

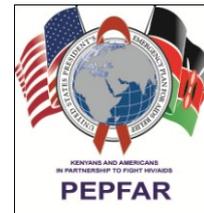
Republic of Kenya



MINISTRY OF HEALTH

# The Kenya Health Enterprise Architecture Version 1.0

November 2015



November 2015

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## Foreword

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I am glad that the Ministry of Health has developed the Health Enterprise Architecture. As physicians to the human anatomy, and engineers to schemas and blue prints so is health information systems to health enterprise architecture. We are making great strides in Health Information Technology as a way of reaching greater levels of efficiency and equity in health service provision. Investments in ICT infrastructure, eHealth, mHealth and health information systems should be made in line with the business vision and strategy of the health sector as outlined in the Kenya Health Policy and the Kenya Health Strategic Plan. The Kenya Health Enterprise Architecture (KHEA) is our conceptual blueprint that guides the development, upgrade, integration, and data exchange between information systems across the sector.

We are keen to work together with other Government Ministries, County Governments, Development Partners and the Private sector and other stakeholders and actors as identified in this document as we embark on implementing the KHEA.

As we move forward, let us make reference to this document to ensure we avoid unnecessary duplications of efforts and systems and focus on alignment and leveraging of the limited resources for efficient and effective delivery and management of health services with the goal of meeting the mission of the Kenya Health Sector Strategic Plan *“To deliberately build progressive, responsive and sustainable technologically-driven, evidence-based and client-centred health system for accelerated attainment of highest standard of health to all Kenyans”*.

**Dr Nicholas Muraguri,**  
**Principal Secretary**

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Special thanks also go to Onesmus Kamau, Head of the E-health Unit and his team including Ann Barsigo, Gladys Echesa and Sophia Karanja. We also recognise the staff of the Division of Information Communication Technology (ICT), especially Rachael Wanjiru and Nyokabi Njogu for their input in guiding us to understand the technology landscape. We also recognise the valuable contribution of the County Governments via their respective county executives in charge of health and ICT who took part in workshops to validate the draft blueprint. Mr. Paul Kipronoh Ronoh, Director Programmes and Standards at the ICT Authority, provided valuable input on the alignment of KHEA to the overall Government Enterprise Architecture (GEA).

We equally acknowledge the contribution of USG implementing partners such as ITECH Kenya through Mr. Steven Wanyee who helped this project understand the ongoing work on the National Unique Patient Identifier (NUPI) and Palladium Group for their participation in the development process. Finally, we sincerely thank everyone not mentioned by name who in one way or another participated in the development of this blueprint.

**Dr Jackson Kioko,**  
**Director of Medical Services**

## List of Acronyms

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ADM	Architecture Development Method
API	Application Programme Interface
ARM	Applications Reference Model
ARV	Antiretroviral
BPM	Business Process Management
BRM	Business Reference Model
CPD	Continuous Professional Development
DRM	Data Reference Model
DHIS	District Health Information System
DHS	Demographic and Health Survey
DQA	Data Quality Assurance
EA	Enterprise Architecture
EAI	Enterprise Applications Integration
EHR/EMR	Electronic Health/Medical Records
ESB	Enterprise Service Bus
ETL	Extraction Transformation and Loading
GEA	Government Enterprise Architecture
FEAF	Federal Enterprise Architecture Framework
HIS	Health Information System/s
HL7	Health Level Seven
HPT	Health Products and Technologies
HRH	Human Resources for Health
ICT	Information Communication Technology
IDSR	Integrated Disease Surveillance and Reporting
IRM	Information Reference Model
KEBS	Kenya Bureau of Standards

KEMSA	Kenya Medical Supplies Agency
KEPH	Kenya Essential Package for Health
KHEA	Kenya Health Enterprise Architecture
KHSSP	Kenya Health Sector Strategic and Investment Plan
KNBS	Kenya National Bureau of Statistics
KPI	Key Performance Indicators
MFL	Master Facilities List
NCPD	National Council for Population and Development
NHA	National Health Accounts
PEAF	Pragmatic Enterprise Architecture Framework
PETS	Public Expenditure Tracking Survey
PPB	Pharmacy and Poisons Board
PPPH	Public Private Partnership for Health
SAGAs	Semi-autonomous Government Agencies
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
TOGAF	The Open Group Architecture Framework
TRM	Technology Reference Model
WAN	Wide Area Network
XML	eXtensible Markup Language

## Executive Summary

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The Kenya Health System Policy identifies weak health information systems (HIS) as a key challenge to quality decision making for the health sector. Existing data management systems are only partially integrated: they use multiple uncoordinated data collection systems, some of which provide similar information.

