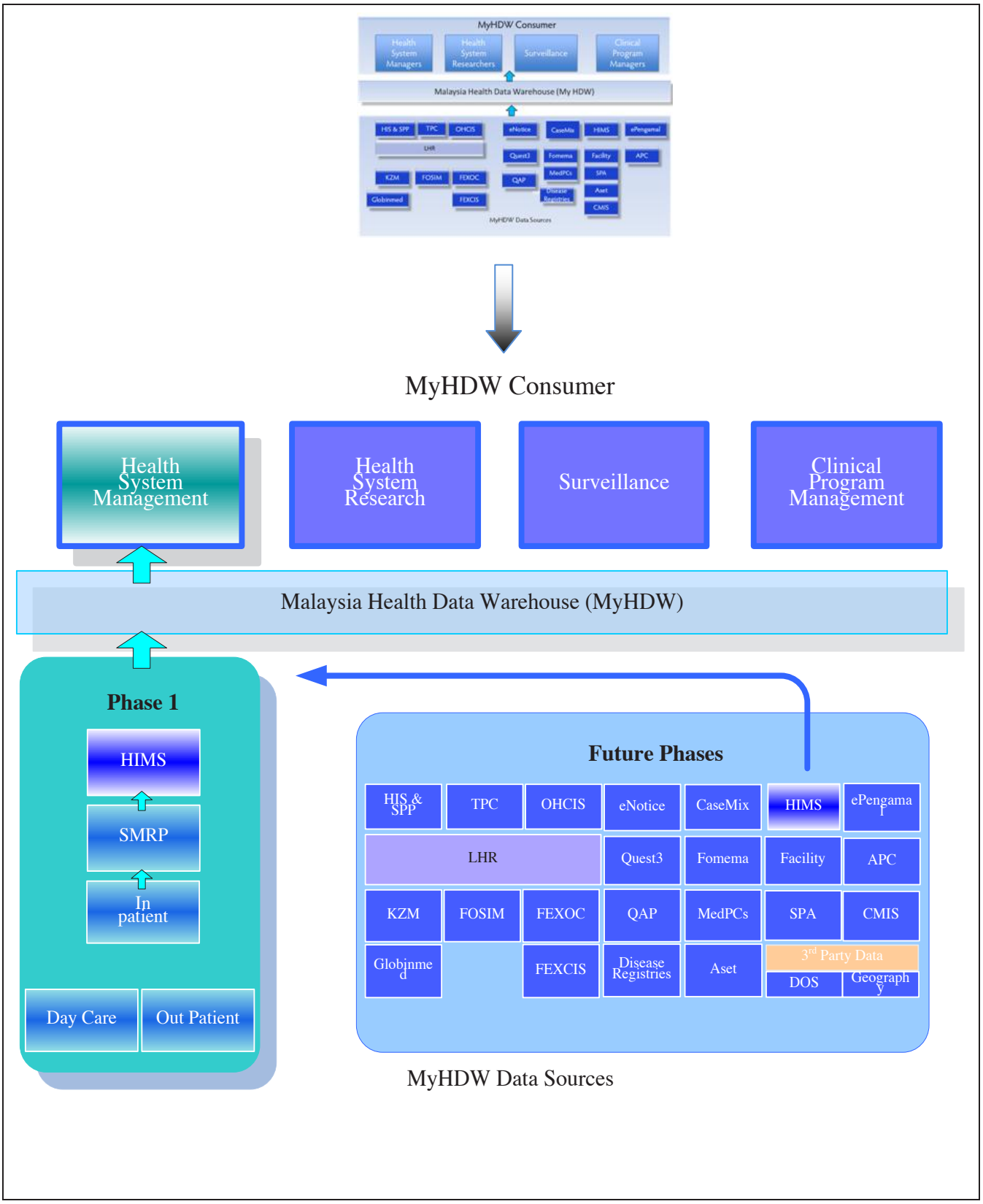


FIGURE 2: EVOLUTION OF MYHDW CONSUMER DIAGRAM



HIGH LEVEL SUMMARY: START-UP PLAN

The benefits of using MyHDW to provide data to manage Malaysia's health system as a whole were outlined in *MyHDW Guidelines and Blueprint*. Key points include the following. MyHDW will provide:

- a high quality, trusted source of information to allow the effective management of the health system;
- good access to data in a secure and privacy sensitive manner;
- data that is linkable and comprehensive allowing questions across the continuum of care;
- integration into key health system management initiatives e.g. KPI's, 1Care, HIMS etc.;
- support for research and surveillance requirements;
- output provisioned at a variety of levels and through different tools and interfaces, and
- increased analytical productivity and efficiency.

For the purpose of Start-up Phase 1, benefit is foreseen from taking an end-to-end approach in implementing SMRP as the first data source. SMRP was suggested due to its maturity and command of the entire process, from acquiring data to the production of reports at an acceptable level of both quantity and quality. The significant benefits of using MyHDW for SMRP are many.

- Efficiency in producing SMRP reports. Although this back-end process is invisible to consumers, efficiency in producing SMRP reports will be accomplished by fully utilizing other components of MyHDW. These include data merging, data cleaning, data scrambling, and developing data marts for analysis and modeling.
- Improved delivery. This will be achieved through increasing productivity and having better access to health information at the right time[2].
- Optimize HIMS. Increased research productivity will enable health managers in their evidence-based decision making and planning.

[2] The use of phrase Right Time versus Real Time was used in *MyHDW Guidelines and Blueprint*. Due to the focus of MyHDW on Secondary Usage, health information produced is not in a real time basis, although current technology allows for real time data collection and report production.

- Produce better output. MyHDW allows consumers to review SMRP reports via different interfaces using a built-in reporting tool. Additionally, analysis can be done on an ad-hoc basis by consumers using Business Intelligence Tools imbedded within MyHDW.

Inadvertently, the benefits noted above will likely be followed by consumer appreciation, optimized data submission and enhanced quality content of the operational level over time.

Introducing other data sources within MyHDW will follow successful implementation of Phase 1, with consideration given to criteria such as maturity, reliability, completeness, etc.

BLUEPRINT REVISITED

With reference to the blueprint, the table below outlines the key steps for the evolution of MyHDW proposed for 2011-2014 and brings the reader up to date on its progress. Additionally, information on completed tasks, tasks involving the start-up plan, and in-progress initiatives are highlighted. Initiatives following the start-up phase in 2013 and 2014 should be considered tentative, pending further analysis closer to implementation. Please note that Initiative/task 11-3 (2): MyHDW Portfolio Plan, 11-3 (3): Start-up Plan and 11-4: Develop Infrastructure Plan reflects the objective of this document.

TABLE 1: KEY TASKS FOR MYHDW PROJECT FROM 2011-2014

REF	INITIATIVE/TASK	NOTES	2011	2012	2013	2014
11-1	Create Business Case and present to ICT SC		●			
11-2	Establish National Health Informatics Council		●			
11-3	Develop 3 Year Strategy and Portfolio Plans	1. eHealth strategy report 2. MyHDW Portfolio Plan 3. Start-up Plan		●		
11-4	Develop Infrastructure Plan	Technology, Tools, Infrastructure Plan		●		
11-5	Gap Analysis between HIS and SMRP/Discharge summary data sets.	Gap analysis to determine if HIS can be used for SMRP/Discharge collections	●			
11-6	Recruit and train core teams - Analysts and IT resources	15 x IT 15 x Analytical/Stats/Research See Appendix 3 for IT resources		●	●	
11-7	Reference Data Model and Data Dictionary	Establish national data standards (structure) – Data Model and Data Dictionary		●	●	●
11-8	Develop Health Information Model/Framework	Overarching map of key questions that need to be answered to support priority KPI's, 1Care and HIMS and delineate the products and data required to answer them.		●		
11-9	Communication Plan	Communication material, roadshow etc. to communicate the MyHDW concept to key stakeholders		●		
12-1	Procure and setup technical infrastructure			●		
12-2	Establish enhanced analytical and technical capacity/capability in HIC and IT			●		
12-3	Build 1 x HIMS databases 'Data Marts' within MyHDW	Establish 1 x Data Marts and Reporting Products – Proposed candidate: SMRP		●		

MyHDW Portfolio Plans (Phase I) - Initiation: Infrastructure, Resources and Initial Deliverables for 2013

REF	INITIATIVE/TASK	NOTES	2011	2012	2013	2014
12-4	Renal & Cancer Registries	If possible house 2 x registries ideally Renal and Cancer within the MyHDW infrastructure. These would be separate from MyHDW but could leverage the same technology and services		●	●	
12-5	Establish Master Data Program – Develop Facility and Professionals Master data	Establish program/function in HIC to develop and maintain master or reference data. Initial master data candidates are Facility and Professionals		●	●	●
12-6	Strategy, planning and policy development, System performance reporting	Report and Information products development for these areas. TBC		●		
12-7	Systems Running - Establish Operations and Support Services	Establish group to maintain and support what has been built		●	●	●
13-1	Add 1 Data Mart to MyHDW from a mature data source- Explore 2 additional Data Marts if resources permit	Establish a Data Mart and Reporting Products from a mature and strategic data source– Likely candidates would be: SMRP, Communicable Diseases, Primary Care, Pharmacy -To be determined based on further analysis. Explore 2 additional Data Marts if resources permit			●	
13-3	Add Public health surveillance data/functionality	Addition of Public Health Surveillance data/function TBC			●	
13-4	Patient safety initiatives, Monitoring access to care	Develop new reports for Patient safety initiatives, Monitoring access to care			●	
14-1	Add 2-3 Data Marts to MyHDW	New Data Marts To be determine after further analysis				●
14-2	Other Registries	To be determined after further analysis				●
14-3	LHR	Begin to utilize LHR data feeds as possible. Further analysis needed				●
14-4	Clinical research studies, Disease and wellness program	Develop new reporting products for these areas				●

Color Legend:

Completed Task
Start-up Plan
In Progress
Future Plan

TECHNICAL INFRASTRUCTURE

OVERVIEW

MyHDW will require a number of infrastructure components including technology, facilities, administrative etc. The following section details the approach, assumptions and components of this infrastructure.

The Malaysian Administrative Modernization and Management Planning Unit (MAMPU) is regarded as the highest authority in setting the standards and policy for developing, modernizing and reforming public administration. MyHDW is a new and innovative approach by the Ministry to modernize the administrative system and its operation, and to improve the efficiency of the material management system, resources, and programs. Meetings with MAMPU were arranged to obtain appropriate input on technology as well as on the security policies and legislations that are fundamental for MyHDW. The following documents were utilized:

1. Electronic Government Activities Act 2007;
2. Information Technology Instruction 2007;
3. *Garis Panduan Mengenai Tatacara Memohon Kelulusan Teknikal Projek ICT Agensi Kerajaan* 2009, and
4. *Panduan Pelaksanaan Pengurusan Projek ICT Sektor Awam*

System sustainability and time to market are perennial issues whenever a system is being developed. One of the measures taken to ameliorate these problematic issues is to involve local expertise from either the public and/or private sector during project development. MIMOS Berhad, a National Research and Development Agency in ICT under the purview of Ministry of Science, Technology and Innovation (MOSTI), has been identified as one of the local expert groups that has the capability and resources that are needed. They can provide strong technical project management, system integration, appropriate software processes, technology platforms, requirements analysis and innovation capability. Partnerships with agencies such as MIMOS will need further exploration. The Ministry's Information Management Division will be actively involved during MyHDW development, in order to build up the internal resources and capabilities needed to sustain the system.

There will be two primary strategies used to develop ICT infrastructure.[3] The first will maximize the current available resources within MoH. Cost effectiveness and appropriate budget are key considerations. Expenditures need to be planned carefully. At the moment, there are 25 hospitals with Hospital Information System (HIS) installed while most of the hospitals have the basic ICT infrastructures available. It should be noted that the Ministry's Information Management Division also has a data center that meets the MyHDW requirements and is currently applying for a ISMS (ISO 27001) license. A strategy that utilizes all of the infrastructure owned by MoH will be explored.

Additionally, it is recommended to adopt a 'Best of Breed' approach to certain key components like database servers. A Best of Breed approach has already proven itself in other international agencies. This approach has the potential to achieve high productivity, provide good total cost of ownership. Identification of these 'Best of Breed' products and vendors can be determine through third party reviews such as Gartner (e.g. Magic Quadrant Review) . While open source and low cost solution may seem attractive in the short term, this type of solutions has, on occasion, been associated with project failures, particularly in the absence of local support. Rather than take the open source approach, consideration will first be given to fostering local organizations and utilizing locally developed products, particularly those associated with other government owned R & D agencies like MIMOS. Care must be taken to balance the MyHDW project requirements with broad support for Malaysian innovation and associated agencies.

PRIMARY TECHNOLOGY INFRASTRUCTURE ASSUMPTIONS

Selecting the appropriate hardware and software to support MyHDW requires certain capacity and capability assumptions be made. These assumptions are drawn from industry best practice, international experience, predicted data volumes, information requirements and likely usage patterns. The components for an enterprise data warehouse and Business Intelligence environment are well established and with this and the above in mind the primary technical infrastructure assumptions are as listed below:

1. Hardware and software acquisitions, which will be included in the Year 1 one-time costs, must be able to scale sufficiently to allow for future expansion. Maximum user concurrency for MyHDW (portal, BI, and database) will be 200 users during the lifespan of this plan, with a concurrency of 50 acceptable for the first year. User concurrency is a major factor determining the load on key components of database and BI servers. It should be noted that user concurrency is difference from the total number of users accessing the system and refers to usage occurring at the same time or in parallel. For

[3] Infrastructure refers to the basic facilities/structures necessary for an operation to function. Generally, it can be defined as the set of interconnected structural elements that provide the framework supporting an entire structure of development, which in this context refers to the development of MyHDW.

example 50 concurrent users could equate to hundreds or thousands of registered users accessing the system.

2. Scalability as mentioned will be a key consideration in specifying and configuring any hardware and software.

3. From a disk sizing perspective an initial capacity of 20TB with the ability to scale to much higher volumes will be required. While SMRP will not in itself need this amount of space, disk sizing will need to consider Data Warehouse staging, testing environments and scratch space. The database storage infrastructure will need to be enterprise level and likely employ a scalable enterprise storage rack (SAN), manage redundancy and fault tolerance and be expandable as data volumes increase. Statistical tool disk usage can in most instances be satisfied using cheaper disk technologies.

4. For Database, Business Intelligence (BI) and Extract Transformation and Load (ETL) multiple environments will be required for Production, Development, User Acceptance testing (UAT) and Systems Integration Testing (SIT). The later three would be 5-30% of the Production system specification. This replication of specialized environments needs to be taken into account in sizing, configuration and software licensing.

5. Web applications, including mobile applications, will be primary mechanisms to access the system. The use of browser technology allows for low maintenance and impact at the site accessing the tools. An exception to this will be access by statistical tools like SPSS which will be deployed on internal MOH networks using a client server or desktop model. Only Business Intelligence (BI) and Enterprise Portal tools will be provided for external use.

6. MyHDW will support a multi-channel approach ranging from simple reports, complex interactive reporting through to ad-hoc query. The latter two are considered self-service models. These models allow for a wide range of deployment options and information to be produced driven by user need and not restricted to the availability of centrally located analysts. While this allows significantly better access to information it can such as in the case of ad-hoc query put a high burden on database and BI servers. Specification for these servers and associated hardware and software should take this multichannel approach into account.

7. Approved internet-SSL and private extranet channels will be considered as possible ways to access data and tools. See security section and appendixes for further details.

8. Clarification from MAMPU regarding technology and security policy & legislation, as well as the issues of data ownership and the use of cloud computing for public data will be required.

9. Incoming data will be formatted according to the NHDD/DDSA formats, will be cleaned at the central level, and validated later during ETL processes.

10. There will be two modes of data collection: (1) traditional batch, and (2) integration with existing systems. Development will support the two modes of data collection in both phases (Phase 1: Batch collection, Phase 2: Right Time and/or message-based transactions). It should be noted that MyHDW will not collect real time data, even for surveillance purposes. If the later is required a separate system that utilizes primary data may be developed.

11. Any Enterprise Portal technology utilized must be compatible with the chosen BI vendor's products.

12. Identity Management (IDM) and associated techniques like Single Sign-on (SSO) will be employed by MyHDW access control services.

13. Database, BI and Portal technology must have comprehensive security features. Particular emphasis will be on selective access to data, role based security, auditing, logging and custom availability of functionality particularly in the BI tool.

14. Ideally GIS software will need to integrate with the BI tool(s) so that data can be passed between the products.

15. Development tools such as Data Modeling tools will also need to be utilized. For Data Modeling tools these must support standard Entity/Relationship (E/R) modeling, Dimensional Modeling and be compatible with the selected database technology.

LOGICAL ARCHITECTURE

An agreed upon phased development strategy determined that the logical architectures are also phased. The diagrams below show the logical architecture that will be deployed in Phase 1 and Phase 2.

FIGURE 3: PHASE1, LOGICAL ARCHITECTURE/INFRASTRUCTURE

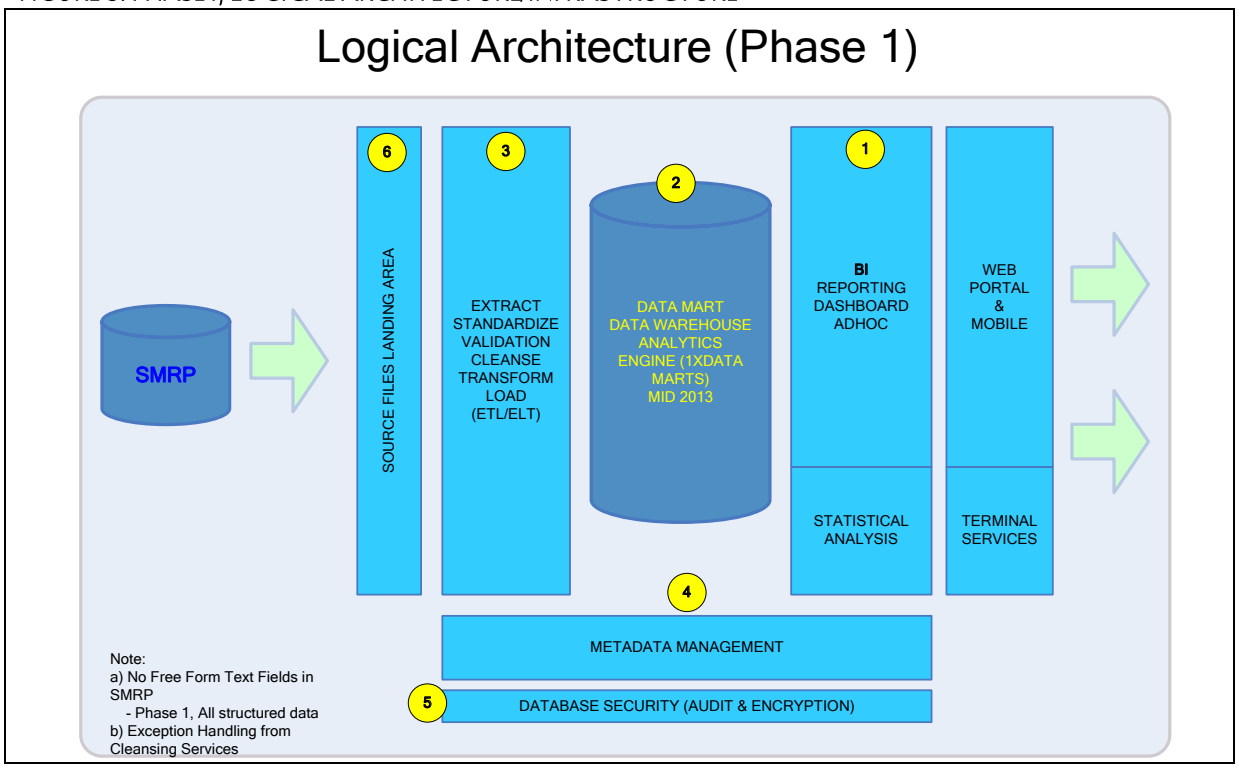
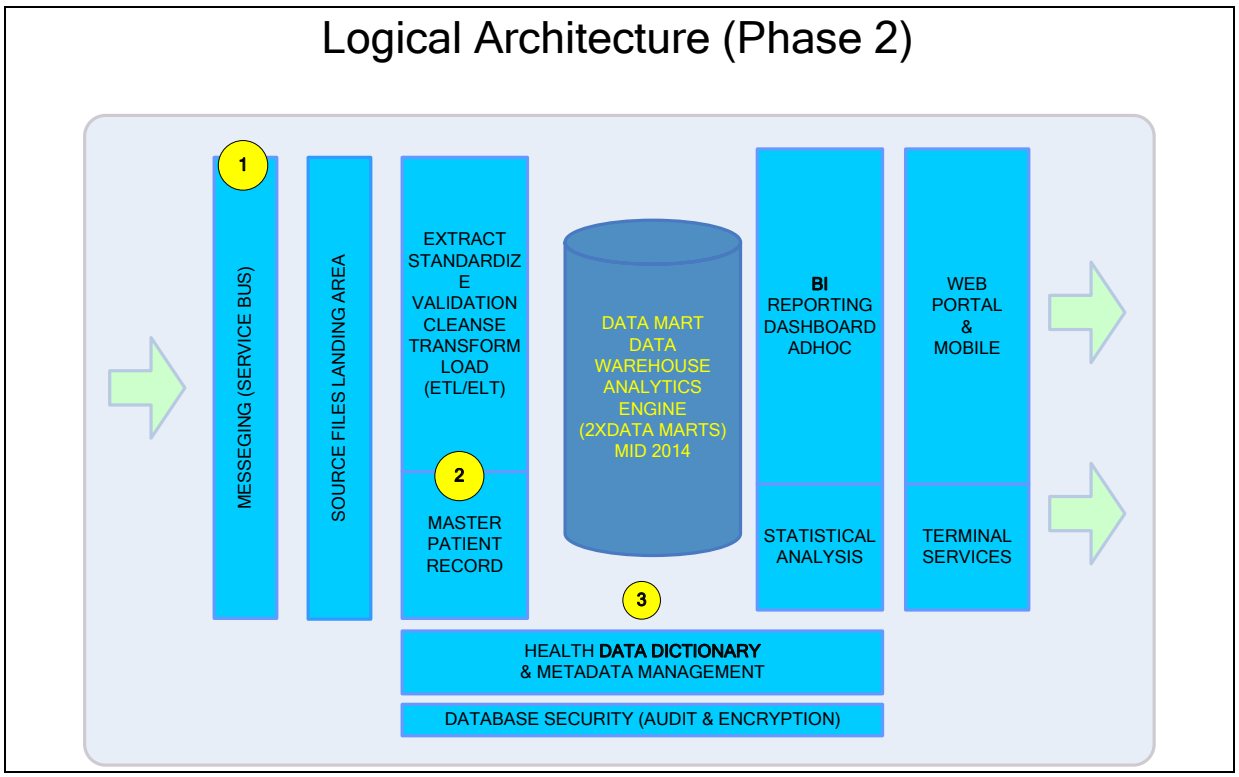


FIGURE 4: PHASE 2 LOGICAL ARCHITECTURE/INFRASTRUCTURE



PHASE 1 IMPLEMENTATION

The inpatient SMRP database has been selected as the first data source and reporting system to be loaded into MyHDW. This database was chosen because of maturity, stability, wide deployment and the high value of its data. SMRP has been collected since 1999 from all public hospitals in Malaysia and is currently available in 35 fixed-formatted reports. Tentatively, the time frame for Phase1 is between January 2013 until December 2013. Phase 1 will focus on one data mart and relevant information products (reports, dashboard etc).