The recommendations in this blueprint aim at delivering the following value to the health sector:

1. **Present the health sector as a single enterprise:** The comprehensive KHEA blueprint treats the sector as a single enterprise in which providers use one common service delivery model to deliver a wide but seamless range of services to the community. The national and county MOHs, the private sector, Semi-autonomous Government Agencies (SAGAs) and other health entities will be effectively integrated so that the sector functions as a single entity in providing the services.
2. **Enable rapid execution of strategic priorities:** The blueprint will deliver measurable parameters to assure effective use of strategic information as well as information assets to enable the improved accessibility of health information and services through a range of channels and on a continual basis. The demands from citizenry and other stakeholders for increased service levels, security and quality will be met more readily when stakeholders' strategic information and other Information Communication Technology (ICT) investments align with the Kenya Health Sector Strategy and Investment Plan (KHSSP) 2014-2018.
3. **Improving value for money:** Health service providers are obliged to deliver efficient and effective health service to the people of Kenya. This blueprint will enable health initiatives to adopt a whole-of-sector approach that better supports service delivery in a more cost-effective way by encouraging collaboration and information sharing that improves decision making.
4. **Deepen collaboration with stakeholders:** The blueprint will add value through seamless partnering with the private sector and discovering new ways of delivering service. This will be achieved through initiatives that design and implement products and services that encourage innovation and improve overall quality of healthcare.