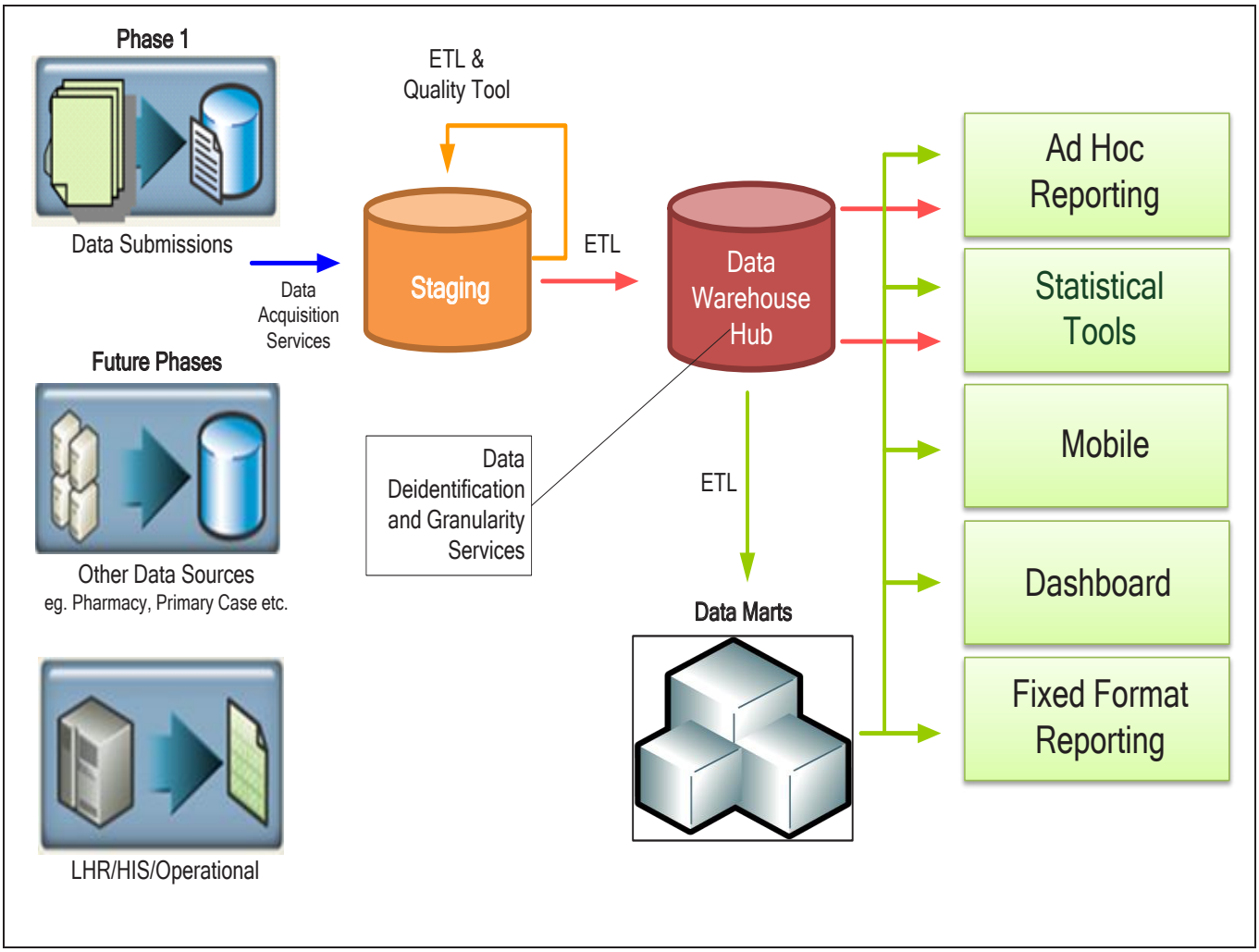
Additional assumptions regarding Phase 1 are as follows:

1. All the predicted users will be MOH users, and will be comprised mainly of healthcare providers and managers (maximum 200 concurrent users, though in practice this will rarely exceed 50) and researchers (starting with 5 concurrent users).
2. Stakeholders will be able to run reports, perform ad hoc queries etc. Outputs will be in a variety of formats; native BI, PDF and Excel.
3. Access will be via the 1Gov*Net network as per the stated policy.
4. Statistical tools will be provided server or desktop based within internal networks only. Server based deployments will utilize terminal service or similar for the researchers in Phase 1 and will be set-up in certain specified locations/premises only.
5. Researchers users will be given access to de-identified data only.
6. Data will be processed via batch files. Any incoming data will be validated but not necessarily be cleaned.

HIGH-LEVEL PROPOSED INFRASTRUCTURE/DATA FLOW DIAGRAM

The diagram of the schematic architecture shown on the next page maps the data flow from submission level to the warehouse and then to the proposed output tools. *Refer Appendix 4 for MyHDW schematic physical architecture.*

FIGURE 5: HIGH LEVEL DATA FLOW



COMPONENTS

The criteria for infrastructure components/tools for MyHDW are shown in the following table. These are illustrative of key factors only and should not be consider a definitive specification. *Please refer Appendix 5 for the Hardware Bill of Material (BOM) specifications.*

TABLE 2: MYHDW INFRASTRUCTURE COMPONENT/TOOL CRITERIA

CRITERIA	OPTIONS	NOTES
PHASE 1		
Database		
High performance with specific features to support data warehousing	• Normal Relational Management Database Management System (RDBMS) • Appliance based • Columnar based	
Maximum 200 concurrent users – Normal high watermark 50 concurrent users mix loads		
Compression technology		
Good security features - role base security, encryption, logging and audit, virtual private database etc		
Scalable		
Data Protection	• From Server/Hardware failure • Establish RPO & RTO (recovery time and recovery point)	
Optimization/ Performance tuning capability		
Disk Storage - SAN	• Fiber Channel • Expandable Rack	
Business Intelligence (BI) tools		
Maximum 200 concurrent users – Normal high watermark 50 concurrent users mix loads		
Scorecard and Dashboard		
Reporting		
OLAP		
Advanced analysis & ad hoc		
Alert & proactive notification		
Comprehensive security control to access data, report and features		
Extract, Transform and Load (ETL) tools		
Data quality (validation)		
High performance		
Comprehensive transforms		
Integration of web services		
Data profiling		
Data integration		
Data types – Structured and unstructured		
Data mapping		

Masking (for de-identifying data)		
Inpatient data		• 4 million encounters per record • Monthly loading – 333K
Midrange server		Vendor-dependent server specification
Enterprise Portal		
Collaboration		
Maximum 200 concurrent users – Normal high watermark 50 concurrent users mix loads		
Customer experience (User friendly)		
Supports Single Sign-on (SSO)		
Support BI Portlets		
Personalization by users		
Intranet portal		
Statistical Server		
• Phase I : 5 Users • Phase 2 : 25- 50 users		Single user licence : MYR 12,000 (5 user = MYR 60,000)
Network Equipment		
• Routers (5) • Switches (4) • Firewall, VPN (4)		
PHASE 2		
Messaging/Service Bus/Middleware		
Support the standards		e.g. HL7
Geographical Information System (GIS)		
Integrated with BI Server		

STATISTICAL TOOLS

There are various open-sourced, license-based, and propriety statistical tools available on the market, each with its own strengths and weaknesses. The choice of statistical tool is usually dependent on need and the familiarity of the researcher. The key component for any research/analysis, however, is actually the data management process. Poorly managed data can lead to various issues including misrepresentation of data, over consumption of memory, and adding unnecessary load to the system.

For Phase 1 implementation of MyHDW, the application Statistical Package for the Social Sciences (SPSS) is the statistical tool of choice. This decision was based on current usage and

application availability. Using SPSS also maximizes use of current resources. There are eight copies of SPSS available at the moment, all installed on high performance desktops[4] located in the MoH Headquarters. By utilizing this existing resource, some RM 96,000 will be saved, which will then be available for other infrastructure requirements.

We recommend that the current data managers acquire database management knowledge and skills, in order to produce more technologically-efficient datasets. We also recommended the acquisition of a server-based statistical tool as the MyHDW development progresses into Phase 2.

[4] SPSS (desktop) approximately cost: RM12,000 each.

SECURITY AND PRIVACY

OVERVIEW

The increase in access to health information associated with MyHDW demands that the system has a good security mechanism and privacy framework in place in order to maintain data confidentiality, integrity, availability, accountability and assurance. Protecting confidential information is a requirement for MyHDW, and in some instances, it is also an ethical and legal requirement. At the individual level, information security has a significant effect on privacy thus comprehensive security measures are required to protect the system and health information from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction.

SECURITY ASSUMPTIONS

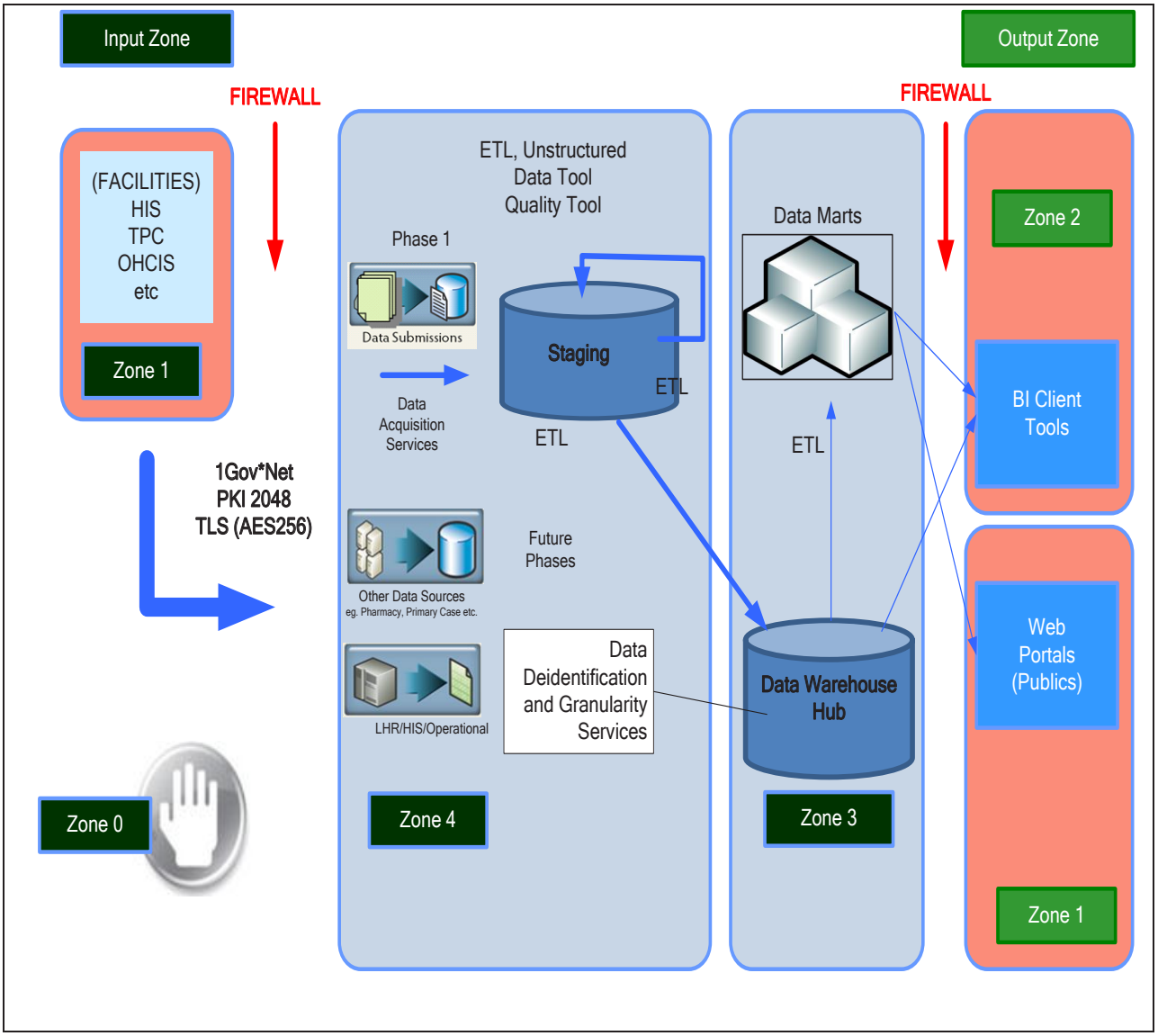
Assumptions about the Security and Privacy components are listed below.

1. Personal Identifiable Identification (PII) will be de-identified in MyHDW. Consideration should be given to locally developed Data Scrambling/De-identification technology developed by MIMOS to ensure the highest level of security of PII.
2. Highly sensitive data, e.g. Diagnosis of AIDS, will require special mechanisms for access and obfuscation of sensitive data.
3. The use of de-identification and encryption will be aligned with security zoning.
4. Four network channels will be needed for security purposes:
   (i) Healthcare and appropriate MOH employee access.
   (ii) As above but for 'Power Users', particularly those doing ad-hoc query or developing new reports from scratch.
   (iii) Community or general access for the public, media etc.
   (iv) Statistical tool access for internal researchers.

SECURITY ZONING

Figure 6 below shows the proposed security zoning architecture for the MyHDW project. *Please refer to Appendix 6 for the configuration of security mechanisms according to the proposed security zones, Appendix 7 for Security Deployment Strategy, and Appendix 8 for details regarding Authentication and Encryption*.

FIGURE 6: SECURITY ZONING ARCHITECTURE



SERVICE AGREEMENT

In order to be able to access information stored within MyHDW, a Service Agreement will be required. The purpose of the Service Agreement will be to limit clients' rights to use and disclose confidential information, including Personal Identifiable Identification, obtained from MyHDW. Clients will assume responsibility for ensuring that users of the system in their organizations are aware of the terms and conditions of the service agreement. Similarly, the government, acting as the custodian and sentinel for all data collected will be responsible for safeguarding its IT environment, securing its data holdings and to protecting health information with administrative, physical and technical security safeguards appropriate to the sensitivity of the information. In addition to the Service Agreement, all matters pertaining to the utilization of the system must comply with existing ethics, policy and legislation e.g. Medical Ethics Committee, Private Healthcare Facilities Act.

PRIVACY FRAMEWORK

The protection of individual privacy, the confidentiality of records and the security of information will be a requirement of MyHDW. In support of this an integrated privacy and security program is recommended. A framework outlining data governance, privacy and security protection is ideally needed. This will reference policies, protocols, and procedures. A key consideration will be any privacy policy that impacts or is impacted by MyHDW. This policy should define rules on the collection, use, disclosure, retention and destruction of personal health information and de-identified data.

DATA ARCHITECTURE

NATIONAL HEALTH REFERENCE DATA MODEL (HRDM)

It is recommended that a National Health Reference Data Model (HRDM) is implemented within fiscal year 2012 as per Blueprint Plan. This artifact will allow for precise and consistent definition of major concepts within the Malaysian Healthcare System. Furthermore, the relationship between these concepts or entities will be defined and selectively certain concepts will be further elaborated by addition of standardized attributes or data elements. These data elements will form part of a National Data Dictionary which will act as a supplement to HRDM.

It is a common practice when developing systems within large organizations to develop an Enterprise Data Model. In Healthcare this is similarly required but because of the complexity and non standardizations of business processes, complex stakeholder relationships, and governance conditions a simplified and low risk strategy is necessary to effectively complete a data model in this arena. This strategy is to adopt an abbreviated or "Reference "approach to the creation and maintenance of this data model. This Reference Model is similar to a conceptual data model but closer to implementation in scope and limited to only the most necessary data concepts. A similar approach has been used by the Canadian Institute for Health Information (CIHI) with its CIHI Reference Data Model to good effect. Based on success in this organization a similar approach is recommended for MyHDW.

From an implementation and deployment standpoint, it is recommended that if possible a pre-existing reference data model from a health care domain is adopted and modified for the Malaysian system. Other than CIHI's product vendor organizations such as Oracle and IBM also have comprehensive data models which might be considered. An evaluation process will need to be established to determine a starting point of this initiative i.e. whether to begin from scratch or which of any pre-existing models are available or suitable for MyHDW.

An enterprise data model in the manner described allows for maximum efficiency and standardization of both processing data within the acquisition and loading stages of a Data Warehouse (DW) and downstream in the provisioning of information products. Furthermore, reporting and BI products will be capable of providing a significantly broader range of answers because of this approach. This includes the ability to link data across the continuum of care in a normalized way, combine health cost and human resource data with clinical administrative information and many other critical linkages required for reporting purposes and key performance indicators.

The utilization of HRDM within MyHDW will required detailed modeling (logical, physical models) as required by the Extract Transform and Load (ETL) processes. Furthermore, the HRDM will act as a standard for the creation of Dimensional Models required for individual

subject areas within MyHDM. Please see the following references for further details associated with Dimensional Modeling and Master Data Management[5,6].

NATIONAL HEALTH DATA DICTIONARY (NHDD)

As mentioned above, certain key data elements will be added to HRDM where necessary to fully describe a concept or because critical to the use of a concept in practical application. These data elements will be managed within the NHDD initiative. Commonly, data models are populated with data elements during its logical of physical development. HRDM in contrast to this will selectively be populated with data elements only if high priority or necessary for concept definition.

DATA WAREHOUSE ARCHITECTURE (DW ARCHITECTURE)

It is recommended that an additional deliverable be added to the Blueprint, which more fully defines the data architecture within MyHDW. Currently there are a few common methodologies used in industry practice to efficiently standardize and represent data within a data warehouse or analytical environments. Two common methodology examples are: Kimball's Service Bus or Inman's Spoke and Hub. Please see the ISO/TR 22221:2006 and ISO/TS 29585:2010 references for further details associated with data architectures and methodologies. A white paper which described and specified this data warehouse architecture of the Malaysian Healthcare should be developed for the MyHDW.

HEATH INFORMATION FRAMEWORK (HIF)

A key aspect of getting value and a high return on investment on MyHDW will be having a solid understanding of the questions that need to be answered for the management of healthcare programs and the development of key performance indicators. Furthermore, this understanding needs to be obtained and supplemented with a standardized set of attributes associated with these questions, such as when is the information needed, where the data is coming from and which business process/program and associated decisions are supported by this information.

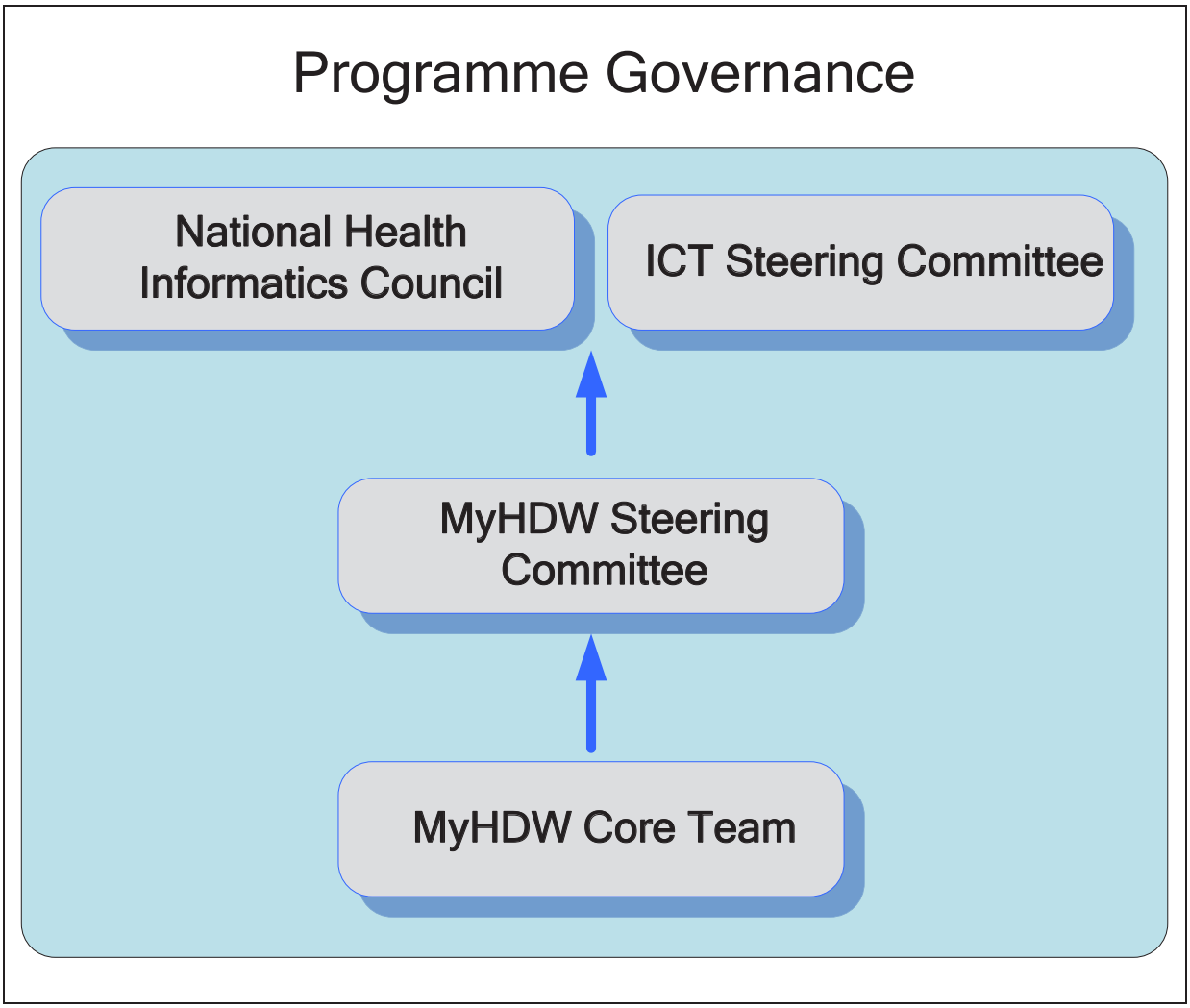
In summary, the Health Information Framework; outlines health information needs by asking performance-based questions, shows readiness of the infrastructure to provide data and develop products that help answer questions, and identifies how information products can influence healthcare system improvements. It is recommended that this deliverable be developed prior or in parallel to the HRDM.

[5] ISO/TR 2221:2006: Health Informatics - Good Principles and Practices for a Clinical Data Warehouse. International Organisation for Standardisation, Geneva, Switzerland.
[6] ISO/TS 29585:2010: Health Informatics - Deployment of a Clinical Data Warehouse. International Organisation for Standardisation, Geneva, Switzerland.

PROGRAM GOVERNANCE

The main activities which comprise program governance for MyHDW pertain to its direction, ownership and sponsorship, ensuring the effectiveness of its management functions, and reporting and disclosure. It is proposed, therefore, that the 3 level board structure illustrated in the diagram below be used for MyHDW Programme Governance. .

FIGURE 8: PROPOSED STRUCTURE FOR PROGRAMME GOVERNANCE FOR MYHDW



The Core Team, led by HIC, will have responsibility for overseeing the day-to-day project management of MyHDW, with members from the MOH Health Information Management Division, and MIMOS providing key advice. The Core Team will review the program plan, coordinate the functional outputs and submit progress reports to the Steering Committee.

The Steering Committee will have higher level oversight responsibility for MyHDW. They will conduct timely reviews of the program plan as well as review progress reports, as a means to gauge MyHDW performance. The intention is that the Steering Committee will act as regular forum where key issues reported by the Core Team can be resolved. It will play a role in

decision-making above the powers relegated to the Core Team. The committee membership will include representatives from the Planning and Development Division, MAMPU, and other stakeholders from the various divisions of MOH, private and non MOH hospitals and research institutes etc..

Finally, the Steering Committee will be answerable to both the National Health Informatics Council and the ICT Steering Committee, who ultimately are the program owners and sponsors of MyHDW.

RESOURCES: STAFFING AND SERVICES - BUILDING CAPACITY

OVERVIEW

This section considers the resource framework required for MyHDW project, in light of the blueprint objectives and feedback obtained from the subsequent workshops. MyHDW is expected to require a considerable period of time to implement. Cost effectiveness, clear return on investment and sustainability are key measures of success. Local conditions and project readiness must be taken into account as well.

The basic strategy for human resources for the project focuses on the development of strong internal capacities and empowerment of human capital. Ideally, core team members come from within Ministry of Health, while specialty services that are currently lacking will be outsourced. Engaging suitable government agencies like MIMOS will help in acquiring the required expertise for the start-up phase. A strategy that utilizes the continuous transfer of knowledge to permanent staff will be adopted throughout the project to ensure its long-term sustainability.

PROJECT RESOURCE/TIMELINE

The main assumptions that affect human resources directly are:

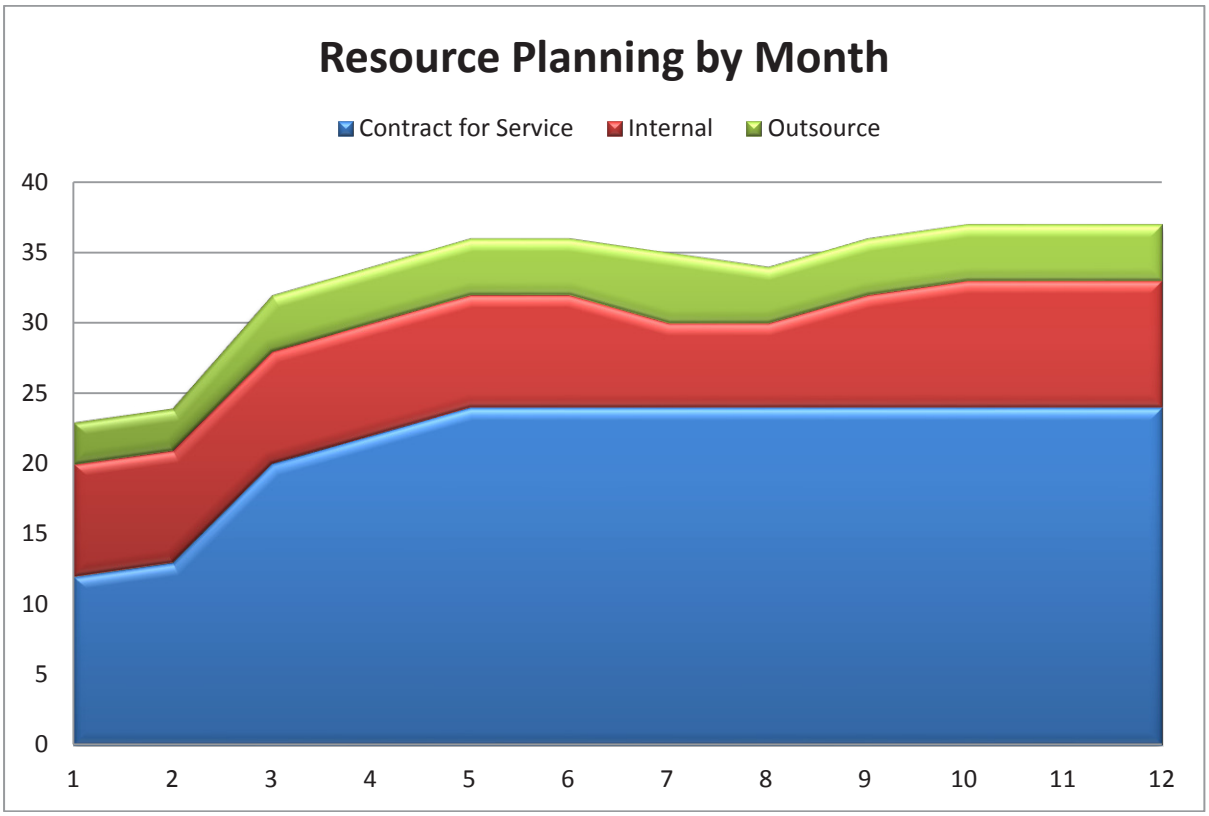
1. that SMRP will be the initial and only data source during Phase 1, and
2. that the project team will be located in a single location (i.e. utilizing a site with readily available infrastructure for MyHDW).

The following section contains a discussion of the initiation plan and resources required during the first 12 months. *See Appendix 9 for details on Proposed Resource and its timeline.*

**There are 6 stages proposed for Phase 1. Each stage requires approximately 30 to 40 man/months, although the execution period varies. For example, the Stage 5: Training requires 1 month, while the Stage 3 (Solution Development) and Stage 6 (Implementation) requires the longest execution period, some 3 months time.*

Two major groups to draw human resources from were identified, namely the Business and Technical groups. Start-up Phase 1 will require an average of 33 Full-time Equivalents (FTEs). The highest need in terms of core personnel throughout Phase 1 is for Solutions Developer, Medical Record Officers, and a Business Intelligence team.

Graph 1 shows the number of personnel required during Phase 1. The graph shows that the category for contract for service requires the highest number of personnel initially. This is due to the lack of current in-house expertise in this area. Nonetheless, by taking a continuous knowledge transfer approach throughout the project, we can build internal capacities within MyHDW.



GRAPH 1: THE NUMBER OF PERSONNEL REQUIRED (BY CATEGORIES) ACCORDING TO MONTHS 1-12 IN PHASE 1

ESTIMATED RESOURCE COSTING

Table 3 below shows the proposed costing for the resources needed in Phase 1. Two different costing methods have been proposed. Option 1 consisted of only external resources, while Option 2 took into account the internal resources available without additional budget to the project. The internal resources that were identified includes Medical Record Officers, Statisticians, Trainers, and Auditors.

TABLE 3: ESTIMATED COST OF RESOURCE

	CATEGORY	MAN MONTH	OPTION 1 (RM)	AVAILABILITY	OPTION 2 (RM)
Project Manager	Consultant	12	360,000	Contract for Service	360,000
Project Stakeholder					
BUSINESS					
Sr. Business Analyst	Consultant	12	360,000	Contract for Service	360,000
Business Analyst	Lead	24	360,000	Contract for Service	360,000
Medical Record Officers	Developer	36	360,000	Internal	
Statisticians	Lead	18	270,000	Internal	
Change Management Team / Trainers	Developer	26	260,000	Internal	
Audit	Lead	6	90,000	Internal	
Privacy Officer	Consultant	12	360,000	Contract for Service	360,000
TECHNICAL					
Technical Team Manager	Lead	12	180,000	Contract for Service	180,000
Projector Coordinator	Developer	12	84,000	Contract for Service	84,000
DBA	Lead	12	180,000	Contract for Service	180,000
Data Architect	Lead	12	360,000	Contract for Service	360,000
Data Architect Consultant	External Consultant	6	360,000	Outsource	360,000
System Eng. / System Admin. / Network Eng.	Developer	9	90,000	Internal	
ETL Engineer	Lead	20	300,000	Contract for Service	300,000
Solution Architect (Technical / Solution Lead)	Consultant	12	360,000	Contract for Service	360,000
Technical Data Warehouse Consultant	External Consultant	12	720,000	Outsource	720,000
Solution Developer	Developer	40	180,000	Contract for Service	400,000
Testing and QA	Lead	28	420,000	Contract for Service	420,000
BI Developer	Developer	30	300,000	Contract for Service	300,000
Senor BI Developer Consultant	External Consultant	12	720,000	Outsource	720,000
Data Quality Engineer	Lead	11	165,000	Contract for Service	165,000
Information Security Consultant	Lead	10	150,000	Contract for Service	150,000
Technical Writer	Developer	12	84,000	Outsource	84,000
Web/Graphic Designer	Developer	5	20,000	Outsource	20,000
	TOTAL		**7,313,000**		**5,883,000**

The total cost for Option 1 was RM 7,313,000, while Option 2 cost was RM 5,883,000.

HIGH LEVEL SUMMARY

Managing resources well is one of the crucial aspects in successful project management and the most important aspects of managing resources are cost effectiveness and sustainability. The main priorities for enhancing both cost effectiveness and sustainability these are developing the system's internal capacity and maximizing the intellectual capital. Another critical component is building healthy partnerships with other stakeholders. Good partnerships can dramatically accelerate the project, implementation, especially in the commencement period, while failure to do so will impede successful implementation. Please see Key Strategies section for further details.

COST ESTIMATES

The summarized cost estimates in Table 4 below compare a cost estimate drawn from *MyHDW Guidelines and Blueprint* and one drawn from the MyHDW Initiation Plan Workshop 2/2012 held on May 2012.

TABLE 4: COMPARISON OF COST ESTIMATES FROM BLUEPRINT VERSUS INITIATION PLAN WORKSHOP

	INITIAL ESTIMATED COST (AS PER BLUEPRINT) Year 0 – Year3	REVISED COST (AS PER WORKSHOP)		
		PHASE 1 Jan - Dec 2013	PHASE 2 2014 - 2015	TOTAL 2013 - 2015
ONE TIME COSTS				
Hardware	1,087,500	3,230,500	650,000	3,880,500
Software	5,960,680	14,821,000	4,562,800	19,383,800
Professional Services/Consulting	1,800,000	1,800,000	0	1,800,000
Subtotal	**8,848,180**	**19,851,500**	**5,212,800**	**25,064,300**
RECURRING COST: STAFF/COMPENSATION/EXPENSES				
Analytical Staff	2,400,000 (15 Statistician & Researchers)	1,440,000 (Business Group)	0	1,440,000 (Business Group)
Technical Services*	11,628,000	4,803,000	0	4,803,000
Subtotal	**14,028,000**	**6,243,000**	**0**	**6,243,000**
TOTAL	**22,876,180**	**26,094,500**	**5,212,800**	**31,307,300**

Note:
* Including Facilities, Services, and Operations; The Revised Cost does not include cost for Facilities and Operations due to usage of available resources.

The cost estimates found above are based on Option 2 as discussed in the "Estimated Resource Cost" section. This option uses the available resources and facilities. It should be noted that the revised cost worked out during the workshop was the assumed market list price. It is estimated, however, that the procurement and tendering process will result in significant discounts from the vendors. Based on the consultant's experience, as well as the size of this project, expectations are that a probable discount of at least 40% on software, 25% on services, and 25% on hardware can be negotiated.

In summary, the initial estimate for Year 0 – Year 3 totaled RM22.9 million. A revised estimate of RM31.3million was calculated by the workshop, but a significant reduction in this total is expected once the procurement and the tender process is concluded. *See **Appendix 10** for revised details of costing for Hardware and Software.*

KEY STRATEGIES

A number of important strategies are critical to the success of the MyHDW project. The adoption of the MyHDW Start-up concept is the overarching strategy. This differs from a pilot project or Proof of Concept (POC) in that this approach includes all aspects of the longer-term MyHDW initiative and its associated considerations. Based on international and industry experience, it is clear that a healthcare information data warehouse and its associated systems are both feasible and achievable. There is, therefore, little to be gained from either a pilot or POC. Moreover, the adoption of such an approach would both delay reaping the benefits of MyHDW and dilute the resources allocated to the project.

The chosen strategy, to provide both immediate and longer-term requirements and enhance overall value, is the deployment of a stable data mart and associated reports. This will provide intrinsic benefits such as improved access to information and reporting (Dashboard, KPI etc,) which in turn helps to establish the overarching project infrastructure and capabilities.

To ensure the successful deployment of MyHDW and enhance workforce productivity, a strategy of adopting a 'best of breed approach' to certain key technologies is indicated. The key technologies like Business Intelligence, Databases, Portal and Extract, Transfer and Load (ETL) products are all central to MyHDW. This approach has proven itself to be very successful in other national healthcare organizations. While Open Source and low-cost solutions may seem attractive in the short-term in some instances, the use of this type of solution has on occasions been associated with project failures, particularly in the absence of local support. Rather than taking that approach, consideration will be given to fostering local innovation and utilizing locally developed products, particularly those associated with government owned R&D Agencies, such as MIMOS. Care must be taken to balance the MyHDW project requirements with broader support for Malaysian innovation and associated agencies.

The long-term sustainability of the system is clearly key to the success of the MyHDW project. Healthcare IT projects, such as the Hospital Information System (HIS) within MOH often find the high cost of licensing, customization and maintenance of foreign IT products to be challenging. This is one of the significant roles that can be played by the government R&D agencies such as MIMOS. By utilizing locally developed technology platforms that are already owned by the Government of Malaysia this issue is avoided. Technology platforms such as at the Extract, Transform and Load (ETL) layer can be customized and updated to suit future needs. Adaptation to changes in the format of data sources that feed MyHDW will be more cost-effective because all the source codes of these technology platforms are visible and already owned by the Government of Malaysia. The same holds for the Security layer, where local IT Security technologies are critical to the self-sufficiency of the nation.

Given that data warehouse initiatives are long-term investments, sustainability and a clear return on investment are key considerations in operationalizing this endeavor. Local conditions and project readiness must also be taken into consideration. As such, resourcing

for this initiative will, in most instances, be derived from either local or existing internal capacity and through partnership with other suitable government R & D agencies such as MIMOS. It is assumed, that in general, human capital will come from the redeployment of the existing roles within the Ministry of Health or other partners in this project. While ideally the core members of the team should be local, certain services that require specialized skill may need to be outsourced. In addition, during the start-up years of the project, it may be that certain key roles that are difficult to fill locally will also need to be contracted. It is strongly recommended that in these instances a knowledge transfer approach should be adopted so that the long-term goals of sustainability and local oversight can be realized.

The use of external partnerships is an important factor and strategy for both the start-up and the long-term sustainability of MyHDW. One option for consideration is to utilize facilities and services from MIMOS, specifically technical project management, system integration, business analysis, software development process, technology platforms and innovation techniques. By taking a two-year incubation period approach with MIMOS for the technical aspects of the project, the longer-term oversight can be returned to the Ministry if appropriate at the end of this period. This may require cross-training of MIMOS and MoH resources by specialists in key roles associated with healthcare data warehousing, business intelligence and associated analytics. The location of the core project team will need careful consideration to ensure that technical and business resources have easy access to one another. Given the interrelatedness of census and vital statistics data and healthcare analysis, a close partnership in terms of data sharing and reporting with Department of Statistics, Malaysia should also be encouraged. Thus, in addition to product synergies and alignment between the organizations, this will provide reinforcement at the governance level: joint representation at the National Health Informatics Council, for example. Statisticians and analysts from the DOSM, Malaysia should be seconded into Health Informatics Centre for the duration of this initiative.

CONCLUSION

After considering the 'lessons learned' from international examples, particularly those from Canada, Malaysia seems well positioned to deliver the MyHDW start-up successfully. The key advantages are clear:

1. a strong relationship between this initiative and the critically important transformation of the national healthcare system, and

2. the associated need for timely, comprehensive and trusted health information.

Furthermore, good and straightforward federal governance on healthcare will facilitate this agenda. Particular care needs be taken in the areas of capacity building and sustainability. It is strongly believed that adherence to the strategies outlined in this report will provide for this.

It is recommended that the remaining deliverables associated with developing a three-year strategy and portfolio plan and the eHealth strategy (11-3) are completed within the stipulated time to ensure good value for money, effective planning and successful alignment with the national agenda on healthcare transformation.

APPENDICES

APPENDIX 1 – HIGH LEVEL MANAGEMENT MEETING

APPENDIX 2 – WORKSHOP PARTICIPANTS

APPENDIX 3 – FUNCTIONAL CATEGORIES OF SECONDARY DATA USE

APPENDIX 4 – SCHEMATIC PHYSICAL ARCHITECTURE

APPENDIX 5 – HARDWARE BILL OF MATERIAL (BOM)

APPENDIX 6 – SECURITY MECHANISM BY ZONE

APPENDIX 7 - SECURITY DEPLOYMENT STRATEGY

APPENDIX 8 - AUTHENTICATION AND ENCRYPTION

APPENDIX 9 – RESOURCES/TIMELINE

APPENDIX 10 –REVISED MyHDW HARDWARE AND SOFTWARE COSTS

APPENDIX 1 – HIGH LEVEL MANAGEMENT MEETING

DATE	TIME	
21 May 2012	8.30 am - 9.00 am	Secretary General Ministry of Health Malaysia
21 May 2012	9.00 am - 9.30 am	Deputy Director General (Research & Clinical Support Program) Ministry of Health Malaysia
29 May 2012	9.30 am - 12.00 pm	President & Chief Executive Officer MIMOS Bhd.
30 May 2012	9.00 am - 12.00 pm	Deputy Undersecretary Information Management Division
31 May 2012	9.00 am - 12.00 pm	ICT Consultants - Public Sector ICT Division Malaysian Administrative, Modernisation and Management Planning Unit (MAMPU)
30 May 2012	3.00 pm - 5.00 pm	Chief Statistician Department of Statistics, Malaysia

APPENDIX 2 – WORKSHOP PARTICIPANTS

	GROUP 1 - RESOURCES	
	Name	**Agency/Department**
1.	Azrin Zubir, Dr.	Meridien
2.	Gabe Rijpma	Microsoft
3.	Norfazlin binti Zamani	Health Informatics Centre
4.	Tan Bee Bee	Health Informatics Centre
5.	Ahmad Jessree bin Kamaruddin	Health Informatics Centre
6.	Amal Nasir Mustafa, Dr.	Institute for Medical Research
7.	Andy David	SAP
8.	Asmah Bt Ismail	Allied Health Science Division
9.	Azahadi bin Omar, Dr.	Institute of Public Health
10.	Chu Geok Theng, Dr.	Oral Health Division
11.	Dina Hafizah Mansor	Meridien
12.	Dul Hadi Mat Junid, Datuk Dr.	Malacca State Health Department
13.	Dzaharuddin Mansor, Dr.	Microsoft
14.	Hilmi bin Harun	Kedah State Health Department
15.	Hussein Mohd Ali	Microsoft
16.	Jaafar B Jamaan	Information Management Division
17.	Kelly Walker	IBM
18	Mahani Ahmad Hamidy, Dr.	Planning and Development Division
19.	Maria Mushtaq	SAP
20.	Mohd Alias Syed Ahamed	CGM
21.	Nurazlinda Abdullah	SAPURA
22.	Nurulhuda binti Ramlan	Health Informatics Centre
23.	Selahuddeen bin Abd Aziz, Dr.	Hospital Pakar Sultanah Fatimah, Johor
24.	Suhaimi Rahman	ORACLE
25.	Syed Amir Shakeed Almakki	Planning and Development Division
26.	Tan Ming Heng	Mesiniaga
27.	Thomas Eugene Chia	IBM
28.	Wan Ahmad Jafri	MIMOS
29.	Wan Syamsul Kamar bin Wan Ishak	STRATEQ SDN BHD
30.	Wei Bin	IBM
31.	Zanariah binti Husin, Dr.	Hulu Langat District Health Office

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	GROUP 2 - TECHNOLOGY: SECURITY	
	Name	**Agency/Department**
1.	Ng Kang Seong	MIMOS
2.	Fathullah Iqbal Ab Rahim, Dr.	Health Informatics Centre
3.	Ferwahn Fairis Ab. Karim, Dr.	Health Informatics Centre
4.	Mohd Nizam bin Jamaluddin, Dr.	Health Informatics Centre
5.	Ahmad Faisal Merican	IBM
6.	Ahmad Fauzi Tumini B Ali	Pulau Pinang State Health Department
7.	Anuar Zainal	Medical Development Division
8.	Arief Affendi	SAPURA
9.	Fareedah Ibrahim	Hospital Raja Permaisuri Bainun, Perak
10.	Fazli Mat Nor	MIMOS
11.	Hamdan Buyong, Dr.	Telehealth Division
12.	Jamalul Rijal bin Abd Aziz	Health Informatics Centre
13.	Jennifer Aloysius	Wilayah Persekutuan Labuan Health Department
14.	Kamal Hijjal bin Kassim	Mesiniaga
15.	Lilian Lee Yen Wei	Wilayah Persekutuan Labuan Health Department
16.	Masnizar bin Jamian	Hospital Pakar Sultanah Fatimah, Johor
17.	Mohamad Jamal Sulaiman	ABYRES
18	Mohamad Yurzi Ghani, Dr.	Hospital Sultanah Nur Zahirah, Terengganu
19.	Mohd Hazwan Mohamad	Engineering Services Division
20.	Muhammad Zulhelmi Ahmad Hijazi	National Heart Institute
21.	Norabiah Muda	STRATEQ SDN BHD
22.	Norbaniana binti Baharum	Information Management Division
23.	Norfilzatun Borhan, Dr.	Institute for Health Management
24.	Patrick Boyle	IBM
25.	Raja Iskandar Shah	ABYRES
26.	Raphael Couzet	Microsoft
27.	Rohani	MIMOS
28.	Rohaya binti Ahmad	Information Management Division
29.	Samsuil Fuad Manaf	Telehealth Division
30.	Sharul Niza Saleh	National Heart Institute
31.	Steve Boley	SAP
32.	Tajul Ahamad	SAP
33.	Tengku Ahmad Rosdan bin Tengku Langgi	Hospital Sultanah Nur Zahirah, Terengganu
34.	Wei Liang Beh	ORACLE

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	SECRETARIAT

	GROUP 3 - TECHNOLOGY: INFRASTRUCTURE	
	Name	**Agency/Department**
1.	Kavitha Rathika	Microsoft
2.	'Ismat binti Mohd Sulaiman, Dr.	Health Informatics Centre
3.	Azrulreezal Azannee Abdul Wahab, Dr.	Health Informatics Centre
4.	Andrian Lee	SAP
5.	Deepabarathy Mutha Kumaran	National Institute of Health
6.	Farina Zulkarnain	Allied Health Science Division
7.	Fazlina Suriayanti binti Fazil	Health Informatics Centre
8.	Hamidah binti Minhat	Health Informatics Centre
9.	Hasmah binti Sahat, Dr.	National Cancer Institute
10.	Indra Dang Anom binti Osman	Malacca State Health Department
11.	Jemsee Ongai	Wilayah Persekutuan Labuan Health Department
12.	Jens Stief	CGM
13.	Junidah Raib	Food Division
14.	Lim Jew Hiang	Pulau Pinang State Health Department
15.	Lokman bin Dasuki, Hj.	Hospital Kuala Lumpur
16.	Maizura Musa	Medical Practice Division
17.	Mazura binti Mahat, Dr.	Oral Health Division
18	Mior Zakuan Ahmad	Hospital Sandakan, Sabah
19.	Muhaini Mat Dong	Pahang State Health Department
20.	Muhamad B Ismail, Dr.	Disease Control Division
21.	Nordiana Jupri	Meridien
22.	Normazlida Abu Bakar	Health Informatics Centre
23.	Norsuhada binti Sulaiman	Health Informatics Centre
24.	Nur Arifah Radhiah Abdul Aziz	Terengganu State Health Department
25.	Rashidi Talib	National Heart Institute
26.	Rosnita binti Abdul Kahar	Food Safety and Quality Division
27.	Ruhayah Bt Omar	Kelantan State Health Department
28.	Salinah Kassim	National Heart Institute
29.	Shamsaini binti Shamsuddin, Dr.	Traditional and Complimentary Medicine Division
30.	Sharifah Sazliha Sulaiman	Hospital Tuanku Fauziah, Perlis
31.	Siti Raha M.I.	IBM
32.	Vigneswaran	MIMOS
33.	Zainuhaswani Mohamed	Kelantan State Health Department

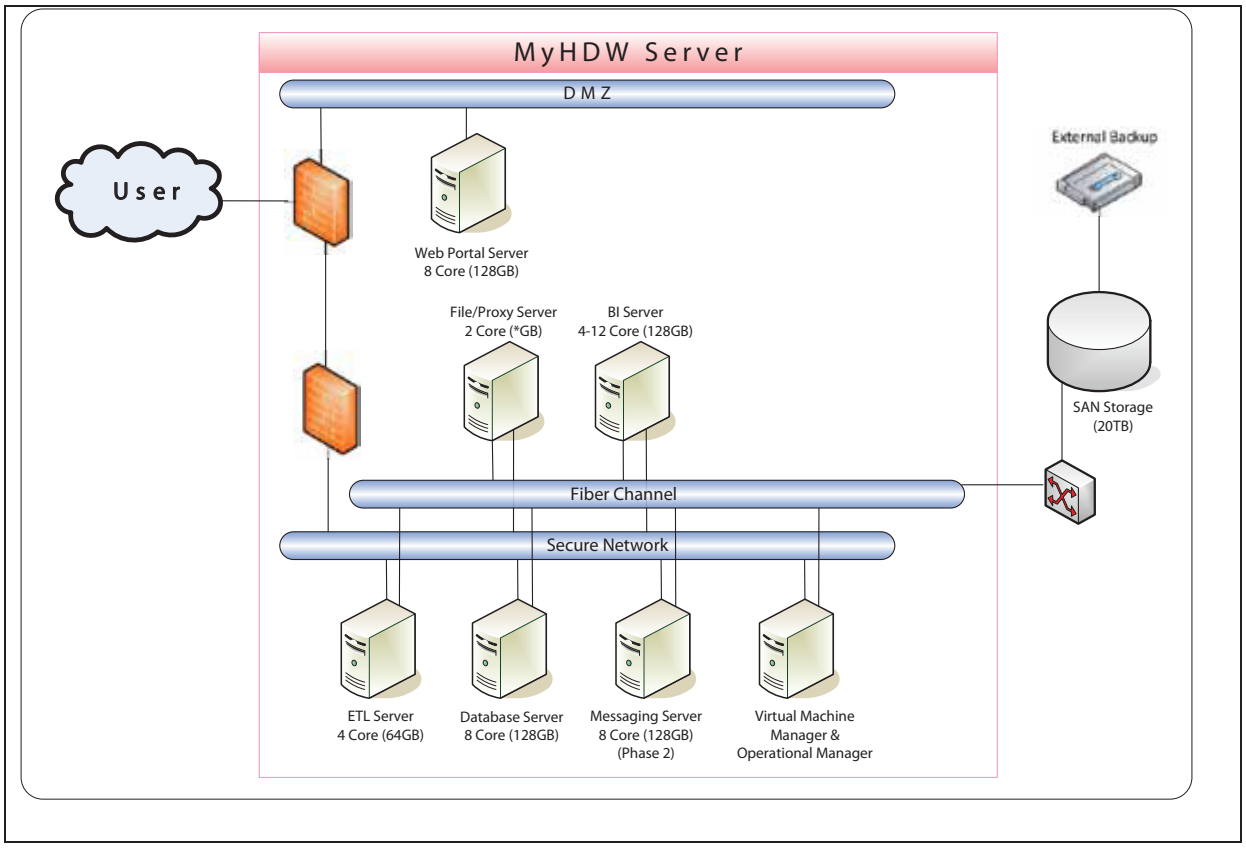
	FACILITATOR
	SECRETARIAT

APPENDIX 3 – FUNCTIONAL CATEGORIES OF SECONDARY DATA USE

Category	Description	How Secondary Data is Used
Health System Management [7]	Improve the efficiency and effectiveness of the health system	Cost management Strategy, planning and policy development Resource allocation, priority-setting and funding Resource utilization System performance reporting
Research	Insights in regards to improved medical treatments and programs of care, and better understand the performance of the system and health of the population	Clinical research studies Comparative effectiveness and evaluation Retrospective analysis of policies, initiatives and interventions Population research Modeling and simulation
Surveillance	Provide data on certain disease/events which leads to preventive and control activities Evaluation of public health programs/practices Alert on potential outbreaks/risks	Disease Surveillance Public health education Public health reporting
Clinical Program Management	Improve delivery of clinical care and evidence-based best-practice	Quality control and improvement Disease management Patient safety initiatives Monitoring access to care

[7] As a reference, the general public falls loosely under category Health System Managers.