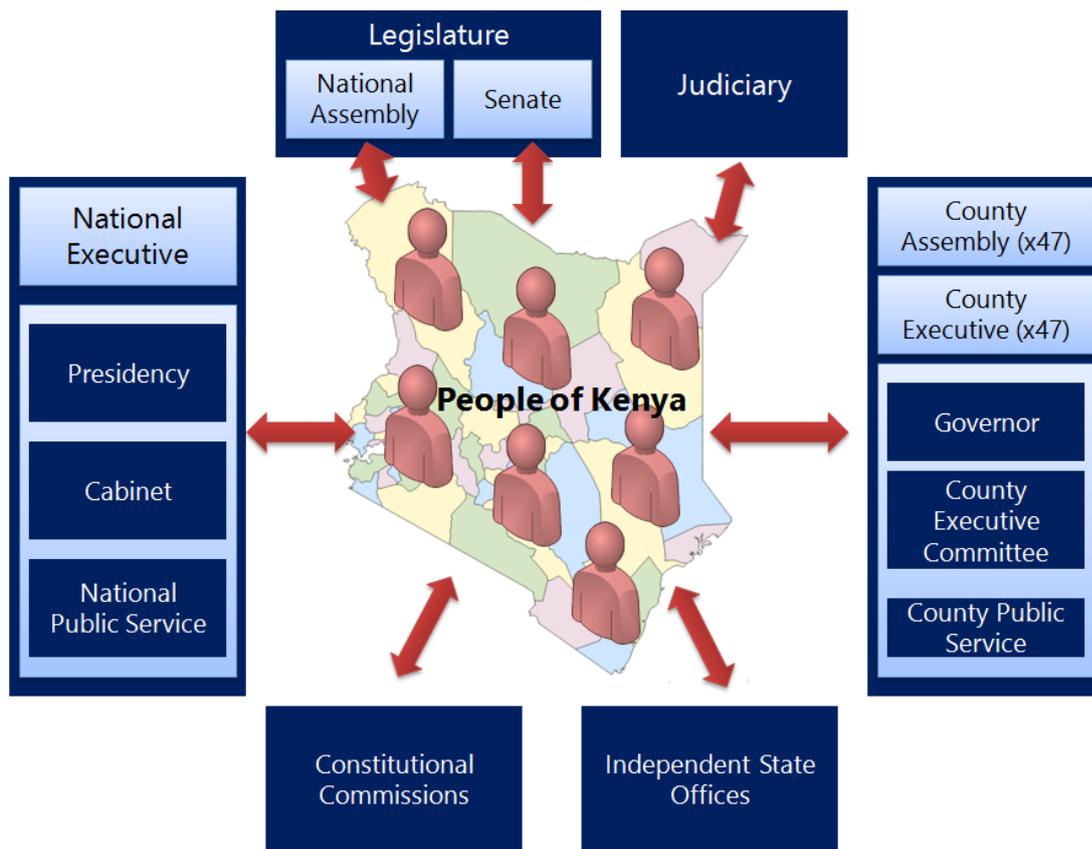
# 1.0 Introduction

The Architecture Definition Document describes the architectural artefact for the Kenya Health Enterprise Architecture (KHEA). The document covers all architecture domains in scope (business, data, application and technology) and examines all relevant states of the health sector architecture (baseline, transition and target).

## 1.1 Devolved System of Government

The Constitution of Kenya 2010 created 47 counties which are devolved units of government. Figure 1 illustrates the new overall structure of government and its direct links to the population. The Government has identified development areas that need to be strengthened for efficient management of service delivery. One of those areas is health information.

Figure 1: Devolved System of Government:



Source: Adapted from <http://www.icj-kenya.org/dmdocuments/books/devolution%20handbook.pdf>

## 1.2 Need for Enterprise Architecture in the Health Sector

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According to the Kenya Health Policy, 2014 - 2030, “one of the key challenges in the Kenyan health sector identified in the First Medium Term Plan of Vision 2030 document is weak health information systems”. The policy identified several weaknesses but relevant to the scope of enterprise architecture was the “lack of integration, many parallel data collection systems, and poor coordination”.

The Ministry of Health (MOH) in collaboration with development and implementing partners are in the process of establishing a strong, unified and integrated web-based host country owned and managed national health information system that generates quality data to be used at all levels to improve health service delivery. Central to this goal is the development of a comprehensive Kenya Health Enterprise Architecture (KHEA) and the resultant Data Services Layer in a Service Oriented Architecture (SOA).

## 1.3 Scope of the Project

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### 1.3.1 Broad Scope of Work

The MOH with support from United States Agency for International Development (USAID)-funded AfyaInfo project set out to develop, design, document and disseminate a comprehensive KHEA whose scope covered business, data, applications and technical architectures. The scope included blending guidance from the leading architecture frameworks in the industry.

### 1.3.2 Deliverables

1. Stakeholder mapping document and stakeholder engagement plan.
2. Comprehensive KHEA, Data architecture blueprint for applications development containing;
  - a. Core data set or minimum data set
  - b. Documented data domains, data systems and the relationship between different data sources
  - c. Meta data dictionary
  - d. Data models

### 1.3.3 Health Enterprise Architecture Case Studies

Below is a list of similar – and at least partly successful – enterprise architecture initiatives which have been or are being executed. Appendix 2 contains a summary of each case study.

1. **Mozambique Ministry of Health:** Mozambican Open Architecture Standards and Information Systems (MOASIS)
2. **Rwanda Ministry of Health (eHealth Coordination Unit):** Rwanda Health Enterprise Architecture

3. **Ontario Ministry of Health and Long-term Care: eHealth Architecture Blueprint**
4. **Office of the National Coordinator for Health IT: Federal Health Architecture**
5. **Office of the National Coordinator for Health IT: Federal Health Architecture, Federal Health Information Model**
6. **Singapore Ministry of Health: National Electronic Healthcare Record**
7. **Australian Department of Health and Aging: Connected Health**
8. **Government of Tamil Nadu, Department of Health and Welfare: Tamil Nadu Health Management Information System**

## 1.4 Vision, Goals and Objectives

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### 1.4.1 Business Goals

The KHSSP recognises the need for a robust monitoring and evaluation framework to track the progress of the enterprise architecture initiative implementation. The KHSSP expects a comprehensive framework to:-

- Guide health sector decision making, showing the implications of progress (or lack of it) being made by the sector;
- Guide implementation of services by providing information on the outputs of actions being carried out;
- Guide the information dissemination and use by health sector stakeholders and with public;
- Provide a collaborative approach to monitoring progress by different planning elements that make up the sector: counties, programmes, semi-autonomous government agencies (SAGAs) and others.