APPENDIX 4 – SCHEMATIC PHYSICAL ARCHITECTURE



APPENDIX 5 – HARDWARE BILL OF MATERIAL (BOM)

PHASE 1

INFRASTRUCTURE COMPONENT / TOOL	HARDWARE	PRODUCTION	DEVELOPMENT	UAT & SIT
Database Server	CPU	8 Core	3 Core	3 Core
	RAM	128 GB	64 GB	64GB
Extract, Transform & Load (ETL) tools	CPU	4 Core	2 Core	2 Core
	RAM	64 GB	32 GB	32GB
Business Intelligence (BI) tools	CPU	8 Core (need to segment the public BI server)	2 Core	2 Core
	RAM	128 GB	64 GB	64GB
Enterprise Portal	CPU	8 Core	4 Core	4 Core
	RAM	128 GB	64 GB	64GB
Statistical Server	CPU	48 Core	-	-
	RAM	192 GB	-	-

Note: CPU – Central Processing Unit, RAM – Random Access Memory, BI – Business Intelligence

PHASE 2

INFRASTRUCTURE COMPONENT / TOOL	HARDWARE	PRODUCTION	DEVELOPMENT	UAT & SIT
Messaging/Service Bus/Deliverables	CPU	8 Core	4 Core	4 Core
	RAM	24 GB	8 GB	8GB
Geographical Information System (GIS)	CPU	4 Core	1 Core	3 Core
	RAM	64 GB	32 GB	32 GB

Note: CPU – Central Processing Unit, RAM – Random Access Memory

APPENDIX 6 – SECURITY MECHANISM BY ZONE

	ZONE 1	ZONE 2	ZONE 3	ZONE 4
AUTHENTICATION	Choice of authentication user ID / password authentication only for health care providers. General public – no authentication	2 factor authentication	Server Certificates VPN	• Server certificates (2048) • Client certificates (2048) • VPN / PN • Biometric
AUTHORIZATION (ACCESS CONTROL)	Centralized authorization	Centralized authorization	Centralized authorization	• Digital Certificate (2048) Lightweight Directory Access Protocol (LDAP) • Centralized authorization
DATA CONFIDENTIALITY (ENCRYPTION)	HTTPS (TLS AES 256)	• HTTPS(TLS AES 256) • Storage encryption (AES 256)	• VPN • Private Network (PN) • Storage encryption (AES 256)	• Virtual Private Network (VPN) • Hypertext Transfer Protocol • Secure (HTTPS) / TLS 256 semantic key • Storage encryption (AES 256)
PHYSICAL	None	• ISM & Confirmation • Standard DC	• ISM & Confirmation • Standard DC	ISM & Confirmation Surveillance
INTEGRITY (NO TEMPERING)	None	Audit trail	Audit trail	• Digital signature * Trusted Platform Module (TPM) • Audit trail
DISASTER RECOVERY (DR)	Similar security measures across the board			Encrypted archiving
NETWORK ZONES		Shared or can be DMZ	Behind DMZ	Dedicated

APPENDIX 7 - SECURITY DEPLOYMENT STRATEGY

As mentioned in the earlier parts of the document, the MyHDW project will be implemented in two phases.

PHASE 1

1. Use the existing data center; combining Zone 3 and Zone 4 as a single zone in Phase 1.
2. Incorporate the sources of information in batches; to include SMRP in the initial phase.
3. The information upload channel will be using the 1Gov*Net as per stated policy. Utilization of the TLS & PKI channels will be beneficial, especially when taking the private sector into consideration, but it will incur cost.
4. Information security: data scrambling at central level, SSO, user authentication & system administrator, database server back-up
5. Two firewalls to be deployed at the input (information upload) and output (analytic component) points.
6. Opening up Zone 1 access to the internet (in view of private healthcare facilities), until their eventual inclusion into 1Gov*Net (needs confirmation with the directive from MAMPU)

PHASE 2

Full establishment of Zone 4.

In Phase 1, researchers may have to go to a certain specified location/premise to do their analysis on secure channels. Currently, there is an existing VPN deployed in the Institute of Medical Research (similar to the channel between Zone 2 and Zone 3 in the Security Zoning Architecture diagram), but the current bandwidth may not be sufficient. This network can be referred to as an example of Phase 1 implementation on the output zone.

Extensions of the research component to other places will be done in the Phase 2. Dedicated devices to access this information are needed due to the sensitivity of health information and high security reasons.

APPENDIX 8 - AUTHENTICATION AND ENCRYPTION

It was decided for security and privacy to be further configured based on user categories. This decision was made in view of the fact that different type of users will certainly have different functions and data needs. For example, healthcare managers might need to view certain health information in a bigger picture, while researchers may need the information at a more detailed level. Thus, access to information will need to be adjusted based on the type of user reviewing the information. The table below shows the security configuration based on user category.

TABLE 5: SECURITY CONFIGURATION BASED ON USER CATEGORY

	USER CATEGORY	ACCESS (OUTPUT) LOCATION	CONCURRENT USERS	SINGLE SIGN ON	CHANNEL SECURITY	AUDIT TRAIL	AUTHENTICATION	INFORMATION ZONES
LOW	PUBLIC *	Zone 1	200	Yes	TLS (AES256), any device	No	Single factor	Non-sensitive De-identification
	HEALTHCARE MANAGERS	Zone 1	100	Yes	TLS (AES256), any device	Yes	Single factor with higher security requirements	Sensitive De-identification
	RESEARCHERS **	Zone 1+2	50	Yes	TLS (AES256), dedicated device	Yes	2 Factor	Granular De-identification
HIGH	POWER USERS **	Zone 1+2	5	Yes	TLS (AES256), dedicated device	Yes	2 Factor	Granular De-identification

Note:
**Public: General Public & Healthcare Providers – differ at type of information viewed*
***Research & Power Users differs at function*

The Single Sign-On (SSO) approach is beneficial as a common access, since it will be easier for both user and system manager. Once a user progresses to accessing certain other types of information, further authentication will be needed.

- Security zoning not only applies to the areas of architecture, but also to the type of information accessed (in view of more granular data projected to come in later).
- The general public will not need authentication, but healthcare managers will require authentication. The reason for this is simply that public data, e.g health facts and health indicators, are non-identifiable data that is already disseminated to the general public even before the deployment of MyHDW.
- SSO are tied to the category of user
- In the current general practice, user authorization is done at the facility level. For data warehouse, the system administrator should be located centrally.

APPENDIX 9 - RESOURCES/TIMELINE

Stage 1	Requirements Analysis												
Stage 2	Solution Design												
Stage 3	Solution Development												
Stage 4	Solutions Test & QA												
Stage 5	Training												
Stage 6	Implementation												
	Data Governance												

NO.	COLUMN1	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1	Project Manager	1	1	1	1	1	1	1	1	1	1	1	1
2	Project Stakeholder												
	BUSINESS												
3	Sr. Business Analyst	1	1	1	1	1	1	1	1	1	1	1	1
4	Business Analyst	2	2	2	2	2	2	2	2	2	2	2	2
5	Medical Records Officers	2	2	2	5	5	5	3	3	3	2	2	2
6	Statisticians	3	3	3	1	1	1	1	1	1	1	1	1
7	Change Management Team / Trainers	3	3	3	1	1	1	1	1	3	3	3	3
8	Audit										2	2	2
9	Privacy Officer	1	1	1	1	1	1	1	1	1	1	1	1
	TECHNICAL												
10	Technical Team Manager	1	1	1	1	1	1	1	1	1	1	1	1
11	Project Coordinator	1	1	1	1	1	1	1	1	1	1	1	1
12	DBA	1	1	1	1	1	1	1	1	1	1	1	1
13	Data Architect	1	1	1	1	1	1	1	1	1	1	1	1
14	Data Architect Consultant	1	1	1	1	1	1						
15	System Engineer / System Admin / Network				1	1	1	1	1	1	1	1	1
16	ETL Engineer			2	2	2	2	2	2	2	2	2	2
17	Solution Architect (Technical / Solution Lead)	1	1	1	1	1	1	1	1	1	1	1	1
18	Technical Data Warehouse Consultant	1	1	1	1	1	1	1	1	1	1	1	1
19	Solution Developer			4	4	4	4	4	4	4	4	4	4
20	Testing and QA	1	1	1	1	3	3	3	3	3	3	3	3
21	BI Developer	1	1	1	3	3	3	3	3	3	3	3	3
22	Senior BI Developer Consultant	1	1	1	1	1	1	1	1	1	1	1	1
23	Data Quality Engineer		1	1	1	1	1	1	1	1	1	1	1
24	Information Security Consultant			1	1	1	1	1	1	1	1	1	1
25	Technical Writer							2	2	2	2	2	2
26	Web/Graphic Design			1	1	1	1	1					
	Current Total	**23**	**24**	**32**	**34**	**36**	**36**	**35**	**34**	**36**	**37**	**37**	**37**

Core Personnel Multitasking resources

APPENDIX 10 – REVISED MYHDW HARDWARE AND SOFTWARE COSTS

HARDWARE (one-off)	PRICE	SUBTOTAL	CONTINGENCY (30%)	MAINTENANCE	TOTAL COST (RM)
Phase 1:					
Servers (6): Database Server, ETL, BI (100 concurrent users), Web Portal, Statistical Server (SPSS)	1,500,000	2,485,000	745,500	- 3 years warranty no maintenance fee for hardware	3,230,500
SAN 20 TB	225,000				
Rack (2)	40,000				
Network Switch (2)	20,000				
Load Balancer (2)	500,000				
Firewall, VPN (4)	200,000				
Phase 2					
Additional Server (2): Messaging, GIS	500,000	-	150,000	-	650,000
		Total (RM)			**3,880,500**

SOFTWARE	PRICE	SUBTOTAL	CONTINGENCY (10%)	FIRST YEAR MAINTENANCE (22%)	TOTAL COST (RM)
Phase 1					
Database Server (14 unit/core)	3,500,000	11,044,000	1,104,400	2,672,648	14,821,048
ETL (8 unit/core)	1,500,000				
BI Tools (100 unit/core	3,000,000				
Web Portal (16 unit/core)	2,400,000				
Statistical Server: SPSS (50 unit/core)	600,000				
Operating System	20,000				
Operation Manager	24,000				
Phase 2					
Messaging (10 unit/core)	2,400,000	3,400,000	340,000	822,800	4,562,800
GIS (8 unit/core)	1,000,000				
		Total (RM)			**19,383,848**

MALAYSIAN HEALTH DATA WAREHOUSE

PROJECT INITIATION AND DATA AND INFORMATION ARCHITECTURE

DECEMBER 2012

INTRODUCTION

As part of the December 2012 consultancy, we explored a number of factors necessary to launch successfully MyHDW in fiscal 2013. The themes covered as part of this include creating conditions for success for this initiative at both a tactical and project level and also to ensure alignment with a broader eHealth and national agendas. This report documents the consultancy during this period with emphasis on two aspects: the steps necessary to begin the initiative; secondly to document and recommend health informatics standards necessary for alignment of MyHDW with other national healthcare initiatives. Furthermore, to allow the efficient design and development of MyHDW as a system wide and sustainable resource to support the provision of trusted healthcare information in Malaysia.

These two seemingly diverse but necessary components of this initiative are documented as separate sections. The first section will cover recommendations concerning planning, capacity building including team and technology selection, budget and governance. The second section will recommend the necessary standards and architecture required to allow MyHDW to be build efficiently and coexist with other national health systems such as Hospital Information System (HIS) and Lifetime Health Record (LHR). Recommendations will be made concerning a Malaysian Health Reference Data Model (MyHRDM) and an associated Malaysian Health Information Framework (MyHIF). Furthermore, the relationship and interdependencies of these artifacts to existing standards such as the Malaysian Health Data Dictionary (MyHDD) will be elaborated upon. This second section in a sense may be considered a parallel initiative required both to support the effective evolution of MyHDW and also broader eHealth initiatives.

In a sense this report builds upon the plans and recommendations of previous consultancy reports[1,2] and supplements these with emerging opportunities that have arisen during meetings with stakeholders and potential partners during the December 2012 consultancy. These opportunities include partnerships with MIMOS and the Information Management Division (BPM). Meetings with senior stakeholders in Ministry of Health (MoH), MAMPU and MIMOS were undertaken as part of the discussions. Direction was also given by senior officers of the MoH to establish the MyHDW Steering Committee and initiate final budget approvals.

In addition, this report documents as a supplement the MyHDW Proof of Concept (POC) event held December 11th and 12th at MIMOS, Bukit Jalil. Driven by MIMOS and the vendor community, the POC allowed MIMOS and potential technology partners to demonstrate their ability to provision technology and services that may be required for MyHDW. The insights from this event will feed into the formal evaluation process used to select technology for

[1]MyHDW Guidelines and Blueprint, May 2011
[2]MyHDW Portfolio Plan (Phase 1) – Initiation: Infrastructure, Resources and Initial Deliverables for 2013, May 2012

MyHDW and indicate the most appropriate partnership opportunities possible for the start-up and subsequent phases of this initiative.

BLUEPRINT REVISITED

With reference to the blueprint, the table below outlines the key steps for the evolution of MyHDW proposed for 2011-2014 and brings the reader up to date on its progress. Additionally, information on completed tasks, tasks involving the start-up plan, and in-progress initiatives are highlighted. Initiatives following the start-up phase in 2013 and 2014 should be considered tentative, pending further analysis closer to implementation. Please note the 2012 schedule and forward will need to be adjusted to account for delays in initiating the main phases of the project due to pending funding approvals.

TABLE 1: KEY TASKS FOR MYHDW PROJECT FROM 2011-2014

REF	INITIATIVE/TASK	NOTES	2011	2012	2013	2014
11-1	Create Business Case and present to ICT SC					
11-2	Establish National Health Informatics Council					
11-3	Develop 3 Year Strategy and Portfolio Plans	1. eHealth strategy report 2. MyHDW Portfolio Plan 3. Start-up Plan				
11-4	Develop Infrastructure Plan	Technology, Tools, Infrastructure Plan				
11-5	Gap Analysis between HIS and SMRP/Discharge summary data sets.	Gap analysis to determine if HIS can be used for SMRP/Discharge collections				
11-6	Recruit and train core teams - Analysts and IT resources	15 x IT 15 x Analytical/Stats/Research See Appendix 3 for IT resources				
11-7	Reference Data Model and Data Dictionary	Establish national data standards (structure) – Data Model and Data Dictionary				
11-8	Develop Health Information Model/Framework	Overarching map of key questions that need to be answered to support priority KPI's, 1Care and HIMS and delineate the products and data required to answer them.				
11-9	Communication Plan	Communication material, roadshow etc. to communicate the MyHDW concept to key stakeholders				
12-1	Procure and setup technical infrastructure					
12-2	Establish enhanced analytical and technical capacity/capability in HIC and IT					

MyHDW Project Initiation and Data and Information Architecture, December 2012

REF	INITIATIVE/TASK	NOTES	2011	2012	2013	2014
12-3	Build 1 x HIMS databases 'Data Marts' within MyHDW	Establish 1 x Data Marts and Reporting Products – Proposed candidate: SMRP				
12-4	Renal & Cancer Registries	If possible house 2 x registries ideally Renal and Cancer within the MyHDW infrastructure. These would be separate from MyHDW but could leverage the same technology and services				
12-5	Establish Master Data Program – Develop Facility and Professionals Master data	Establish program/function in HIC to develop and maintain master or reference data. Initial master data candidates are Facility and Professionals				
12-6	Strategy, planning and policy development, System performance reporting	Report and Information products development for these areas. TBC				
12-7	Systems Running - Establish Operations and Support Services	Establish group to maintain and support what has been built				
13-1	Add 1 Data Mart to MyHDW from a mature data source- Explore 2 additional Data Marts if resources permit	Establish a Data Mart and Reporting Products from a mature and strategic data source– Likely candidates would be: SMRP, Communicable Diseases, Primary Care, Pharmacy -To be determined based on further analysis. Explore 2 additional Data Marts if resources permit				
13-3	Add Public health surveillance data/functionality	Addition of Public Health Surveillance data/function TBC				
13-4	Patient safety initiatives, Monitoring access to care	Develop new reports for Patient safety initiatives, Monitoring access to care				
14-1	Add 2-3 Data Marts to MyHDW	New Data Marts To be determine after further analysis				
14-2	Other Registries	To be determined after further analysis				
14-3	LHR	Begin to utilize LHR data feeds as possible. Further analysis needed				
14-4	Clinical research studies, Disease and wellness program	Develop new reporting products for these areas				

Color Legend:

Completed Task
Start-up Plan
In Progress
Future Plan

PROJECT INITIATION

Following a fruitful discussion with Secretary General and other senior managers, guidance was provided to proceed with the following recommendations.

1. Initiate MyHDW Steering Committee as directed by Secretary General. This would be chaired by Deputy Director General of Research & Technical Support Programme.
2. Initiate MyHDW budget approval via the Economic Planning Unit (EPU).
3. Provide regular status update to senior managers and Minister of Health on the progress of MyHDW.

DATA AND INFORMATION ARCHITECTURE

National Health Reference Data Model

It is recommended that a National Health Reference Data Model (HRDM) is implemented as per blueprint plan. This artifact will allow for precise and consistent definition of data concepts within the Malaysian Healthcare System. Furthermore, the relationship between these concepts or entities will be defined and selectively certain concepts will be further elaborated by addition of standardised attributes or data elements. These data elements will form part of a Malaysian Health Data Dictionary (MyHDD) that will act as a supplement to HRDM.

It is a common practice when developing systems within large organizations to develop an Enterprise Data Model; in healthcare this is similarly required. The complexities and non-standardisation of business processes in healthcare delivery, complex stakeholder relationships and governance greatly increase the effort and risk of completing an initiative of this type in a reasonable time frame. To ameliorate this unique situation in healthcare a simplifiedapproach to data modeling is recommended. This is to adopt an abbreviated or 'Reference' approach to the creation and maintenance of this Data Model. This Reference Model is similar to a Conceptual Data Model[3,4]but limited to only the most necessary data concepts. This will allow for a rapid development and utilisation of a National Data Model for healthcare without excessive timelines and work effort. A similar approach has been used by

[3] ISO/TR 2221:2006: Health Informatics - Good Principles and Practices for a Clinical Data Warehouse. International Organisation for Standardisation, Geneva, Switzerland.
[4] ISO/TS 29585:2010: Health Informatics - Deployment of a Clinical Data Warehouse. International Organisation for Standardisation, Geneva, Switzerland.

the Canadian Institute for Health Information (CIHI) with its CIHI Reference Data Model to good effect. Based on success in this organization a similar approach is recommended for MyHDW.

From an implementation and deployment standpoint, it is recommended that if possible a pre-existing reference data model from a health care domain is adopted and modified for the Malaysian Healthcare System. Other than CIHI's product, vendor organizations such as Oracle and IBM also have comprehensive data models which might be considered. An evaluation process will need to be established to determine a starting point of this initiative i.e. whether to begin from scratch or which of any pre-existing models are available or suitable for MyHDW.

An enterprise data model in the manner described allows for maximum efficiency and standardization of both processing data within the acquisition and loading stages of a Data Warehouse (DW) and downstream in the provisioning of information products. Furthermore, reporting and BI products will be capable of providing a significantly broader range of answers because of this approach. This includes the ability to link data across the continuum of care in a normalized way, combine health cost and human resource data with clinical administrative information and many other critical linkages required for reporting purposes and key performance indicators.

The utilization of HRDM within MyHDW will require detailed modeling (logical, physical models) as required by the Extract Transform and Load (ETL) processes. Furthermore, the HRDM will act as a standard for the creation of Dimensional Models required for individual subject areas within MyHDW. Please see the following references for further details associated with Dimensional Modeling and Master Data Management (ISO/TR 2221:2006 and ISO/TS 29585).

Recommendations:

1. To establish a team and begin the process of developing Malaysian Health Reference Data Model (MyHRDM) as described above in fiscal 2013. The accountability for the development of this model will fall under the purview of MoH. This will require capacity building in terms of resources that have experience in data architecture, data modeling, and health informatics standard. In addition, governance and processes aligned with the MyHDD initiative will need to be developed.
2. While ideally, the development of MyHRDM would occur prior to the development of the SMRP and other subject areas of MyHDW in practice this may not be feasible due to time constraints. Therefore to allow for the expeditious delivery of MyHDW and its start-up phase, MyHRDM will be developed in parallel.

3. Priority Concepts (Entities), for example Patient, Healthcare Provider etc., will be identified at the beginning of this initiative and developed and specified in such a way to align with MyHDW phases.
4. HRDM development will be coordinated and aligned with other national health informatics standard such as MyHDD and any data specifications associated with HIS and the LHR.
5. A process to determine the starting point of MyHRDM in terms of preexisting model or artifacts will need to be undertaken to ensure the model can be produced in a timely and effective manner.
6. Consideration should be given as an alternative to number 1 above, to a rapid development or 'blitz' approach to developing MyHRDM. In this approach, the development process would occur in a three month period at the beginning of fiscal 2013.

Malaysian Health Data Dictionary (MyHDD)

As mentioned above, certain key data elements will be added to MyHRDM where necessary to fully describe a concept or because critical to the use of a concept in practical application. These data elements will be managed within the MyHDD initiative. Commonly, data models are populated with data elements during its logical or physical development. MyHRDM in contrast to this will selectively be populated with data elements only if high priority or necessary for concept definition.

Recommendations:

1. It will be important to align MyHDD with MyHRDM above. It is recommended that existing processes and governance associated with MyHDD be extended to include the development, maintenance and alignment with MyHRDM.
2. Consideration should be given to the modification of the NHDD format to include the addition of HRDM 'Concepts' to each attribute. The population of the Concepts property in each attribute should be done in an evolutionary manner based on the priorities of the MyHDW Portfolio Plan.

Malaysian Health Information Framework (MyHIF)

A key aspect of getting value and a high return on investment on MyHDW will be having a solid understanding of the questions that need to be answered for the management of healthcare programs and the development of key performance indicators. Furthermore, this understanding needs to be obtained and supplemented with a standardized set of attributes associated with these questions, such as when is the information needed, where the data is coming from and which business process/program and associated decisions are supported by this information. MyHIF is a requirement gathering tool for health information data warehousing design to allow a global understanding of the information need in a holistic and system wide manner. Specifically each row of MyHIF details the following information:

- Question – performance based question that addresses business improvement need. For example how can we improve access to emergency department for patients in need? What is the workload of Day Care Services in the hospital so as to plan for more of such facilities?
- Function – Function affected (e.g. Access, quality, efficiency)
- Information Users – Position or rows that might use the information product, once developed, to inform action that can improve patient care. For example Minister of Health, senior managers in MoH, Hospital Directors and State Directors.
- Candidate Information Product – Likely type of information products for an example, Health Facts, Health Indicators, Statistical Report, Health Indicators, KPI, Dash Boards.
- Available Data/Infrastructure – Does a data source exist? If so what is the data source? Are there standards in place for these data source?
- Frequency – Ideal frequency that these data and information would be available through MyHDW. For example daily, monthly, quarterly or yearly.
- Use of Information Products – How the information/product could affect healthcare performance. For example identify and share best practices to reduce waiting time, monitor health tourism returns from participating Health Tourism Hospitals.
- Priority – The relative priority of the question(s) and associated information products.The evolution and development of a data warehouse system such as MyHDW likely occurs over many years. Practically there is a finite amount of resource available for this work. Therefore it is necessary to prioritize which information is needed from MyHDW to allow for its effective evolution.
- Order Magnitude – Cost to develop and maintained information products. Indicate a nominal value (e.g. High Medium Low) to answer the question(s) associated with a particular information product or report.

Selection of the questions to populate the Information Framework will be based on current - priority questions within Health System Management in Malaysia. In terms of granularity there ideally should be 50 to 100 questions within the framework.

Each question on the framework could optionally have a detailed specification or Use Case associated with it. This would be documented in a separate catalog and allow for sufficient detail to understand usage and cost, etc.

A process and governance similar to that require by the MyHDD and MyHRDM will be required by MyHIF.

In summary, the MyHIF outlines health information needs by asking performance-based questions, shows readiness of the infrastructure to provide data and develop products that help answer questions, and identifies how information products can influence healthcare system improvements. In addition assuming governance and processes are in place it will allow

for priorities to be set for information requirements. This will further allow an effective maturity model for the evolution of MyHDW.

Recommendations:

1. It is recommended that MyHIF be developed prior or in parallel to MyHRDM. MyHIF will act as a global and generalized requirement for both MyHDW and the secondary usage aspect of MyHRDM. As such the successful development of MyHRDM is dependent on the availability of MyHIF. Given the planning timelines for the initial start up phases of MyHDW, to ensure these are met, a parallel process will be required. Critical to the success of this parallel process will be careful alignment with the data utilized in the start-up plan, i.e. SMRP.
2. A template for MyHIF and detail Use Cases should be developed.
3. The governance and processes to support the evolution of MyHIF be established. The identification and priority setting of MyHIF will require consultation at a high level within the healthcare stakeholder community and this will ideally require alignment with existing governance and processes.
4. Consideration should be given as an alternative to number 1 above, to a rapid development or 'blitz' approach to developing MyHIF. In this approach, the development process would occur in a three month period at the beginning of fiscal 2013.

MyHDW PROOF OF CONCEPT (POC)

During this period, there were two days presentation of POC; one by MIMOS, and the second by the vendors. POC was proposed during this period of consultancy for the purpose of the presentation to the consultant. It was initially proposed by one of the vendors on the BI tools to demonstrate their capability and Health Informatics Centre (HIC), MoH offered the same to other vendors on this opportunity. The POC was presented to MoH staff on the 11-12th December 2012. Following the PoC presentation, some vendors requested for a full POC on MyHDW to be presented to MoH. Likewise, MIMOS offered the same.

The following are the issues that were raised:

1. The choice of technology following the POC by MIMOS and vendors –criteria for selection/success factor includes costing, technical support and functionality. This relates also to priority system, locking in and maintenance cost. MIMOS do offer five years technical support for the SOCSO project. Comparison with other products, scalability factors and issues primarily accountability, choice of technology;
2. Feedback of the technology by the vendors; and

Evaluation disclaimer

This POC is not a formal evaluative process. This will be performed as part of normal ministry process. The notes that follows are our observation and comments based on materials and demonstration shown to us during the two days of POC. These clearly are only at a high level and are provided as a record of the event. The more formal evaluation mentioned previously will, in a detailed way, evaluate at a level necessary for MyHDW project, to make decisions about selection of appropriate vendor and tools.

POC Environment

Each vendor/partner was given two months to prepare for the POC. Invitation to participate and instructions were given on 10th October 2012. All vendors/partners who agreed to participate were required to do the following:

1. Mandatory Criteria:
    a. To Produce 3 pre-formatted reports:
        i. PER PD 202: Laporan Bulanan/Tahunan Kemasukan ke Hospital/Institusi Mengikut Jantina, Kumpulan Etnik, Kumpulan Umur dan Purata Harian Pesakit Dalam Mengikut Kelas Katil (*Montly/Yearly Reports on Admission to Hospital/Institution of Sex, Ethnicity, Age Group and Average Inpatient Patient Day According to Bed Classes*);
        ii. PER PD 204: Laporan Bulanan/Tahunan Kemasukan Ke Hospital/Institusi Mengikut Punca Rujukan (*Monthly/Yearly Reports on Admission to Hospital/Institution According to Source of Referral*);
        iii. PER PD 206: Laporan Bulanan/Tahunan Morbidity dan Mortality untuk Pesakit Dalam (*Monthly/Yearly Report on Morbidity and Mortality for Inpatient*);
    b. The correct format of the required reports is produced;
    c. Accuracy of the report; and
    d. Each report can be further drilled down/viewed at National Level, State Level and Hospital Level.

2. Optional Criteria for Business Intelligence (BI) tool:
    a. Flexibility of creating new calculations and adding additional dimensions and metrics to a report or building ad-hoc report from scratch;
    b. Visualization tools including dashboards;
    c. Geographical Information System (GIS) integration or native functionality;
    d. Security filtering of function and data depending on user signed on/role;
    e. Ability to handle high user concurrency while maintaining good performance;
    f. Web based interface for reporting and analytic tools;
    g. Level of analytical functions including statistical functions;
    h. User management tools and interfaces such as Analytical Portal;
    i. How the vendor will support the product.

3. Optional Criteria forExtract, Transform and Load (ETL) tool:
    a. Ability to handle high volumes of data while maintaining good performance during loads;
    b. Possible productivity gains in using tool and general ease of use;
    c. Level of power of mapping and transformations available;
    d. Metadata capabilities;
    e. Ability to call Web services and third party tools such as statistical tools (e.g. SAS,SPSS);
    f. Work flow and automation capabilities;
    g. How the vendor will support the product.

The demonstrations were done at MIMOS Auditorium, Bukit Jalil, Kuala Lumpur. The venue was offered by MIMOS of which MoH willingly accepted.

Panelists for Day 1 session was Deputy Director General (Research & Technical Support) as Chairperson for Day 1; Director of Planning and Development Division; Sr. Deputy Director (Planning) of Planning and Development Division and also as Chairperson for Day 2; Deputy Undersecretary of Information Management System (BPM); Director of Telehealth Division; a Public Sector ICT Consultant from MAMPU; and Mark Fuller as MyHDW Consultant.

Members of the audience were from Hospital, State and District level, consisting of Hospital Directors, Medical Record Officers, Information Technology Officers, Medical Officers; and MoH stakeholders at ministry level - *Please refer to Appendix 2 and Appendix 3.*

Each presentation was followed up by a question and answer (Q&A) session at the end with the panelist and audience.

POC D1 – 11TH DECEMBER 2012 – MIMOS PRESENTATION

MIMOS is a National Research and Development Agency in ICT under the purview of Ministry of Science, Technology and Innovation (MOSTI).

An end-to-end solution by MIMOS' developed technology products was presented. These products covered BI tools, ETL tools, including data scrambling capabilities and Document Management and Portal System.

In addition, MIMOS included a number of open source products within their stack of technology; for example a Relational Database Management System (RDBMS). While these products have not been developed by MIMOS because of their open source nature, they are in the position to maintain, enhance and support them as part of their technology offering.

MIMOS presented the e-Knowledge Management System (eKMS) framework as a container for all of their products. This interface allows each tool to be selected and furthermore integrated for the purpose of this PoC. MIMOS mentioned that they are able to offer a fully managed environment in terms of a cloud and infrastructure as a service provision. MIMOS' technology infrastructure seems extremely comprehensive and high performance.

ETL:

The Extract, Transform and Load (ETL) demonstration was done using Mi-Morphe. This is a data migration and cleansing tool, and was their core offering in terms of an ETL solution proposed for MyHDW. It should be noted that Mi-Morphe is the one tool currently being used in the PERKESO ICT project. Given the scale of this initiative, it is our belief that a more detailed evaluation of Mi-Morphe may be warranted as the tool can be shortlisted as a potential ETL product for MyHDW. MIMOS' encryption technology was also demonstrated as part of their ETL capability. The high performing nature of this feature is noted. This performance aspect of these features is a differentiator for MIMOS in this regard.

BI:

MIMOS presented both their own internally-developed Business Intelligence (BI) tool and one open source tool named Pentaho. The MIMOS tool was used to present the SMRP data, according to requirement, in terms of static report and dynamic report. Simple charting reports were presented, and Geographical Information System (GIS) capabilities were also showcased. MIMOS' BI seems to be in an early stage of evolution for a BI tool and more comprehensive functionality were demonstrated through Pentaho, a commonly used BI tool. SMRP data were presented using both of these tools and seemed accurate. Performance of reports seemed good. Rudimentary export options to PDF were also demonstrated.

In addition to BI services MIMOS also demonstrated their own Mi-Stat product which is based on the open source tool named R. No detailed demonstration was done on this product.

Portal and Document Management:
A basic portal and document management system (DBS) was presented. These allow reports that have been generated by MIMOS BI tool to be presented in a portal environment based on role-based security. This document management system is based on an open source product and is further enhanced by MIMOS's security offering. In addition, Mi-DMS has some additional features such as traceability and collaboration abilities. The strength of MIMOS' security enhancing technology stood out as a key feature of this tool. In comparison with other commercial enterprise portals and document management system, Mi-DMS appears to be at an early stage of development.

Security Technology:
Security and privacy features are at work implemented thru Mi-ARMC which is a role-based identity management and security product. In addition to acting as a SSO and identity management (IDM system) for MIMOS' portal products, technologies for such as the previously mentioned scramble & encryption features were also part of MIMOS' security offering. Again it is noted that in this regard MIMOS' technology seems strong and quite mature, particularly in the area of performance. During the demo, the performance of encryption has been approximately at least 50x faster than similar technologies.

Database/RDBMS:
For the demo, MIMOS utilise a mature open source RDBMS, PostgreSQL. During the presentation, MIMOS indicated they are capable of supporting any major commercial or open source RDBMS.

Overall, MIMOS presented an extremely high quality, thorough solution in response to HIC's POC requirement. Its strengths are its positioning as a national partner with MOH and the scale of its technical operations and the quality of technical resources available. There seems to be a difference in maturity in some of the MIMOS' developed technology offering, and further evaluation is needed.

POC D2 – 12TH DECEMBER 2012 – VENDOR PRESENTATION

Day 2 of the POC allowed commercial vendor to demonstrate their products and services in response to the methodology and requirements of the POC. The following vendors were invited and agreed to participate:

IBM Malaysia Sdn. Bhd.
Oracle Corporation Malaysia Sdn. Bhd.
Microsoft (Malaysia) Sdn. Bhd.
Mesiniaga Bhd.
CompuGroup Medical (CGM) Malaysia Sdn. Bhd.
SpeedminerSdn. Bhd.
CISCO Systems (Malaysia) Sdn. Bhd.

The last two vendors decided not to participate after further discussion.

Each vendor was given about 45 min to present their solution including a short Q&A session at the end of the presentation. In most instances where technology solution were presented, local and vendor provided hardware such as laptops were utilized. No vendor during the demonstration ran their offerings off a cloud based solution, though many were capable of doing so. Each vendor, in most instances demonstrated mandatory requirements, and in some instances some optional requirements as part of their presentation. Overall, the quality of presentations was good.

IBM Malaysia Sdn. Bhd. /Sturn Technologies Sdn. Bhd.

IBM presented a complete solution for MyHDW based on their extremely mature technology stack for database, ETL, BI, and enterprise portal. Sturn were acting as a system integrator in the capacity of POC.

ETL:
The ETL offering was Infosphere/Datastage. This is a mature and well-established ETL offering. The team effectively prepared and cleansed the data before the presentation, though the subsequent results show incorrect totals. The reason for this was due to the wrong source provided to Sturn during the development process. This was due to administrative error, not any intrinsic issues with the tools. Infosphere offers a very comprehensive and high-profile environment for ETL and was considered as one of the best of breed technologies in this space.

BI Tools:
IBM presented its Cognos BI offering. This is also considered one of the best of breed in the enterprise reportin and BI arena. The quality of the presentation in the static form and the dynamic form wasvery strong, so as to be expected. No mapping or GIS

capabilities were demonstrated during the presentation, although Cognos was known for this capability.

Portal and Document Management:
No portal technology was demonstrated though IBM was known for strong technology in this regard.

Security Technology:
IBM did not demonstrate its security technologies during the presentation but itswell known to have deep offerings in this regard.

Database:
During the presentation, IBM mentioned the Netezza technology as an offering but there was no explicit mention of which database technology used. It is assumed that IBM's UDB database was used during the event.

IBM did a good presentation and responded to the mandatory and some of the optional conditions. They did provide a booklet outlining their solution at the beginning of the event and made a reasonable effort to cover the optional criteria, though they ran out of time. It's noted that for the production of the SMRP report, the totals were incorrect. As previously noted, it was not a problem of the technology but the administrative oversight between the vendors.

Microsoft (Malaysia) Sdn. Bhd.

Microsoft presented an end-to-end solution in terms of theoretical capabilities of their products. Only a sample of SMRP data was used during the demonstration. In this sense they did not complete the POC. Unfortunately the presenters left without notification prior to the panel discussion.

ETL:
The theoretical capabilities of Visual Studio and its ETL offering Integration Services using the subset of SMRP data were demonstrated. Integration Services is a mature product and an integral part of Microsoft's datawarehousing and ETL offering. Data was loaded into a STAR schema from the ETL processors for the purpose of the BI demonstration.

BI:
Microsoft Reporting Services and Excel 2013 were highlighted as the BI offering for Microsoft. The sampled SMRP was presented using Reporting Services, but total was incorrect due to sampling technique implemented. Reporting Services seems a solid and mature BI offering. Furthermore, the features of Microsoft's new Excel 2013 product were demonstrated. A particular note was the Microsoft PowerPivot feature, the ability to publish to Microsoft SharePoint portal offering and Active Directory

Security Integration. Microsoft Excel 2013 seems a strong offering though no SMRP data was presented during its presentation.

Portal and Document Management:
Microsoft presented its Microsoft SharePoint product. Microsoft SharePoint is a strong and well established Portal and Document Management.

Security Technology:
No presentation of security technology is presented though Microsoft has a strong capability in this regards.

Database/RDBMS:
SQL Server was offered as a database technology offering and is a well established and mature product.

Microsoft presentation and effort was appreciated. Strictly speaking, they did not meet the requirement of the POC due to incomplete SMRP data used and due to the fact that they did not participate during the Panel Discussion.

MesiniagaSdn. Bhd. /Microstrategy Singapore

Mesiniaga as a system integrator presented a complete POC offering in terms of technology through partnership and intrinsic services offering. In terms of technology partners, these were MicroStrategy for BI and IBM for ETL and Database. Both MicroStrategy and IBM has Portal offerings. The former is built in the enterprise reporting product.

ETL:
IBM SPSS Modeler product was used by Mesiniaga for POC. Data was successfully loaded into what we assume to be IBM UDB Database. The total as presented by MicroStrategy seemed correct.

BI:
MicroStrategy was demonstrated as Mesiniaga partner for BI. The BI offering correctly presented the SMRP data in the format specified both in the static and dynamic offering. A compact and well-crafted presentation of MicroStrategy features was presented. MicroStrategy is known to be amongst the top of best of breed products for BI tools. The quality of the answer by MicroStrategy was thorough and comprehensive. There was some confusion during the Mesiniaga presentation of appropriate usage of statistical tool such as SPSS. But apart from this, the BI presentation from MicroStrategy was successful.

Portal and Document Management:
While no specific portal product was demonstrated, MicroStrategy's intrinsic BI portal was shown and considered a good feature for MyHDW.

Security Technology:
No formal presentation of Security Technology was given by Mesiniaga, though during the Q&A session, MicroStrategy provided information to support both functional and data-related security features sufficient for MyHDW.

Database/RDBMS:
No database was presented. It is assumed that the database used was IBM UDB.

Mesiniaga and its partner, MicroStrategy and IBM, effectively met the mandatory requirement of the POC. MicroStrategy in particular as a vendor stood out of its capability as a BI tool. Many of the optional criteria were not demonstrated, but some of the specific answers were brought forth during the Q&A session.

Oracle Corporation Malaysia Sdn. Bhd.

Oracle and eNCoral presented an end-to-end solution in terms of tech and services in its response to POC. The POC was well executed and both mandatory and optional requirement was answered. The results from the SMRP data were correct. It was unfortunate that the BI offering was not able to be presented due to technical issues during the demonstration.

ETL:
Oracle presented its ETL offering, Oracle Data Integration (ODI) linked to its back-end database technology. The ETL walkthrough was comprehensive, well done and thorough. SMRP data was clearly demonstrated to have been loaded accurately and efficiently.

BI:
Oracle was unfortunately unable to present its BI offering during POC due to technical difficulties at the event. Oracle's BI capabilities are considered strong and amongst the best of breed technology. Oracle during its presentation also mentioned its new Exalytic in-memory analytics product.

Portal and Document Management:
Portal and document management capabilities were not presented during the POC due to the aforementioned difficulties. Oracle's theoretical capabilities are strong through its WebLogic and Universal Content Management (UCM).

Security Technology:
No security technologies were demonstrated during the POC, though Oracle is known to have a comprehensive solution in this regards.

Database/RDBMS:
The database used was Oracle 11g. This performed well and accurately. Oracle also mentioned its high performing data warehouse appliance, which is Oracle Exadata.

Oracle and eNCoral gave a good POC presentation. In terms of ETL criteria options, perhaps they gave the most comprehensive answer. Since BI solution was unable to be presented, we make no further comment on its aspect of the presentation. SMRP data in terms of being loaded accurately into the oracle database seems correct, and as expected.

CompuGroup Medical (Malaysia) Sdn. Bhd. (CGM)

CGM did not complete the POC as requested but did offer a presentation on its capability and service offering. The SMRP data provided was also not used; instead, what was presented was the EIS module that was deployed in Hospital Bintulu. CGM, was previously known as ProfDoc. This is a solution based on Business Objects including Krystal reports and business objects Infoview. The demonstration involving Hospital Bintulu data, in addition to fallen outside the boundaries of the POC seemed to perform very slowly. While the vendor clearly has certain experience with some local hospitals, it is unclear whether they have the capability to deliver MyHDW.

CONCLUSION

We are very appreciative of all the efforts of MIMOS and vendors who participated in this POC, which we hope will further enhance CME/CTE series. It is clear that there are strong partnership opportunities with MIMOS, and addition certain vendors have strong offering which could be highly suitable for the MyHDW initiative. In terms of products and vendor selection, the next steps associated with this will be handled via the normal channel and procedures associated with MAMPU and MoH.

APPENDICES

APPENDIX 1 – HIGH LEVEL MANAGEMENT MEETING

APPENDIX 2 – PARTICIPANTS FOR POC D1

APPENDIX 3 – PARTICIPANTS FOR POC D2

APPENDIX 1 – HIGH LEVEL MANAGEMENT MEETING

DATE	TIME	
10 Dec 2012	9.00 am –10.00 am	Deputy Director General (Research & Clinical Support Programme) Ministry of Health Malaysia
12 Dec 2012	8.00 am - 9.00 am	President & Chief Executive Officer MIMOS Bhd.
17 Dec 2012	11.30 am - 12.30 pm	Secretary General Ministry of Health Malaysia
20 Dec 2012	2.30 am –4.30 pm	ICT Consultants - Public Sector ICT Division Malaysian Administrative, Modernisation and Management Planning Unit (MAMPU); Director, Telehealth Division, Ministry of Health Malaysia; Sr. Asst. Secretary, Information Management Division (BPM), Ministry of Health Malaysia.
20 Dec 2012	5.00 am - 6.00 pm	Deputy Director General (Medical Programme) Ministry of Health Malaysia

APPENDIX 2 – PARTICIPANTS FOR POC D1

	Name	Agency/Department
1.	Maimunah A. Hamid, Dato' Dr.	Deputy Director General Research & Technical Support Programme
2.	Nooraini Baba, Dato' Dr.	Director Planning & Development Division
3.	Rahimah binti Mohd Ariffin, Dr.	Sr. Deputy Director (Planning) Planning & Development Division
4.	Jaafar Jamaan	Deputy Undersecretary Information Management Division (BPM)
5.	Noriati Baharum	Public Sector ICT Consultant MAMPU
6.	Mark Fuller	MyHDW Consultant
7.	Ahmad Khairuddin, Datuk Dr.	Institut Jantung Negara (IJN)
8.	Ariffin Marzuki Mokhtar, Dr.	Institut Jantung Negara (IJN)
9.	Asnida Anjang Ab Rahman	Bahagian Pembangunan KesihatanKeluarga
10.	Bahari bin Dato' Tok Muda Hj. Awang Ngah, Dato' Dr. Hj.	Hospital Sultan Haji Ahmad Shah (HoSHAS)
11.	Deepabarthy Muthu Kumaran	National Institute of Health (NIH)
12.	Dul Hadi bin Mat Junid	Jabatan Kesihatan Negeri Melaka
13.	Faizul bin Arifin	Hospital Raja Permaisuri Bainun
14.	Fatimah 'Afifiah Alias	Hospital Kuala Lumpur
15.	Fauziah binti Zainal Ehsan	Bahagian Pembangunan Kesihatan Keluarga
16.	Rosaida Hj Md Said, Dr.	Hospital Ampang
17.	Jenny Tong, Dr.	Hospital Seremban
18	Raja Marzuki Raja Mokhtar	Jabatan Kesihatan Negeri Terengganu
19.	Khusaini bin Hj. Mohd Daron	Clinical Research Centre (CRC)
20.	Ku Aznal Shahri Ku Abd Hamid	Hospital Serdang
21.	Fadhilah Zowiyah Yasmin Mansur, Datin Dr.	Pusat Sumber Transplant
22.	Lim Yam Ngo, Dr.	Hospital Kuala Lumpur
23.	Maimun Binti Adam	Hospital Kuala Pilah
24.	Marinan binti Ibrahim	Jabatan Kesihatan Wilayah Persekutuan KL & Putrajaya
25.	Mohamad Uzuman bin Nordin Ali	Hospital Sultanah Nur Zahirah
26.	Mohamed Ali Abdul Kader, Dato' Dr.	Hospital Pulau Pinang
27.	Mohammad Azahari	Hospital Kuala Pilah
28.	Mohd. Azahar Bin Mustapha	Hospital Segamat
30.	Mohd. Faizal Bin Abdullah, Dr.	Hospital Sultanah Nur Zahirah
31.	Mohd. Zahari bin Ab. Raak	Hospital Kota Bharu
32.	Mohd Zainuldin bin Taib	Institute for Medical Research (IMR)
33.	Muhammad Zulhelmi bin Ahmad Hijazi	Institut Jantung Negara (IJN)
34.	Nafal Safwati binti Md Pauzi	Jabatan Kesihatan Wilayah Persekutuan KL & Putrajaya
35.	Noor Amirah Muhamad	National Heart Association Malaysia
36.	Norakmar binti Tahir	Jabatan Kesihatan Negeri Perak

37.	Norazlina binti Mohd Noh	Hospital Kuala Pilah
38.	Norehan binti Mihad	Institut Jantung Negara (IJN)
39.	Norsima Nazifah Sidek	Hospital Sultanah Nur Zahirah (HSNZ)
40.	Nur Ellya Saed	Bahagian Sumber Manusia
41.	Nurul Akma binti Mahamid Amin	Clinical Research Centre (CRC)
42.	Nurul Jannah binti Ahmad	Jabatan Kesihatan Negeri Terengganu
43.	Nurul Kharmila Abdullah, Dr.	Hospital Kuala Lumpur
44.	Rahayu binti Shafie	Bahagian Pembangunan Kesihatan Keluarga
45.	S. Gunavathy Selvaraj	National Health Association Malaysia
46.	Salinah binti Kassim	Institut Jantung Negara (IJN)
47.	Shamala Devi K, Dr.	Clinical Research Centre (CRC)
48.	Sivaganasan A/L Ramalingam	Institut Pengurusan Kesihatan
49.	Sunny Chee	National Heart Association Malaysia
50.	Wan Mohd Noor bin Wan Ishak	Jabatan Kesihatan Negeri Pahang
51.	Wan Rozain bin Wan Said	Hospital Pekan, Pahang
52.	Zahroh Hasanah binti Darwis Harahap	Bahagian Kawalan Peralatan Perubatan
53.	Zaleha Othman	Jabatan Kesihatan Negeri Pahang
54.	Zariah Abd. Aziz	Hospital Sultanah Nur Zahirah
55.	Zuliza binti Ahmad Nor	Hospital Raja Permaisuri Bainun
56.	Zurriyati binti Ya'kub	Institut Penyelidikan Sistem Kesihatan
57.	Rohaya binti Roais	Jabatan Kesihatan Negeri Perlis
58.	Noradiah Ismail	Bahagian Perkembangan Perubatan
59.	Ahmad Jessree bin Kamaruddin	Pusat Informatik Kesihatan
60.	Mohd Suhaimi bin Mohd Yunus	Pusat Informatik Kesihatan
61.	Tan Bee Bee	Pusat Informatik Kesihatan
62.	Dr. Mustaffa bin Jaapar	Pusat Informatik Kesihatan
63.	Dr. Md Khadzir bin Sheikh Ahmad	Pusat Informatik Kesihatan
64.	Dr. 'Ismat binti Mohd Sulaiman	Pusat Informatik Kesihatan
65.	Dr. Azrulreezal Azannee bin Adbul Wahab	Pusat Informatik Kesihatan
66.	Dr. Fathullah Iqbal bin Ab Rahim	Pusat Informatik Kesihatan
67.	Dr. Norfazlin binti Zamani	Pusat Informatik Kesihatan
68.	Dr. Nur Shaema binti Darus	Pusat Informatik Kesihatan
69.	N. Rajkumar a/l V. Nagarethinam	Pusat Informatik Kesihatan
70.	Salwa Krishnan binti Abdullah	Pusat Informatik Kesihatan
71.	Norsuhada binti Sulaiman	Pusat Informatik Kesihatan
72.	Hamidah binti Minhat	Pusat Informatik Kesihatan
73.	Nor Almyza Laila Majnun	Pusat Informatik Kesihatan
74.	Wan Nasrun bin Wan Sulaiman	Pusat Informatik Kesihatan
75.	Nora binti Ahman	Pusat Informatik Kesihatan
76.	Nor Syakira binti Ahmad Shah	Pusat Informatik Kesihatan
77.	Temah binti Alias	Pusat Informatik Kesihatan
78.	Normaizan binti Yahaya	Pusat Informatik Kesihatan

79.	T.A. Charles a/l T.S Arokiam	Pusat Informatik Kesihatan
80.	Sabariah Rahman	Pusat Informatik Kesihatan
81.	Mohd Nasir bin Mohd Noor	Jabatan Kesihatan Negeri Kelantan
82.	Balkish Mahadir	Institut Kesihatan Umum
83.	Dr. Dahlia Saidin	NUC. Med
84.	Dr. Irene Cheah	MNNR
85.	Lee Sit Wai	Farmasi
86.	Nor Baniana Baharum	Jabatan Kesihatan Wilayah Persekutuan Kuala Lumpur
87.	Zulmaidi Mat	Comm
88.	Oktalid Abdullah	Comm
89.	Mohamed Ameer bin Azeez	Bahagian Kawalan Kualiti Makanan
90.	Khairi Sulaiman	Sapura
91.	Ahmad Shukri	Sapura
92.	Dr. Mollyza Zain	Hospital Selayang