To achieve the goals of the M&E framework, , KHSSP points out the need to strengthen the country's capacity for information generation, validation, analysis and dissemination to deepen collaboration, increase accountability and enhance traceability of the initiatives being executed in the investment areas. This will be achieved through *“establishing a strong, unified and integrated web-based host country owned and managed national health information system that generates quality data used at all levels to improve health service delivery”*.

### 1.4.2 Architecture Goals

The KHEA blueprint describes a health sector reference model that:

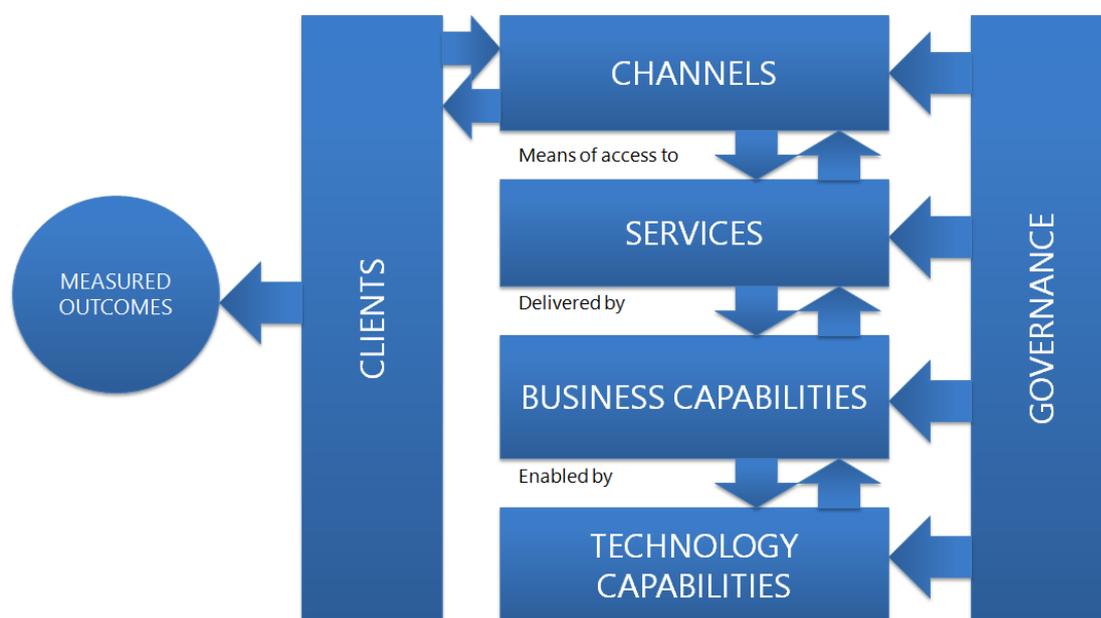
- *Provides a common language* for agencies involved in the delivery of cross-agency services
- *Enhances collaboration* by identifying duplicate, re-usable and sharable services

- Assists in *describing and analyzing* IT investments as a basis for objective rationalisation of investment in Information Communication Technology (ICT) projects
- Assists in *making government* citizen-centric, results-oriented and market-based by enabling more cost-effective and timely delivery of ICT services through a repository of standards, principles and templates for the design and delivery of business-driven ICT capabilities that better serve the citizen.

### 1.4.3 Architecture Vision Statement

KHEA envisions a *framework that supports repeatable and predictable generation and usage of quality* information at all levels. This vision is illustrated by Figure 2.