	CHAIRPERSON
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APPENDIX 3 – PARTICIPANTS FOR POC D2

	Name	Agency/Department
1.	Rahimah Mohd Ariffin, Dr.	Sr. Deputy Director (Planning) Planning & Development Division
2.	Amiruddin Hisan, Dr.	Director Telehealth Division
3.	Jaafar Jamaan	Deputy Undersecretary Information Management Division (BPM)
4.	Noriati Baharum	Public Sector ICT Consultant MAMPU
5.	Mark Fuller	MyHDW Consultant
6.	Dr. Noradiah Ismail	Bahagian Perkembangan Perubatan
7.	Dr. Selamah Othman	Bahagian Perkembangan Perubatan
8.	Hj. Arzmi Mawsol	Bahagian Sumber Manusia
9.	Dr. Dahlia Saidin	NUC. Med
10.	Fatimah 'Afifah Alias	Hospital Kuala Lumpur
11.	Dr. Hjh. Rosaida Hj. Md Said	Hospital Ampang
12.	Kasmiati binti Muhammad Kassim	Hospital Ampang
13.	Ku Aznal Shahri Ku Abd Hamid	Hospital Serdang
14.	Lee Sit Wai	Farmasi
15.	Maimun bte Adam	Hospital Kuala Pilah
16.	Maizatul Tanty binti Abdul Mutalib	Bahagian Keselamatan dan Kualiti Makanan
17.	Mohd Uzuman bin Nordin Ali	Hospital Sultanah Nur Zahirah
18	Dato' Dr. Mohamed Ali Abdul Kader	Hospital Pulau Pinang
19.	Mohamad Azahari	Hospital Kuala Pilah
20.	Mohd Nasir bin Mohd Noor	Jabatan Kesihatan Negeri Kelantan
21.	Dr. Muhamad bin Ismail	Bahagian Kawalan Penyakit
22.	Norakmar binti Tahir	Jabatan Kesihatan Negeri Perak
23.	Norazlina binti Mohd Noh	Hospital Kuala Pilah
24.	Nor Baniana Bahrum	Jabatan Kesihatan Wilayah Persekutuan Kuala Lumpur
25.	Norsima Nazifah Sidek	Hospital Sultanah Nur Zahirah
26.	Nur Ellya Saed	Bahagian Sumber Manusia
27.	Nurrul Akma binti Mahamad Amin	CRC
28.	Nurul Jannah binti Ahmad	Jabatan Kesihatan Negeri Terengganu
30.	Dr. Shamala Devi K	CRC
31.	Dr. Shereen Ch'ng Suyin	Hospital Selayang
32.	Wan Rozainbin Wan Said	Jabatan Kesihatan Negeri Pahang
33.	Zaharoh Hasanah binti Darwis Harahap	Bahagian Kawalan Peralatan Perubatan
34.	Dr. Zariah Abd. Aziz	Hospital Sultanah Nur Zahirah
35.	Raja Marzuki Raja Mokhtar	Jabatan Kesihatan Negeri Terengganu
36.	Hanapiah binti Mohamad	KKM

37.	Junidah Raib	Bahagian Pemakanan
38.	Zarina Abdullah Sani	Bahagian Pembangunan Kesihatan Keluarga
39.	Fatimah binti Padzin	Jabatan Kesihatan Negeri Selangor
40.	Azean Izamurni A. Aziz	Jabatan Kesihatan Negeri Selangor
41.	Basheer Ali Majeed	Abyres
42.	Jacob Thomas Jr.	Abyres
43.	Zukiah Fazilah	Jabatan Kesihatan Negeri Terengganu
44.	'Aisyah Ruslan	Malaysian National Neonatal Registry
45.	Dr. Md Khadzir bin Sheikh Ahmad	Pusat Informatik Kesihatan
46.	Ahmad Jessree bin Kamaruddin	Pusat Informatik Kesihatan
47.	Mohd Suhaimi bin Mohd Yunus	Pusat Informatik Kesihatan
48.	Tan Bee Bee	Pusat Informatik Kesihatan
49.	Dr. Mustaffa bin Jaapar	Pusat Informatik Kesihatan
50.	Dr. 'Ismat binti Mohd Sulaiman	Pusat Informatik Kesihatan
51.	Dr. Azrulreezal Azanee bin Abdul Wahab	Pusat Informatik Kesihatan
52.	Dr. Fathullah Iqbal bin Ab Rahim	Pusat Informatik Kesihatan
53.	Dr. Norfazlin binti Zamani	Pusat Informatik Kesihatan
54.	Dr. Nur Shaema binti Darus	Pusat Informatik Kesihatan
55.	N. Rajkumar a/l V. Nagarethinam	Pusat Informatik Kesihatan
56.	Salwa Krishnan binti Abdullah	Pusat Informatik Kesihatan
57.	Dr. Ferwahn Fairis Ab. Karim	Pusat Informatik Kesihatan
58.	Maisarah binti Ab. Hamid	Pusat Informatik Kesihatan
59.	Nora binti Ahman	Pusat Informatik Kesihatan
60.	Mohd Faizal bin Ramli	Pusat Informatik Kesihatan
61.	Nor Syakira binti Ahmad Shah	Pusat Informatik Kesihatan
62.	Nor Mazlida binti Abu Bakar@ Harun	Pusat Informatik Kesihatan
63.	Sazlina Soyat	Micro Strategy
64.	Law Boon Kim	Sturn Group Sdn Bhd
65.	Elena Teo	Oracle
66.	Eddy Liew	Oracle
67.	Raphael Couzet	Microsoft
68.	CP Chan	CGM
69.	Mohd Alias Syed Ahamed	CGM
70.	Lakshu Balasubramaniam	Microsoft
71.	Jamie Lee	IBM

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MALAYSIAN HEALTH DATA WAREHOUSE

HEALTH REFERENCE DATA MODELLING, TECHNOLOGY SELECTION AND GENERAL OBSERVATIONS

JUNE 2013

INTRODUCTION

As part of a continuing process to evolve and establish Malaysian Health Data Warehouse (MyHDW), time was reserved during June and July 2013 to set direction and make recommendations concerning a number of complex and high priority items previously identified in the Blueprint andGuidelines. Specifically the initiation of a National Health Data Model, Technology Selection and a number of other factors such as the positioning of MyHDW within a broader National eHealth initiative, Data Warehouse Architecture and SNOMED CT applicability. To assist in this process subject matter experts were gathered from Health Informatics Centre (HIC) of Planning Division, MAMPU, Telehealth, BPM, MIMOS and other healthcare agencies.

It was previously recommended that a National Health Reference Data Model be developed and maintained to support the effective implementation of MyHDW and as a supplement to the National Health Data Dictionary initiative. Based on international experience,initiatives such as these are deemed to be necessary though often an onerous processes. Workshops were held to educate those present on techniques and best practices associated with this activity in addition to the necessary conditions required to establish a program of work. Outputs from the workshops include initial concept and model definitions and also details of process, governance and resource requirements. Furthermore, recommendations concerning practical steps required to establish a program for a Malaysian Health Reference Data Model (MyHRDM) as an adjunct to the Malaysian Health Data Dictionary (MyHDD) are given. Discussions were also held on the applicability of MyHRDM to current development work such as SMRP V2.0, MyHDW prototypes and also data warehouse requirements and associated architectural directions.

Technology selection for MyHDW is another critical area which was addressed through the development of a systematic methodology for product selection, evaluation and recommendations. The workshop participants, guided by the consultant firstly develop the evaluation method and criteria and then carried out detailed reviews of commercial, Open Source and MIMOS products to determine the best fit for MyHDW, based on local conditions, resource constraints and international experience. This report based on these workshops makes tentative recommendationsfor technology and tools that those present consider are ideally suited for the initiative. It will be left to the technology partner to make the final determination guided by this work as to the exact products to be used. Recommendations are also provided based on participant discussions concerning the location, infrastructure and service levels of the data centre that will host MyHDW technology.

General observations are also given in the report on a collection of items deemed important at this stage for MyHDW's initiation, these include considerations around MyHDW's role in the National eHealth Strategy, Analytical resource capacity, SNOMED CT usage and data warehouse architecture.

In conclusion it is felt that the output of the workshops and consultations including senior officers from Ministry of Health and MIMOS,was successful in progressing the advancement of

a MyHRDM and in informing and guiding appropriate technology selection in a manner consummate with project and local requirements and furthermore better positioning of MyHDW within the eHealth landscape.

MALAYSIAN HEALTH REFERENCE DATA MODEL (MYHRDM)

Work on MyHRDM took place during the first two weeks of the consultancy. In week one meetings were held with representatives from HIC of Planning Division, Telehealth Division, Information Management Division, Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) and MIMOS to educate them on data modeling and its importance to health informatics and system development initiatives. In addition, reviews were undertaken of the data models produced by MIMOS for the *Sistem Maklumat Rawatan Perubatan* (SMRP) V2.0 project and early drafts of the data marts that were designed for MyHDW. The team present were shown basic techniques utilised in building data models for healthcare systems development. These techniques were elaborated on to demonstrate the importance of enterprise level data models in the use of health informatics standards and as an underpinning for building high quality and cost effective healthcare systems. International examples were provided including process and governance considerations. The positioning of a Malaysian Health Reference Data Model (MyHRDM) as a necessary supplement to the Malaysian Health Data Dictionary (MyHDD) was also discussed and recognized by those present as being of importance.

The participants were then divided into break-out groups and were asked to deliberate on MIMOS's proposed SMRP V2.0 data model and identify from this key concepts that may occur at a national level. This review process unearthed possible inconsistencies in the proposed models when considered in light of a national position. There was also recognition that the addition of **concept definitions** would greatly benefit data elements in the MyHDD by better setting context for these items.

The participants were then assigned the identified concepts and asked to work on definitions for these also, if time allowed to develop an associated data model. One of the key lessons learned is that by looking at healthcare modeling holistically it changes the thinking and approach of modeling of individual systems such as SMRP V2.0 and that furthermore there is not always a shared understanding of the commonly used concepts. This can lead to confusion and possibly poorly integrated system design. Of particular note was the advice given by the consultant to ensure that concept definitions were precisely worded and that for example multiple concepts within a definition be avoided.

As intimated it was agreed upon during the workshop that a focused effort to produce an initial version of MyHRDM be undertaken during the consultancy including **process** and **governance** setup. As defined in the previous report, this product will allow for consistent definition of data concepts within the Malaysian Healthcare System. Furthermore, the relationship between these concepts or entities will be defined and selectively certain concepts will be further elaborated by the addition of standardised attributes or data

elements. These data elements will form or part of a MyHDD that will act as a supplement to MyHRDM.

The use of the term Reference data model was explained to the group and compared with the more traditional terms used in data modeling, such as Conceptual, Logical and Physical data model. It was noted that when developing systems within large organizations, it is best practice to develop an Enterprise Data Model; in healthcare this is similarly required. The complexities and non-standardisation of processes in healthcare delivery, complex stakeholder relationships and governance warrant the use of a Reference data model approach as this greatly increases the chance of successfully completing an initiative of this nature. This Reference Data Model is similar to a Conceptual Data Model[1,2]but limited to only the most necessary data concepts. This will allow for a rapid development and utilisation of a National Data Model for healthcare without excessive timelines and work effort. A similar approach has been used by the Canadian Institute for Health Information (CIHI) with its CIHI Reference Data Model to good effect. Based on success in this organization a similar approach is recommended for MyHDW.

The objectives of week two was to begin the process of developing a Start-up version of MyHRDM. Participant organisations in this session were HIC of Planning Division, Information Management Division, Oral Health Division, Teleprimary Care of Family Health Division, National Blood Bank, Medical Devices Division, Pharmacy Division, Nutrition Division, MAMPU and MIMOS. *Please see Appendix 2 for details of workshop participants.*

After some initial data modeling training for those participants who did not attend the initial workshop, the team was divided into four groups and tasked with developing initial versions of concept definitions as instructed by the consultant. Each group received a predefined list of concepts (entities) and were asked to defined these as in a precise manner as to be suitable for MyHRDM. The predefined list was derived from the initial workshop and supplemented by some early and its Data Models produced by the initial break-out groups. Definitions of concepts were derived from different perspectives including legal, clinical, international examples and local reporting needs. The participants were encouraged to beprécised in their definition so as to make the concepts usable in a real world situation and for ultimate deployment via MyHRDM in MyHDW. Furthermore, Use Cases were developed to validate the concept descriptions both from a clinical settings perspective and also from aninformation and reporting requirement.

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[1] ISO/TR 2221:2006: Health Informatics - Good Principles and Practices for a Clinical Data Warehouse. International Organisation for Standardisation, Geneva, Switzerland.
[2] ISO/TS 29585:2010: Health Informatics - Deployment of a Clinical Data Warehouse. International Organisation for Standardisation, Geneva, Switzerland.

CONCEPTS (ENTITIES)

During the workshop, the following concepts were investigated and discussed by the working groups. Definitions were developed and refined by group discussion and revised by the consultant which may provide input to the initial version of MyHRDM. *Please see Appendix 3 for details.*

TABLE 1: CONCEPTS (ENTITIES)

CONCEPTS	
Admission	Incident
Assessment	Intervention
Case	Medical Device
Client	Newborn
Clinical Observation	Next of kin
Cost (Health expenditures and Macro cost)	Organ
Dead Person	Organisation
Discharge	Person
Discipline	Place
Donor	Programme
Drug	Provider
Encounter	Service
Episode	Specialty
Facility	Specimen
Health Service Event	Visit

USE CASES

A common technique for validating Data Models including concepts and entity definitions is to employ Use Cases. For the purposes of MyHRDM, Use Cases are descriptive scenarios either within a functional/clinical context or alternatively at an aggregate or reporting level.

REPORTING/INFORMATION – SECONDARY USAGE USE CASE

The following is an example of a reporting Use Case: The Use Cases in this instance assists in the validation of the data model and concept itself in meeting reporting requirements for example in the area of Health System Management.

Q: How many hospital discharges by state in Malaysia for 2012

- Select all Inpatient Discharges by discharge year for 2012. Group results by Place (state) and Facility (facility ID)

Q: How many hospital discharges by state in Malaysia for 2012 for knee replacement?

- Select all Inpatient Discharges by discharge year for 2012. Group results by Place (state) and Facility (facility ID). Where Intervention ICD 9CM Code for Knee Replacement.

Q: How many hospital readmissions associated with Knee Replacements from 2009-2011 were performed in 2012 by state and hospital in Malaysia?

- Select all Inpatient Discharges by discharge year 2012 from all Inpatient Discharges where Intervention ICD 9CM Code for Knee Replacement was conducted between 2009-2011 and select same Client and group by Place (state) and Facility (facility ID).

** The terms that is currently use in the above diagram is exploratory*

CLINICAL/PRIMARY USAGE USE CASE

An example of a functional Use Cases by way of illustration developed during the workshop follows: This type of Use Case allows for the validation of concepts within a health data model at an individual, patient, or clinical level.

Service Event 1; Episode 1; Visit 1; Encounter 1: MA; Assessment 1: MA

- Mdm SA, 50 years old lady brought by family member to the Emergency Department, Hospital A. She has previous history of right fracture of head of femur and had undergone Right Total Hip Replacement 3 weeks ago. Currently, she presented with fever and pain at the surgical site. She was assessed by MA at the Triage.

Service Event 2; Encounter 2, 3: MO ED, Ortho MO; Assessment 2, 3: MO ED, Ortho MO on-call; Clinical Observation 1: ED; Discipline 1, 2: Emergency, Orthopaedic; Admission 1: Orthopaedic Ward

- She was seen by ED MO and sent for X-ray for suspected Infected Implant. She was referred to an Orthopaedic on-call doctor and admitted to Orthopaedic Ward.

Encounter 4, 5: Ortho, Anaes; Assessment 4, 5: Ortho, Anaes; Discipline 3: Anaes; Clinical Ob 2,3: Ortho, Anaest; Specimen 1, 2, 3: Blood C&S, Swab C&S, Implant; Drugs 1, Intervention 1

- She was reassessed in the ward and prescribed drugs. While being observed, blood C&S and swab C&S was sent to the laboratory. Condition deteriorates despite treatment given, removal of implant was planned. She was assessed by an Anaesthetist. The operation was successful. The implant was sent to the Laboratory for analysis

Encounter 6…: Physiotherapist…; Incident 1; Assessment; Clinical Observation

- While recovering, she was seen by physiotherapist 3 times a day. During one of the session, she slipped and hit her head on the floor. She had a small hematoma.

Assessment; Clinical Observation

- She refused to do further physiotherapy and remained bed-ridden. During ward round, she complained of chest pain and breathlessness. SpO2 80% and suspected of Pulmonary Embolism due to Deep Vein Thrombosis. Despite resuscitation, condition deteriorates and died.

Encounter; Next of Kin; Organ; Donor; Intervention; Discipline; Discharge; Dead Person

- Family was called and counseled for organ donation. Family consented for cornea donation. After procedure completed, body was sent to the Mortuary and released to the family.

** The terms that is currently use in the above diagram is exploratory*

MODELLING

During the workshop participants worked on various representations of Health Data Models to illustrate and refined concept definitions. During the last day of the workshop, a group of professional Data Models and ICT professionals developed two prototype Data Models for MyHRDM for consideration of the participants. Along with all concept definitions and Use Cases, these will be used by the initial stages of MyHRDM once ownership, process, and governance consideration are established. *Please see Appendix 5 for these exploratory MyHRDM models.*

TABLE 2: CONCEPTS AND ITS DEFINITION

Concepts	Definition
Admission	A process of admitting a client into a ward in a health care facility to receive health care
Assessment	An act of evaluation of a client/medical product to reach a decision for the next cause of action
Client	A person who receives health service(s)
Clinical Observation	Summary of the patient's illness and intervention documented by a healthcare provider while providing health service to a client
Cost	* Item discussed but need further work
Dead Person	* Item discussed but need further work
Discharge	A formal ending process of a particular admission in a health care facility
Discipline	An organisation of specialists with similar specialties
Donor	A person or next of kin of that person who has consented to give away the client's of organ, tissue or blood
Drug	Any substance used in diagnosis, treatment or prevention of disease or other abnormal condition as a component of medication
Encounter	A specific moment of contact between client and provider
Episode	From a time of need for a specific kind of care until a specific outcome is achieved
Facility	Any health industry related premises or vehicle
Health Service Event	Registration of a client to a particular type of health service in a health care facility
Incident	An event/happening that causes an unanticipated harm to a client while receiving health service provided by a healthcare facility
Intervention	An act of interfering with the outcome or course of a condition as to prevent harm or improve function
Medical Device	* Item discussed but need further work
Newborn	A person aged less than or equal to 28th days of life who receives health service(s)
Next of kin	A person who is a relative or a friend of a client
Organ	A structured arrangement of tissues that perform specific function

Organisation	A group of individuals working towards common goal
Person	An individual
Place	A particular position or point in space/location.
Programme	A system of services designed to meet a health care need
Provider	A person who is positioned to a health facility(s), and may be registered by professional board, and provides health service(s) to client(s)
Service	Grouping of care / discipline provided to a client
Specialty	A branch of discipline where the healthcare provider has specialized qualifications and training.
Specimen	Blood, Tissue, Organ, living byproduct
Visit	An act of client going to a health care facility to seek health care.

MYHRDM INITIATION PLAN, PROCESS AND GOVERNANCE

It will be important to establish a program to further develop and maintain MyHRDM. Meetings were held during the workshop with representatives from HIC of Planning Division, Telehealth Division, Information Management Division, MAMPU, and MIMOS to deliberate on this. References made to CIHI CRDM Toolkit as an example that could be utilized as a template for processes and governance associated with this type of program.

It was recommended and agreed during the discussion that a proposal should be developed including resource requirements for the MyHRDM program for consideration by National Health Informatics Committee (NHIC). It is further recommended that the lead for this program should come from MAMPU supported by HIC of Planning Division for the secretarial function. Assuming this notion is approved and funded and the appropriate organisational identified, the first task of this group will be to create an initial ratified version of MyHRDM. As part of this the MyHRDM program will also need to establish appropriate processes and policies to support the effective use and development of MyHRDM. The initial version 1.0 of MyHRDM should be based on the workshop material and subsequent modelling and be available in the Q1 of 2014 in preparation for the initial stages of MyHDW.

The availability of strong modelling resources will be a necessity for the successful delivery of this initiative, a number of possible resources that fit this profile were identified in Information Management Division and MIMOS and a follow up discussion concerning the availability of these individuals will be undertaken. In addition to the modelling skills mentioned, these resources will need good communication skills and the ability to interact with senior members of MOH during their work. It should be noted that for the purposes of developing and presenting the model a professional data modelling tool be obtained. For example, CA Erwin, Visio Professional Edition, etc.

RECOMMENDATIONS

Based on discussion during the workshops the following are recommended:

1. Continue and complete an initial version of Concept definitions and associated data model based on the workshop materials. This should be sufficient to support and be used by SMRP V2.0 and MyHDW start-up phases and should begin immediately.

2. Healthcare services in Malaysia are provided by number of agencies including Ministry of Health (MoH), Ministry of Education (MoE) and local councils. Furthermore within the MoH, ICT programs are organised into numerous divisions and centers. It is therefore important to identify a central agency that could coordinate across these groups. Based on these factors it is recommended that MAMPU be considered as the lead for MyHRDM. The secretariat would remain with HIC. Conformance and use of MyHRDM should be mandated by MAMPU.

3. To speed up the development of MyHRDM it is recommended that existing models, governance and processes from international health informatics organisations be used as a guide if possible. CIHI's Reference Health Data Model and associated toolkit is particularly suitable for this purpose. These materials were provided to HIC by CIHI through a recent communication under the conditions of confidentiality.

4. To align the Malaysian Health Data Dictionary (MyHDD) andMyHRDM. This will be managed through recommendation #2 and the addition of a Concept (Entity) attribute in each data dictionary item. Once Concept definitions are stabilised through the completion of recommendation#1 above these should be applied to existing MyHDD items where feasible. Furthermore an ongoing process as outlined should be established to keep MyHDD and MyHRDM aligned on and ongoing basis.

5. To consider further versions of MyHDW Information Framework (MyHDWIF) which may include questions and information currently not provisioned by existing reports and KPIs that were used in the initial version.

6. The MyHRDM will use MyHDWIF to support and validate its development. MyHDWIF will also need alignment in terms of further development, processes and governance with both MyHDD and MyHRDM. HIC should continue to be the custodian of this artifact and should work with the groups above to ensure its alignment and utilisation.

TECHNOLOGY SELECTION

In week three, a concentrated effort to determine the technology selection for MyHDW was undertaken. The objective of this endeavour was to ensure in an impartial way that the correct technology is chosen to support MyHDW through the development of a systematic methodology, evaluation and process to determine suitable recommendation for our technology partner. This process also needed to account for proven products and vendors suitable for a large scale health information data warehousing environment within the Malaysian context. Furthermore consideration of the right positioning of locally developed software and technology needed to be factored into the deliberations. Present for this were the following organisationsHICof Planning Division, Information Management Division, MAMPU and MIMOS. The consultant outlined a methodology and systematic approach to support this process. Breakout group composition was predetermined during the planning stages of the workshop and the chair and secretary of each group was chosen from non-MIMOS staff due to the inclusion of some of their technology during the evaluation.

The key steps for the evaluation process were as follows:

METHODOLOGY

- Summary Requirements
- Short List Products
- Criteria and Scorecard
- Summary Scorecard
- Recommendations

SUMMARY REQUIREMENTS

The breakup groups were asked to develop requirements at a summary level for three MyHDW technologies. These were Business Intelligence (BI), Extract Transform and Load (ETL) / Data Integration and Relational Database Management System (RDBMS). These tools were prioritise over other MyHDW technologies (hardware, enterprise portal and security) as being of particular importance and complexity. Requirements were drawn from the previous MyHDW Blueprint reports. It is also been recognised that a dedicated data warehouse requirement and architecture document is needed. This deliverable has been added to the updated blueprint plan at the end of this report. Requirement categories were as follows:

- Must Have – This feature must be present in the tool and any products without this would be disqualified for further considerations
- Very Important – A critical technical or non-technical factor associated with the tool or vendor
- Important – A critical technical or non-technical factor associated with the tool or vendor
- Nice to Have – An optional technical or non-technical factor associated with the tool or vendor

BUSINESS INTELLIGENCE AND REPORTING REQUIREMENTS

The Business Intelligence, analytical and reporting requirement for MyHDW will need to be comprehensive, high performing and flexible. It is envisioned that many categories of users will need to be serviced. This ranges from power users, analysts, report consumers and casual users. Furthermore features such as ad-hoc query environment, interactive enterprise reporting, data visualisation, dashboard, data exploration and Geographical Information Systems (GIS) all need to be present. Along with this the selected technology will need to provide for a wide range of analytic capability, security and privacy enhancing functionality, and the ability to scale to high numbers of concurrent users while maintaining good performance time. The following details the specific requirements needed for the BI environment for MyHDW.

TABLE 3: BUSINESS INTELLIGENCE AND REPORTING REQUIREMENTS

REQUIREMENT	DESCRIPTION	PRIORITY
Reporting	Able to support static, interactive report with tabular & graphic presentation	Must have
Ad-hoc query	Ability to support ad-hoc query environment from structured data	Must have
Interface	End user interface must be browser based (developer environment may be client server)	Must have
Scalability	Can scale to high volumes of data and users e.g. must be capable of managing 50 concurrent users and underlying data volume in 100 million rows range	Must have
Publishing	High quality / desktop publishing level output possible	Very important
Visualisation	Dashboard and visualisation capabilities	Very important
Mobile support	Native mobile support	Very important
GIS integration	Integrated GIS capability	Very important
Analysis	Strong analytic capability including some mid-level statistical functions (a comprehensive set of advance statistical function is not expected)	Very important
Security and privacy	Comprehensive security and privacy enabling technology in the areas of data, function and access	Very important
ROLAP	Ideally ROLAP based	Very important
Portal technology	Can integrate or has portal technology	Very important
Testing and deployment	Must provide a high quality development testing and deployment capabilities	Very important
Report sharing	Ability ideally to share reports with others or collaboration capabilities	Very important
Advance analysis	What-if and predictive analysis capabilities ideally	Important
Big data support	Big data, unstructured data analytical capability - Hadoop support	Important
Alerts	Subscription, push capable, scheduling	Nice to have
Integration	Microsoft office integration	Nice to have
Advance statistics	Advanced statistical capabilities	Nice to have

ETL / DATA INTEGRATION REQUIREMENTS

The ability to effectively and in a timely way to load standardised, clean data into MyHDW is a significant activity and will need availability of a quality ETL/Data Integration tool. Furthermore this tool needs to be able to handle both development, testing and operations associated with MyHDW, in addition to the ability to scale to the volume and complexity of healthcare data at a national level. It is common practice for a large scale data warehouse to incorporate tools such as this to help them run efficiently and maintain good total cost of ownership, MyHDW is no exception to this. Considerations associated with the availability of trained resources and fit into the target technical infrastructure are also of great importance as is the quality and availability of vendor support. The need for a high degree of data integration and data cleaning functionality in addition to the complexity mentioned above will be a particularlyemphasised requirement for MyHDW. The following details the specific requirements needed for the ETL environment for MyHDW.

TABLE 4: ETL / DATA INTEGRATION REQUIREMENTS

REQUIREMENT	DESCRIPTION	PRIORITY
Conform to MyHDW blueprint		Must have
Risk Mitigation	Successfully deliver product and support	Must have
Connectivity	Wide connectivity to multi data source, input source	Must have
Scalability	Vertical (add CPU cores, RAM) and horizontal (add machines) - for future expansion	Must have
Good Productivity	Have GUI to simplify the development process - for developers Fast learning curve (reduces the time to train and use the tools), ease of use	Very Important
Good Reliability	Responsive and reliable	Very Important
Performance	Performance to handle big data volumes	Very Important
Data Quality	Data cleansing and standardization (harmonization)	Very Important
Monitoring	Find problems and debug them during and after the development stage	Very Important

RDBMS REQUIREMENTS

Database technology associated with data warehousing including that for large implementations is mature and well proven. The database backend for MyHDW needs to provide for a large complex set of data and pair well with industry standard BI and ETL tools. Furthermore it needs a comprehensive set of features in the areas of performance, security, maintainability as well as supporting high productivity. It also needs to fit well within the target environment in terms of infrastructure and availability of resources. Similarly the viability and presence of a local vendor is also important. The following details the specific requirements needed for the RDBMS environment for MyHDW.

TABLE 5: RDBMS REQUIREMENTS

REQUIREMENT	DESCRIPTION	PRIORITY
High Performance	Must satisfy current and pending regulatory reporting requirements and mine data for new opportunities. Able to store and retrieve information from multiple data sources in quick manner within specified timeframe (right time - on demand)	Must Have
Maximum concurrent users (200)	Able to handle up to 200 concurrent connections/threads at one time	Must Have
Security	Must ensure unauthorised or unintended or misuse by authorized database user accessing sensitive data are controlled. Must protect information from leakages associated to security vulnerabilities, e.g.: hacking, malware, virus.	Must Have
Scalability	To allow growth to larger database size in support of an ever increasing transaction rate in the future.	Must Have
Data Protection / Integrity (Recovery)	Must ensure accuracy and consistency of data despite hardware and/or system failure upon recovery	Must Have
Performance Tuning	Ability to improve database performance through predefined code optimization, DB load optimization, caching strategy and self-tuning functionality.	Must Have
Audit Logging	Ability to observe and be aware of actions performed by database user.	Must Have
User Friendly	Easy to use (graphical and with good knowledge based) and almost flat learning curve for DBA.	Very Important
Ease of Maintenance	Resources skills and the database updates are easily available	Very Important
Compression Technology	Able to compress data for disk saving and IO improvement with faster search time, efficient use of memory, reduce backup and recovery time.	Very Important
High Availability	Reduce plan downtime using integrated configuration and monitoring functionality through database load management capabilities.	Very Important
License cost	The cost of purchasing database licenses	Very Important
Maintenance cost	The cost of maintaining database	Very Important

NOTES ON OTHER TECHNICAL PRODUCTS REQUIRED BY MYHDW

It has been a conscious strategy during this particular workshop to focus on three products which are perhaps the most complex, vital and thus have the highest priority in terms of the need for guidance as relates to product selection and process. That said there are additional hardware, software and potential services that will also be required. It is hoped that following a similar methodology as outlined in this report that our technology partner(s) will perform similar evaluations on those products with the aim of determining the best fit for MyHDW and technology selected so far. Details of these other products can be found in other MyHDW reports. Specifically choices will be made concerning technology in the areas of hardware, infrastructure, portal and collaboration tools and security. Also as recommended in Blueprint Report a server based deployment of statistical tools (SPSS was selected previously) will be needed. As previously recommended all this product and services will need to be documented in ***MyHDW infrastructure plan.***

In summary, we encourage the technology partner(s) to carry out product evaluation and selection in the following areas above and beyond what is highlighted in the supplement.

- Enterprise Portal e.g. Web Centre, SharePoint, etc. it should be noted that in many instances these tools have identity management and single sign-on capabilities
- Security access control and identity management including single sign-on functionality
- GIS – a GIS tool that works in integrated way with the BI tool will be required. A recommendation from the selected vendor of the BI tool concerning should be requested
- Statistical tools – SPSS server based as per previous report
- Hardware infrastructure including server, disc and network infrastructure as required
- Considerations should also be made regarding the facility that would house the above if none are regularly available

PRODUCT SELECTION SHORTLIST

To allow the efficient and equitable selection of technical products for MyHDW consistent with the methodology outlined a shortlisting process was initiated during the workshop.

The groups were asked to develop a shortlist of viable products to be considered for further discussion and evaluation. Reference to previous workshops, proof of concept and initial evaluation work by HIC Planning Division and MIMOS associated with MyHDW was drawn upon such as the *Malaysian Health Data Warehouse: Project Initiation and Data Information Architecture December 2012* report and *MyHDW: Initiation Phase Workshop in February 2013.*It should be noted that MIMOS technology was shortlisted in all instances due to a commitment to support locally developed innovation and products. In addition products from commercial and Open Source organisations that the group felt best fit the requirement based on the aforementioned reports and previous evaluations were included.

CRITERIA AND SCORECARD

The methodology employed is based upon commonly used approach which is sequential and rigorous in nature. This also adopts a notion of weights and priorities to allow the evaluation process to hone in on particular areas of importance and profile these in an appropriate manner. The steps are as follows:

- Identify Scoring Criteria associated for each tool.
- Arrange these Criteria into logical groups. For example, the Scalability criterion belongs to the Performance group.
- Score all products in the study against all criteria.
- Scores are in the range of 0.0 to 1.00, with 1.00 being the highest possible score.
- Scoring to be done by working group, based on experience with these tools and some market research.
- Assign a weight to each criteria.
- Each criteria to be assigned a Criteria Weight of Low, Medium or High these scores will be multiplied by the score of the categories to apply the necessary weight or prioritisation
- Sum of Category Weights (%) in summary scorecard must add up to 100

The following three tables represent the criteria and their associated weights developed by the working groups during the workshop. In addition to identify criteria each group performed a scoring activity on the shortlisted products selected. It should be noted that only the shortlisted products in RDBMS table were fully scored. As there was not sufficient experience in the working groups associated with commercially available BI and ETL products, these criteria were not scored in the same manner. In these cases a score of 0, 1 or 0.5 were assigned where 1 indicates the presence of a feature, 0 is the absence of a feature and 0.5 means the team was unsure if the feature was present or not.

CRITERIA WEIGHTS

Each criteria identified will be prioritise to apply weight to its score. These weights and rankings arekey to methodology and impose a priority on the final score. Weights of Low, Medium and High are represented as 1, 2 and 3 respectively.The following table is an example list of criteria for ETL/DI productivity criteria and weights:

TABLE 6: CRITERIA WEIGHTS

Productivity Criteria	Weights
Ease of use	3
Development Environment	3
Graphical Interface	1
Vendor Support	2
Debug functionality	3
Test facility	3
Release management	2
Easy to Maintain	3

TOTAL COST OF OWNERSHIP (TCO)

Total Cost of Ownership (TCO) is a composite measure that combines various costs associated with the purchase of the tool combine with expected productivity gains, running cost, etc. For the purposes of this report this should be calculated within a 3 years' time frame though this can be extended to 5 years if felt appropriate. Other factors that make up TCO would be salary, training, licencing costs, support and maintenances and perhaps most significantly productivity gains.

OTHER TCO CONSIDERATIONS

- When evaluating the cost of BI/ETL/DB platforms consider analysis beyond initial license fees to include implementation and administration costs
- For any deployment, consider maximizing the number of people who use the tool or platform to bring down per-user costs by combining projects where possible
- Balance any consideration of cost with functional requirements. Low-cost tools that do not meet requirements will not deliver the expected business benefits.
- Consider how does the national agenda factor into TCO.

BUSINESS INTELLIGENCE CRITERIA

The following table outlines the categories and criteria the working group develop to evaluate business intelligence products. *Please see **Supplemental Technology Selection** reportfor shortlisted products and notional scoring.*It should be noted that full scoring of the criteria on this category was not performed and only the presence or absence of a feature was indicated. The working group had an opportunity to perform the notional scoring on MIMOS Mi-BIS product, the result if this exercise can also been seen in the above appendix.

TABLE 7: BUSINESS INTELLIGENCE CRITERIA

BI			
CATEGORY	**CATEGORY WEIGHT**	**CRITERIA**	**WEIGHT**
Productivity	20	Development environment	3
		Graphical User Interface	3
		Release management (versioning)	3
		Easy to maintain	3
		Ease of use	2
		Vendor support	2
		Build in debug functionality	1
		Test facility	1
Features	20	Reporting designer (Static Reports)	3
		Ad-hoc query (query wizard) & Analysis	3
		OLAP Analysis (multidimensional drilling, statistical function, support pivot-based analysis, support ROLAP)	3
		Dashboard &Visualisation	3
		Scorecard/KPI	3
		Mid-level Functional Statistical Analysis	2
		Single platform supporting mobile, web, desktop (device)	2

BI			
CATEGORY	**CATEGORY WEIGHT**	**CRITERIA**	**WEIGHT**
		Browser-based for the end-user (multi browser)	3
		Collaborative BI (+ Annotation)	1
		Mobile Support	3
		Comprehensive Security and privacy	3
		Offline interactive report	1
		GIS integration	3
		Must work with chosen database	3
		Support multiple platforms (Operating system)	2
		3rd Party Integration: e.g. Microsoft Office	1
		Statistical tool integration	1
		Big data support	2
		Subscription updates (including alert & notification)	2
		Audit trail	3
		External data integration for analysis	3
		Write back values	1
		Scheduling	2
Total Cost of Ownership	25	License	0
		Support & Maintenance	0
		Training	0
		Productivity	3
Performance	25	Scalability - user concurrency	3
		Scalability - data volume & complexity	3
		High availability	1
Viability	10	Vendor viability	3
		Vendor presence locally	1
		Expected product endurance	2
		Availability of resources	3

ETL/DATA INTEGRATION CRITERIA

The following table outlines the categories and criteria the working group develop to evaluate ETL/ Data Integration products. *Please see **Supplemental Technology Selection** reportfor shortlisted products and notional scoring.* It should be noted that full scoring of the criteria on this category was not performed and only the presence or absence of a feature was indicated. The working group had an opportunity to perform the notional scoring on MIMOS Mi-Morph product, the result if this exercise can also been seen in the above appendix.

TABLE 8: ETL / DATA INTEGRATION CRITERIA

ETL/ Data Integration			
CATEGORY	**CATEGORY WEIGHT**	**CRITERIA**	**WEIGHT**
Productivity	25	User Interface Driven: Graphical table mapping, data source creation, drag n drop, user driven data cleaning	3
		Development Environment	3
		Job Monitoring:Reporting of Job Status, ability to monitor job, amount of data transfer at any point of the time, ability to track error	3
		Testing Capability: Validation testing, transformation testing, impact analysis	3
		Debugging: Providing break point and single step debugging process	3
		Ease of Use: Have GUI to simplify the development process - for developers	3
Features	20	Compatible to RDBMS – PostgreSQL, MySQL, Oracle: Must be able to connect to most major relational DB	-
		Transformation library: Provide library embedded in apps to use transformation features	3
		Scheduling: Automatic process on time basis	3
		Data Cleansing: Ability to detect and cleanse data	3
		Support csv, excel, fix length delimited file: Flexibility to use multi and common input source format	3
		Trigger process as Service (Service Oriented): automatically service composition	2
		Data Harmonization: Ontology driven transformation	2
		Platform Independence O/S and hardware: Run on any OS and comply to open architecture	3
		Security (Authentication, Authorization): User and access control management	3
		Audit Trail: Track change of job (when, who,), when the job run	3

ETL/ Data Integration			
CATEGORY	**CATEGORY WEIGHT**	**CRITERIA**	**WEIGHT**
		Real time data integration using Queue (ESB integration): Real time integration (synchronous / async)	2
		Versioning of Job: Version control of job, process	3
		Big data integration - Hadoop integration: Pull big data, parallel processing of data, semi structured	2
		NoSQL: Pull from NoSQL data source	2
Total cost of ownership	20	License: Cost of purchasing tools to use in production and development	
		Technology Transfer: Total cost to move between technology	
		Professional Services: Cost of human resource for development, project management, consultation	
		Training Cost: Training cost to learn the tools	
		Technology Refresh: Cost of moving from one release to another and cost of renewing license	
Performance	20	Scalability: Increase on data performance is still stable, ability to use cores depending on CPU, ability to use different nodes for processing	3
		1 million records a day: Transferring of data daily	3
		Data Cleansing Timing: How long does it take to detect dirty data	3
Viability	10	Roadmap of Product: Product release roadmap	2
		Vendor Availability:24x7, local support, communication medium	2
		Vendor Responsiveness: Effectiveness of resolution timeliness of response	2
		Product Endurance: Lifespan of product in market, product maturity	2

RDBMS CRITERIA

The following table outlines the categories and criteria the working group develop to evaluate RDBMS products. *See **Supplemental Technology Selection** report for shortlisted products and scoring.* It should be noted that full scoring of the criteria was performed.

TABLE 9: RDBMS CRITERIA

RDBMS			
CATEGORY	**CATEGORY WEIGHT**	**CRITERIA**	**WEIGHT**
Productivity	20	Resources skills	3
		Elasticity (Version Upgrades)	3
		Maintenance and Support availability (local)	3
Features	25	Security	
		• Data Encryption	3
		• Controlled Access	3
		• Policy based management	2
		• Transaction Log (Audit Trail)	3
		• Role Based Security	3
		OLAP Support	3
		High Availability	
		• Clustering	2
		• Asynchronous replication	3
		Manageability	
		• Backup and Recovery	3
		Scalability and growth (DB limits)	3
		Internationalisation	2
		Cross platform	
		• Support all standard OS	3
		• DB linkage (multi different DB)	3
		Extensibility	
		Multi Scripting Support (PL/SQL, T-SQL, MDX, XML)	2
		Maximum concurrent users (200)	3
		User Friendly	3
		Management tools	3
Total Cost of Ownership	20	Licensing fee structure (opt-in or opt-out)	3
		Maintenance cost	3
Performance	25	In-Memory Database/appliance	3
		Indexing Support	3
		Partitioning Support	3
		Star Transformation	3
		Performance Tuning	3
		Compression Technology	3
Viability	10	Vendor viability	3
		Vendor presence in Malaysia	3
		Product maturity	3
		Expected product endurance	2
		Market share	2
		Product roadmap	3

SUMMARY SCORECARD

To determine the highest scoring product based on the criteria and weights these values after calculation were presented in a summary scorecard. As only notional scores were available for BI and ETL/DI products this was only preformed for the RDBMS evaluation. If commercial or Open Source tools are determined to be necessary based on the final recommendation of this report, then a summary scorecard will need to be done for the products shortlisted. The following is an example template of a scorecard.

TABLE 10: EXAMPLE SUMMARY SCORE CARD

PRODUCT	A	B	C	WEIGHT
Version				
Productivity				25
Features				25
Total Cost of Ownership				20
Performance				20
Viability				10
Other - TBC				
Total Score				

BI SUMMARY SCORECARD

The working group selected the following category weights and shortlisted products. As mentioned previously the summary scorecard was not completed. *Please see **Supplemental Technology Selection** report.*

ETL SUMMARY SCORECARD

The working group selected the following category weights and shortlisted products. As mentioned previously the summary scorecard was not completed. *Please see **Supplemental Technology Selection** report.*

RDBMS SUMMARY SCORECARD

The working group selected the following category weights and shortlisted products. As mentioned previously the summary scorecard was not completed. ***Please see Supplemental Technology Selection** report.*

RECOMMENDATIONS

Based on the methodology above each group was asked to make a tentative recommendation in its report back and presentation. It should be noted that only the RDBMS evaluation was fully scored for the shortlisted products. The BI and ETL tool evaluations did an abridged version of the scoring as previously mentioned indicating only the presence or absence of a feature rather than an evaluative score. It should also be noted that these recommendations do not replace a formal procurement process in cases where this might be needed. That said, it is hoped that the methodology could be reused in this instance.

In the event that MoH proposed MIMOS as the main technology partner through direct negotiation process, it was further proposed during the workshop discussions that the ultimate decision regarding the selection of the MyHDW technology be responsibility of MIMOS CTO guided by this report.

BUSINESS INTELLIGENCE – BI

*Please see **Supplemental Technology Selection** report for specific recommendations for BI technology.*

EXTRACT TRANSFORM AND LOAD/ DATA INTEGRATION – ETL/DI

*Please see **Supplemental Technology Selection** report for specific recommendations for ETL/DI technology.*

RELATIONAL DATABASE MANAGEMENT SYSTEM – RDBMS

*Please see **Supplemental Technology Selection** report for specific recommendations for RDBMS technology.*

DATA CENTRE

Discussions were held with HIC of Planning Division, Telehealth Division, Information Management Division, MAMPU, and MIMOS to determine the best options for the data centre for MyHDW. It is recommended that the production environment for this be located in *Pusat Data SektorAwam* (PDSA). This new centralized data facility is planned to be available in Q2 2014 for MOH purposes. The utilization of this preexisting infrastructure has the potential to save the initiative approximately RM5 million as none of the major networking items such as LAN switch will be required for procurement. Also discussed was the provisioning of a temporary 1Gov*Net network services to the MIMOS offices in Bukit Jalil during the incubation period. A request from MOH to MAMPU should be made to initiate the process of this deployment. Network bandwidth for this extranet connection should be determined by discussion between MIMOS and Information Management System.*Please see Appendix 7for updated cost of data centre in the proposed site.*

GENERAL OBSERVATIONS

MYHDW ARCHITECTURE AND REQUIREMENT

During the first two weeks a detailed technical session with representatives from MIMOS and MAMPU was also held. The consultant overviewed common data warehouse architecture methodology and the applicability to healthcare. Both Kimball and Spoke and Hub architectures[3] were described along with the advantages and disadvantages of both methodologies. Proposed approaches in regard to MyHDW evolution were discussed in which MyHDW could follow a Kimball architecture for its initial phases and then transition to Spoke and Hub architecture once the first implementation is complete. Further discussion is required to determine which strategy is best suited at this stage.This will be further detailed in a newartifact ***MyHDW Architecture and Requirements***.

SMRP V2.0 AND INITIAL DATA MART REVIEW

During the workshop, HIC and MIMOS presented their current design and requirement for SMRP V2.0 including their proposed data model. The latter model was developed specifically for SMRP, similarly the datamart design was based on the current SMRP reports.

Following review of the model and subsequent Concept definition discussions it was determined that where possible the data model design of SMRP should align and utilize MyHRDM once an initial version is available. This would allow for better long term data integration and efficiencies. Regarding the preliminary data mart dimension models it was noted that these would need further refinement to better support a global MyHDW requirement for ad-hoc queries, dashboard and analysis and not just current SMRP reporting.

SNOMED CT

Malaysia became the 22nd IHTSDO member in late 2012 and started the work on SNOMED CT with Knowledge Lab Division under MIMOS. The initial work is towards the establishment of the National Release Centre under HIC of Planning Division. An IHTSDO consultant was sent to help with exploring the options for initial implementation work. The option that was deliberated includes implementation at the registry level; exploring the databases from the Hospital Information System (HIS); or at the user interface level.

The Cardiology was chosen because some initial work has been explored by the Cardiology group in National Heart Institute (*Institut Jantung Negara*– IJN). The Oncology was chosen because of the commitment of its Head of Service and the newly established National Cancer Institute (NCI).

[3]ISO/TS 29585:2010: Health Informatics - Deployment of a Clinical Data Warehouse. International Organisation for Standardisation, Geneva, Switzerland.

It was agreed to create Reference Set on these two specialties; to choose IHTSDO Workbench as the tool to create the Reference Set; and to map the Cardiology Reference Set with databases in Serdang Hospital and Oncology Reference Set with databases in Hospital Sultan Ismail. The current work progress is the creation of the Reference Sets.

In terms of SNOMED relevance to MyHDW, it should be recognise base on international experience that use terminology will require mapping to other data and classification standards like ICD to be applicable for secondary usage. Furthermore, while the development and maintenance of Reference Set are importance in terms of interface usability, consideration should be given to the resource utilization of Clinicians and on-going engagements required for this.

MyHDW's FIT INTO NATIONAL eHEALTH

During the fourth week of the workshop, a representative from Telehealth Division presented to the working group. *Please see Appendix 8 for an overview of the National eHealthinitiative.* It was recognized during the discussion that MyHDW will play a key role within this and the plan associated with MyHDW and work to date is alignedappropriately with this.

It was also mentioned that there are plans to bring in consultants to support the work for Healthcare Transformation. One of the areas that will be reviewed is the ICT framework. It is recommended that HIC of Planning Division be involved in this latter work. The updated blueprint in the final section of this report reflects this in the item 11-3b.

ESTABLISHMENT OF HEALTH ANALYSIS UNIT

The MyHDW Guidelines and Blueprint recommended that capacity be established for both IT post assigned to technical work associated with MyHDW and also for analytical resources. In discussion with MoH's Director General during the consultancy direction was given to develop a proposal for a health analysis unit which would service the analytical and reporting requirements of MoH and utilise MyHDW.

BLUEPRINT UPDATED

The blueprint has been revised in this report to reflect additional deliverables brought forth during discussions during this consultation. Furthermore, some dates have been adjusted to recognize changes in the start of the initiative.

TABLE 11: KEY TASKS FOR MYHDW PROJECT FROM 2011-2015

REF	INITIATIVE/TASK	NOTES	2011	2012	2013	2014	2015
11-1	Create Business Case and present to ICT SC		●				
11-2	Establish National Health Informatics Council		●				
11-3a	Develop Start-up Plan			●			
11-3b	Participate in NationaleHealthinitiative				●		
11-3c	Develop 3 yearMyHDW Portfolio Plan	MyHDW Portfolio Plan				●	
11-3d	Develop MyHDW Requirement and Architecture Report(s)	Establish and document a global requirement for MyHDW. Develop and recommend architecture to support requirements.				●	
11-4	Develop Infrastructure Plan	Technology, Tools, Infrastructure Plan		●	●		
11-5	Gap Analysis between HIS and SMRP/Discharge summary data sets.	Gap analysis to determine if HIS can be used for SMRP/Discharge collections	●				
11-6	Recruit and train core teams - Analysts and IT resources	15 x IT 15 x Analytical/Stats/Research See Appendix 3 for IT resources		●	●		
11-7	Reference Data Model and Data Dictionary	Establish national data standards (structure) – Data Model and Data Dictionary		●	●	●	●
11-8	Develop Health Information Model/Framework	Overarching map of key questions that need to be answered to support priority KPI's, 1Care and HIMS and delineate the products and data required to answer them.		●	●		
11-9	Communication Plan	Communication material, roadshow etc. to communicate the MyHDW concept to key stakeholders		●	●		
12-1	Procure and setup technical infrastructure			●	●		
12-2	Establish enhanced analytical and technical capacity/capability in HIC and IT			●	●	●	●
12-3	Build 1 x HIMS databases 'Data Marts' within MyHDW	Establish 1 x Data Marts and Reporting Products – Proposed candidate: SMRP			●	●	

REF	INITIATIVE/TASK	NOTES	2011	2012	2013	2014	2015
12-4	Renal & Cancer Registries	If possible house 2 x registries ideally Renal and Cancer within the MyHDW infrastructure. These would be separate from MyHDW but could leverage the same technology and services				●	●
12-5	Establish Master Data Program – Develop Facility and Professionals Master data	Establish program/function in HIC to develop and maintain master or reference data. Initial master data candidates are Facility and Professionals			●	●	●
12-6	Strategy, planning and policy development, System performance reporting	Report and Information products development for these areas. TBC			●	●	
12-7	Systems Running - Establish Operations and Support Services	Establish group to maintain and support what has been built			●	●	●
13-1	Add 1 Data Mart to MyHDW from a mature data source- Explore 2 additional Data Marts if resources permit	Establish a Data Mart and Reporting Products from mature and strategic data source– Likely candidates would be:SMRP, Communicable Diseases, Primary Care, Pharmacy -To be determined based on further analysis. Explore 2 additional Data Marts if resources permit			●		
13-3	Add Public health surveillance data/functionality	Addition of Public Health Surveillance data/function TBC				●	
13-4	Patient safety initiatives, Monitoring access to care	Develop new reports for Patient safety initiatives, Monitoring access to care				●	
14-1	Add 2-3 Data Marts to MyHDW	New Data Marts To be determine after further analysis				●	●
14-2	Other Registries	To be determined after further analysis				●	●
14-3	LHR	Begin to utilize LHR data feeds as possible. Further analysis needed				●	●
14-4	Clinical research studies, Disease and wellness program	Develop new reporting products for these areas				●	●

Color Legend:

Completed Task
On-going / In Progress
Future Plan

CONCLUSION

MALAYSIAN HEALTH REFERENCE DATA MODEL

During this consultancy a focus effort was made to complete, initiate or provide guidance for a number of the more complex and critical component for MyHDW. The core aspects,methodology and process necessary to launch a National Health Data Model along with a startup set of concepts and models for this weresuccessfully undertaken. Furthermore key MOH, MAMPU and MIMOS staff had the opportunity to be instructed in best practices in data modeling in the healthcare domain as appropriate forutilisation in MyHDW and related systems. In addition, consensus and general agreement was obtained regarding the necessity for MyHRDM. It was recommended that in a timely manner the MyHDRM program is established and the first version of the model approved and made available. While this may be outside of the time scale of the SMRP V2.0 initiative, technology partner MIMOS are encouraged to stay aligned with the initial material developed in these workshops until an approved version of MyHDRM is available. The interdependency between MyHDD and MyHRDM was elucidated upon and recommendations provided for amendment to the current product to include concept name and definition. Process, governance and program aspects of MyHDD were also highlighted for alignment with MyHRDM. To successfully launch the new program resources will need to be allocated to this initiative along with the necessary approvals and plan. Candidates suitable within government organisations were identified who might be positioned to run and lead MyHRDM on a go-forward basis. International examples such as those from Canada are available to the MoH and can be used as templates and to fast track the development of MyHRDM. It is recommended that these are used to speed up this development and program initiation.

TECHNOLOGY SELECTION

The technology selection workshop allowed for the successful development of a methodology to support the appropriate selection of products for MyHDW. Please refer to Supplemental Technology Report for further details. The focus of this activity was on BI, ETL/DI and RDBMS tools given their pivotal role and complexity. In addition to the methodology outlined, product selection has been recommended from amongst Open Source, commercial and MIMOS' product offerings while recognising the importance of supporting locally developed innovation. It has been recommended that the ultimate decision concerning product selection will be the responsibility of the technology partner guided by this report and recognising the mission critical nature of the successful delivery of MyHDW. Alignment of the product road maps for MIMOS' BI and ETL/DI tools and the requirements of MyHDW should also be considered. It is encouraged that a detailed **Infrastructure Plan** be developed based on the technology selection as part of the roll out plan of MyHDW so as to fully document and validate this infrastructure.

Consideration should also be given to the long term location of the data centre and hosting of the technology mentioned as relocation can be very expensive and time consuming. In addition to product development MyHDW will after short period become an operational system and will need to be maintained as such along with appropriate service levels.

GENERAL OBSERVATIONS

Other critical or complex items above and beyond those items already discussed were reviewed and deliberated upon. The needs for MyHDW to be included in strategies associated with National eHealth were highlighted during discussion and presentation with Telehealth. It also became clear during the initial workshop that an additional MyHDW blueprint deliverable is required to account for the generalised requirement and architecture for MyHDW. This document along with the proposed infrastructure report will be necessary for our technology partner to efficiently design and initiate the fundamental components associated with acquiring and integrating MyHDW data. These later considerations and associated deliverables should be considered as an important activity to complete prior to MyHDW design and development. SMRP V2.0 design was presented by MIMOS and this proved a useful exercise to juxtapose both the need for MyHRDM and clarity concerning direction for the architecture for MyHDW. MIMOS' technical resources assigned to this task have done a good job in grasping updated requirements of SMRP as well as developing a quality design. It was also apparent during the discussion that guidance in terms of the data warehouse architecture in addition to availability of reference data model would further assist in their work. We also discussed the good progress Malaysia has made recently associated with clinical terminologies such as SNOMED CT and how best these could be incorporated into MyHDW.Furthermore, in relation to analytical resource capacity direction was given by senior management to develop a proposal to advance a unit to support this.

In conclusion, it is felt that advancement in these challenging areas has been achieved and that the business and technical units have sufficient guidance and directions to proceed with the next stages of the Guideline and Blueprint for MyHDW through to implementation. It is important at this stage that clarity regarding resources and budget considerations is obtained as the initiative is now well position to begin in earnest.

APPENDICES

APPENDIX 1 – HIGH LEVEL MANAGEMENT MEETING

DATE	TIME	
26 June 2013	2.30 pm – 5.30 pm	SOCSO visit
2 July 2013	2.30 pm – 4.30 pm	Secretary General Ministry of Health Malaysia
10 July 2013	9.00 am – 5.30 pm	ICT Consultants - Public Sector ICT Division Malaysian Administrative, Modernisation and Management Planning Unit (MAMPU); Deputy Director, Telehealth Division, Ministry of Health Malaysia; Sr. Asst. Secretary, Information Management Division (BPM), Ministry of Health Malaysia.
11 July 2013	4.00 pm – 5.00 pm	Chief Executive Officer MIMOS Bhd
12 July 2013	8.00 am – 9.00 am	Director Planning Division
	9.00 am – 10.00 am	Director General Ministry of Health Malaysia
	11.30 am – 12.00 pm	Chief Information Officer Information Management Unit

APPENDIX 2 – MyHRDM PARTICIPANTS

PARTICIPANTSWEEK 1: 17 – 21 JUNE 2013

	FACILITATOR	AGENCY / DEPARTMENT
	Mark Fuller	MyHDW Consultant
	Dr. Md. Khadzir Sheikh Ahmad	Health Informatics Centre
	GROUP 1	**AGENCY / DEPARTMENT**
1.	Dr. Maizura Musa	Health Informatics Centre
2.	Dr. Seah Boon Keong	MIMOS
3.	Hasmarizwan Umar	ICT Division, Hospital Wanita&Kanak-kanak Sabah
4.	Jaafar Jamaan	Information Management Division (BPM)
5.	Jason Yap Book Hock	MIMOS
6.	Samsuil Fuad	Telehealth Division
7.	Zainuddin Ahmad	Health Informatics Centre
	GROUP 2	**AGENCY / DEPARTMENT**
1.	Azri Abdul Hamid	MIMOS
2.	Charles Hii	MIMOS
3.	Dr. 'Ismat Mohd Sulaiman	Health Informatics Centre
4.	Dr. Nur Shaema Darus	Health Informatics Centre
5.	Hamidah Mat	Information Management Division (BPM)
6.	Ku Aznal Shahri Ku Abd Hamid	ICT Division, Serdang Hospital
7.	Noriati Baharum	MAMPU
	GROUP 3	**AGENCY / DEPARTMENT**
1.	Arvind Ramachandran	MIMOS
2.	Dr. Azrulreezal Azannee Abdul Wahab	Health Informatics Centre
3.	Dr. Fazilah Shaik Alauddin	Telehealth Division
4.	Haniza Mohamad Hassan	Telehealth Division
5.	Henni Jumita	Information Management Division (BPM)
6.	Nor Azlinayati Abd. Manaf	MIMOS
	GROUP 4	**AGENCY / DEPARTMENT**
1.	Azih Yusof	MAMPU
2.	Dr. Amiruddin Hisan	Telehealth Division
3.	Dr. Dickson Lukose	MIMOS
4.	Jamalulrijal Abd Aziz	Health Informatics Centre
5.	N. Rajkumar a/l V. Nagarethinam	Health Informatics Centre
6.	Noor Shabirah Mohd. Shamsuri	Information Management Division (BPM)

PARTICIPANTS WEEK 2: 24 – 28 JUNE 2013

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	Dr. Md. Khadzir Sheikh Ahmad	Health Informatics Centre
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1.	Arvind Ramachandran	MIMOS
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3.	Charles Hii	MIMOS
4.	David Chew	MIMOS
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6.	Dr. Azrulreezal Azannee Abdul Wahab	Health Informatics Centre
7.	Dr. Chu GeokTheng	Oral Health Division
8.	Dr. Maizura Musa	Health Informatics Centre
9.	Dr. Muhammad Ismail	Disease Control Division
10.	Dr. Norris Naim	National Blood Bank
11.	Dr. Nur Shaema Darus	Health Informatics Centre
12.	Dr. Sarmilia Saon	Oral Health Division
13.	Dr. Seah Boon Keong	MIMOS
14.	Faqrurrazzi Abdul Shukur	Health Informatics Centre
15.	Fauziah Zainal Ehsan	Family Health Division
16.	Hamidah Minhat	Health Informatics Centre
17.	Haniza Mohamad Hassan	Telehealth Division
18.	Jaafar Jamaan	Information Management Division (BPM)
19.	Jamalulrijal Abd Aziz	Health Informatics Centre
20.	Jason Yap Book Hock	MIMOS
21.	Ku Aznal Shahri Ku Abd Hamid	ICT Division, Serdang Hospital
22.	Mohd Amin Yaakob	Medical Device Control Division
23.	N. Rajkumar a/l V. Nagarethinam	Health Informatics Centre
24.	Noriati Baharum	MAMPU
25.	Norlaili Shahadan	Health Informatics Centre
26.	Norsuhada Sulaiman	Health Informatics Centre
27.	Nurulhuda Ramlan	Health Informatics Centre
28.	Raja Mariam Ruzila	MIMOS
29.	Razlina Mohamed	MIMOS
30.	Siti Aisah Bahari	Pharmaceutical Division
31.	Suriani Muhamad	Information Management Division (BPM)
32.	Wan Ahmad Jafri Wan Abdul Aziz	MIMOS
33.	Wan Mohd Nasrun Wan Sulaiman	Health Informatics Centre
34.	Zainuddin Ahmad	Health Informatics Centre

APPENDIX 3 – LISTS OF NATIONAL HEALTH REFERENCE CONCEPTS

CONCEPTS INTRODUCED BY WEEK 1 PARTICIPANTS	CONCEPTS ADDED BY WEEK 2 PARTICIPANTS	CONCEPTS REMOVED / TBC
Admission	Assessment	Acute
Class	Case	Care
Client	Care	Case
Cost / Finance	Dead Person	Chronic
Death	Donor	Class
Delivery	Drug	Emergency
Diagnosis / Clinical Observation	Episode	Death
Discharge	Incident	Delivery
Discipline	Medical Device	Identification Document
Encounter	Organ	Location
Fee Category ***	Organisation	Patient
Specialty	Payee ***	Profile
Facility	Place	Registration
Identification Document	Programme	Sector
Location	Registration	Team
Newborn	Health Service Event	Transfer
Next of kin	Sector	Ward
Patient	Specimen	
Payer ***	Visit	
Person		
Intervention / Procedure		
Profile		
Provider		
Service		
Team		
Transfer		
Ward		

Legends:
***: Attributes of Concept Cost / Finance, i.e.Fee Category, Payer, Payor, Payee
TBC: To be confirmed

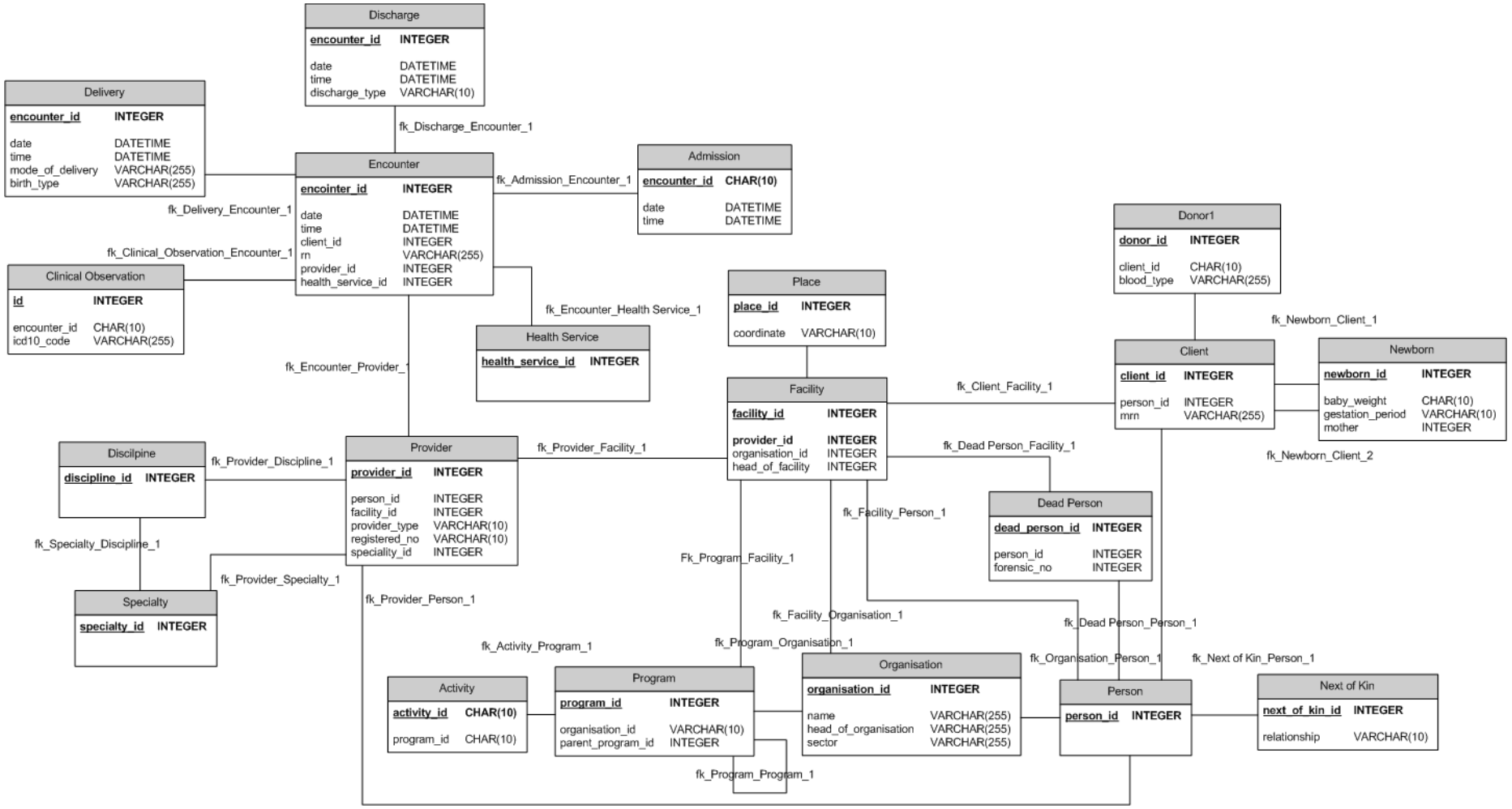
APPENDIX 4 – INITIAL MYHRDM CONCEPT DEFINITION AND ATTRIBUTES

CONCEPTS	DEFINITION	ATTRIBUTES
Admission	A process of admitting a client into a ward in a HEALTHCARE FACILITY to receive health care	• Facility • Client • Registration Date & Time • Ward • Primary responsible provider
Assessment	An act of evaluation of a CLIENT/medical product to reach a decision for the next cause of action	
Client	A PERSON who receives health service(s)	• MRN Number
Clinical Observation	Summary of the patient's illness and intervention documented by a PROVIDER while providing health service to a CLIENT	• Diagnosis • Assessment • Intervention
Cost (Health expenditures and Macro cost)	** Concept need to be further discussed	• Type of cost • Amount • Effort • Material • Resources
Dead Person	A PERSON who is pronounced dead by an individual regulated by law ** Concept need to be further discussed	• Death certificate ID • Burial certificate
Discharge	A formal ending process of a particular admission in a HCF	• Healthcare facility • Client • Discharge Date & Time • Discharge type • Healthcare provider responsible for discharge
Discipline	An ORGANISATION of specialists with similar SPECIALTY	• Name • Qualification • Programme
Donor	A PERSON or NEXT OF KIN of that PERSON who has consented to give away the CLIENT's of organ, tissue or blood	• Donor type • Specimen type
Drug	Any substance used in diagnosis, treatment or prevention of disease or other abnormal condition as a component of medication.	• Drug name • Dosage • Dosage form • Drug schedule • Drug category • Drug registration number • Drug type • Frequency

Encounter	Specific moment of contact between CLIENT and PROVIDER	• When: Visit/Admission/Discharge Date & Time • Where: Location • What: Type of activities (e.g. Consultation, Examination, Investigation, Procedures, Counseling, Wellness) • Who: Client/Provider
Episode	From a time of need for a specific kind of care until a specific outcome is achieved	• Client • Type of Health Service • Outcome of care • Duration
Facility	Any health industry related premises or vehicle	• Type of service • Location • Organisation
Health Service Event	Registration of a client to a particular type of health service in a Healthcare Facility	• Type of health service • Client • Registration Time & Date
Incident	An event/happening that causes an unanticipated harm to a client while receiving health service provided by a healthcare facility	• Type of incident • Date & time • Place • Procedure • Product • Healthcare Provider • Client
Intervention	An act of interfering with the outcome or course of a condition as to prevent harm or improve function	
Medical Device	** Concept need to be further discussed	
Newborn	A PERSON aged less than or equal to 28th days of life who receives health service(s)	• Age (in days) • Gestational age • Birth weight • Head circumference • Length • Mother • Status of newborn (alive and well/fresh stillbirth/macerated stillbirth/Early neonatal death/ill)
Next of kin	A PERSON who is a relative or a friend of a CLIENT	• Type of relationship

Organ	A structured arrangement of tissues that perform specific function	• Organ type
Organisation	A group of individuals working towards common goal	• Organisation name • Type of organization • Sector
Person	An individual	• Identification Documents (ID) • Birth date
Place	A particular position or point in space/location.	• Address • Geo location / Coordinates
Programme	A system of SERVICES designed to meet a health care need	• Type of programme (e.g. Communicable Diseases: Vector Disease Control, Preventive Programme: Zoonosis Control, TB/ Leprosy Control)
Provider	A PERSON who is positioned to a health facility(s), and may be registered by professional board, and provides health service(s) to CLIENT(s)	• MMC Number (doctors) • Type of provider
Service	Grouping of care / discipline provided to a client	• Type of Health Service
Specialty	A branch of DISCIPLINE where the healthcare PROVIDER has specialized qualifications and training.	
Specimen	Blood, Tissue, Organ, living byproduct	
Visit	An act of CLIENT going to a HEALTHCARE FACILITY to seek health care.	• Date & Time • Location/Place • Type of visit • Client • Provider • Number of visit • Episode

APPENDIX 5 – EXPLORATORY MYHRDM DIAGRAM



APPENDIX 6 – MyHDW TECHNOLOGY EVALUATION PARTICIPANTS

PARTICIPANTS WEEK 3: 1 – 5 JULY 2013

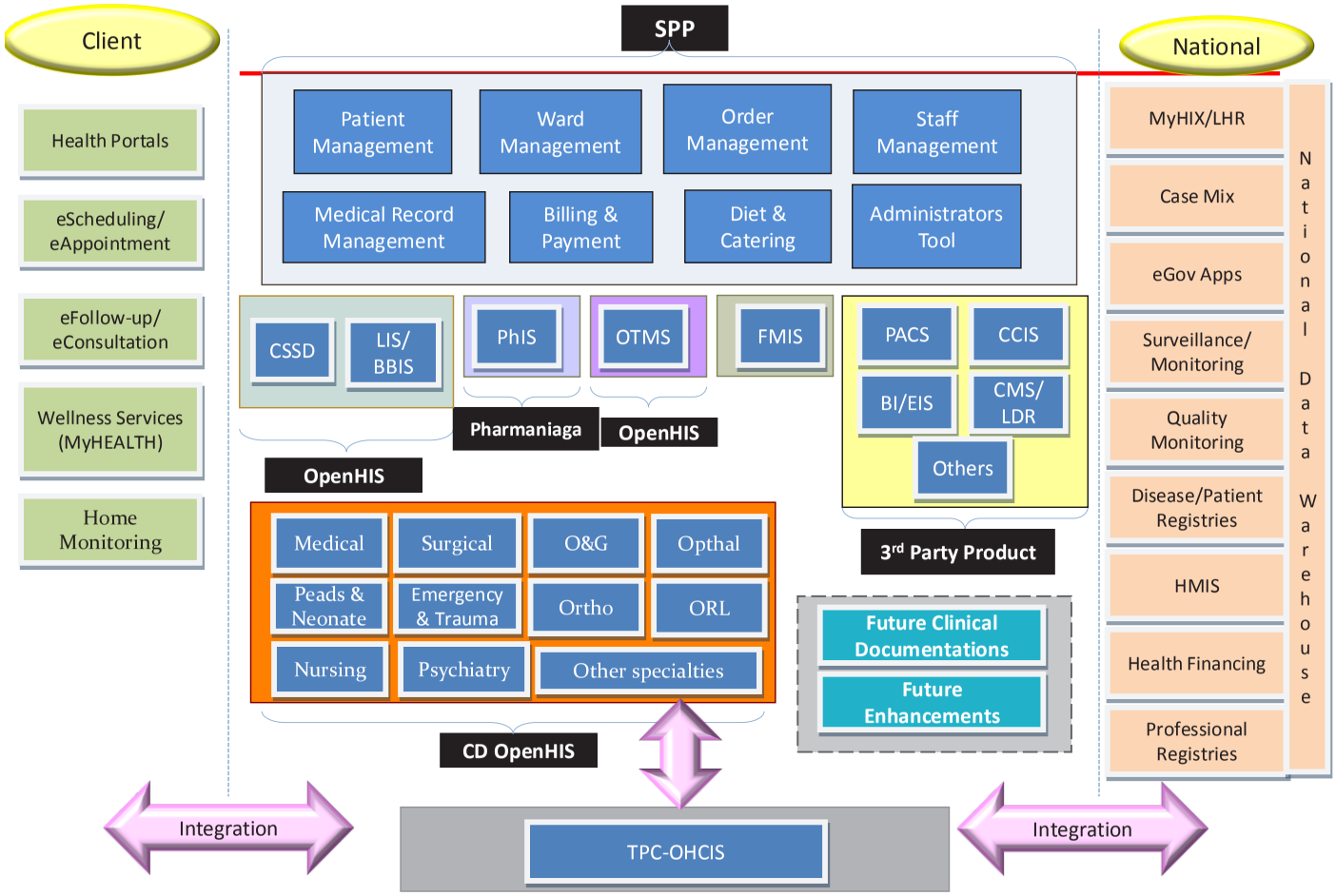
	FACILITATOR	AGENCY / DEPARTMENT
	Mark Fuller	MyHDW Consultant
	Dr. Md. Khadzir Sheikh Ahmad	Health Informatics Centre
	NAME	AGENCY / DEPARTMENT
1.	Arvind Ramachandran	MIMOS
2.	Azih bin Yusof	MAMPU
3.	Azri Abdul Hamid	MIMOS
4.	Dr. 'Ismat binti Mohd Sulaiman	Health Informatics Centre
5.	Dr. Azrulreezal Azannee bin Abdul Wahab	Health Informatics Centre
6.	Dr. Fathullah Iqbal Ab. Rahim	Health Informatics Centre
7.	Dr. Mahshitah Abdul Manan	Information Management Division
8.	Dr. Maizura binti Musa	Health Informatics Centre
9.	Dr. Nur Shaema Bt Darus	Health Informatics Centre
10.	Fazli Mat Nor	MIMOS
11.	Jamalulrijal Abd. Aziz	Health Informatics Centre
12.	Jason Yap Boon Hock	MIMOS
13.	Ku Aznal Shahri Ku Abd Hamid	ICT Division, Serdang Hospital
14.	Mohamad Fairus Khalid	MIMOS
15.	Ng Kwang Ming	MIMOS
16.	Noor Shabirah bt Mohd Shamsuri	Information Management Division
17.	Noriati Baharum	MAMPU
18.	Razlina Mohamed	MIMOS
19.	Thong Tong Khin	MIMOS
20.	Wan Ahmad Jafri Wan Abdul Aziz	MIMOS
21.	Wan Mohd. Nasrun bin Wan Sulaiman	Health Informatics Centre
22.	Yaszrina Mohamad Yassin	MIMOS

APPENDIX 7 – REVISED DATA CENTRE COST

No.	Item	Proposed Technology	Estimated Cost	
			New Data Centre	PDSA
1.	Servers (estimated 17 units)	TBC	1,200,000	1,200,000
2.	LAN switch	Cisco	5,000,000	-
3.	SAN switch	Brocade	186,000	186,000
4.	DNS	Infoblox	124,000	-
5.	Firewall	Palo Alto	1,200,000	-
6.	Storage	TBC	1,200,000	1,200,000
7.	Network Management System	Cisco	33,000	1,200,000
	TOTAL		**RM 7,968,000**	**RM1,644,000**

Legend:
TBC: To be confirmed
PDSA: *Pusat Data SektorAwam* (Proposed site)

APPENDIX 8 – MyHDW'S FIT INTO NATIONAL eHEALTH



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MyHDW CONSULTANT AND SECRETARIATE

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Dr. Rahimah binti Mohd Ariffin
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2. Dr. 'Ismat Mohd Sulaiman
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4. Dr. Azrulreezal Azannee bin Abdul Wahab
5. Dr. Fathullah Iqbal bin Ab Rahim
6. Dr. Nur Shaema binti Darus
7. En. Jamalulrijal bin Abdul Aziz
8. En. Wan Mohd Nasrun bin Wan Sulaiman
9. Pn. Nurulhuda Ramlan
10. Pn. Sarirah binti Abd Rashid
11. Pn. Nor Syakira binti Ahmad Shah

Special Thanks to:

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Dato' Dr. Hj. Abd Rahim bin Hj. Mohamad
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3. Dr. Norfazlin binti Zamani
4. Pn. Nora binti Ahman

MyHDW 2011-2013

ISBN 978-967-0399-67-6