Figure 2: Architecture Vision



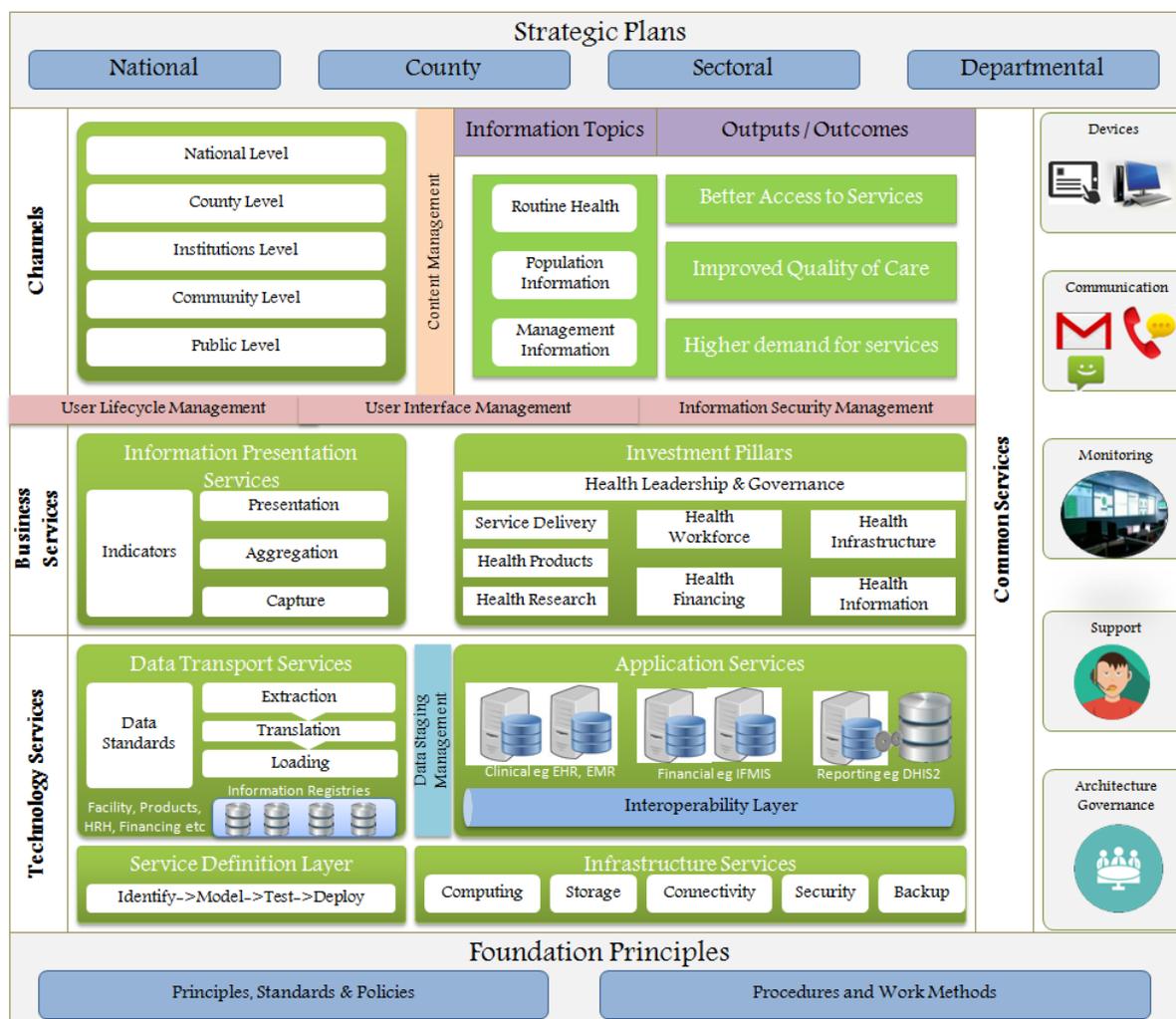
The vision is client focused<sup>1</sup>. In other words, it is expected that a **client** will access **services** through defined and managed **channels** which in turn will interact with defined and managed **business capabilities**<sup>2</sup>. The business capabilities will be enabled by defined and managed **technology capabilities** (applications, data, integration and infrastructure) to deliver services effectively and efficiently. Definition and management of each service layer is part of the **governance** framework.

<sup>1</sup> A client is any recipient of services in the health enterprise.

<sup>2</sup> Business processes and the enterprise structures in place to execute them

Figure 3 is a reference model of the resultant architecture.

**Figure 3: KHEA Reference Model**



The target architecture definitions for each domain will be based on this overall KHEA high level aspiration diagram.

## 1.5 Stakeholder Identification and Analysis

### 1.5.1 Who is a health sector stakeholder?

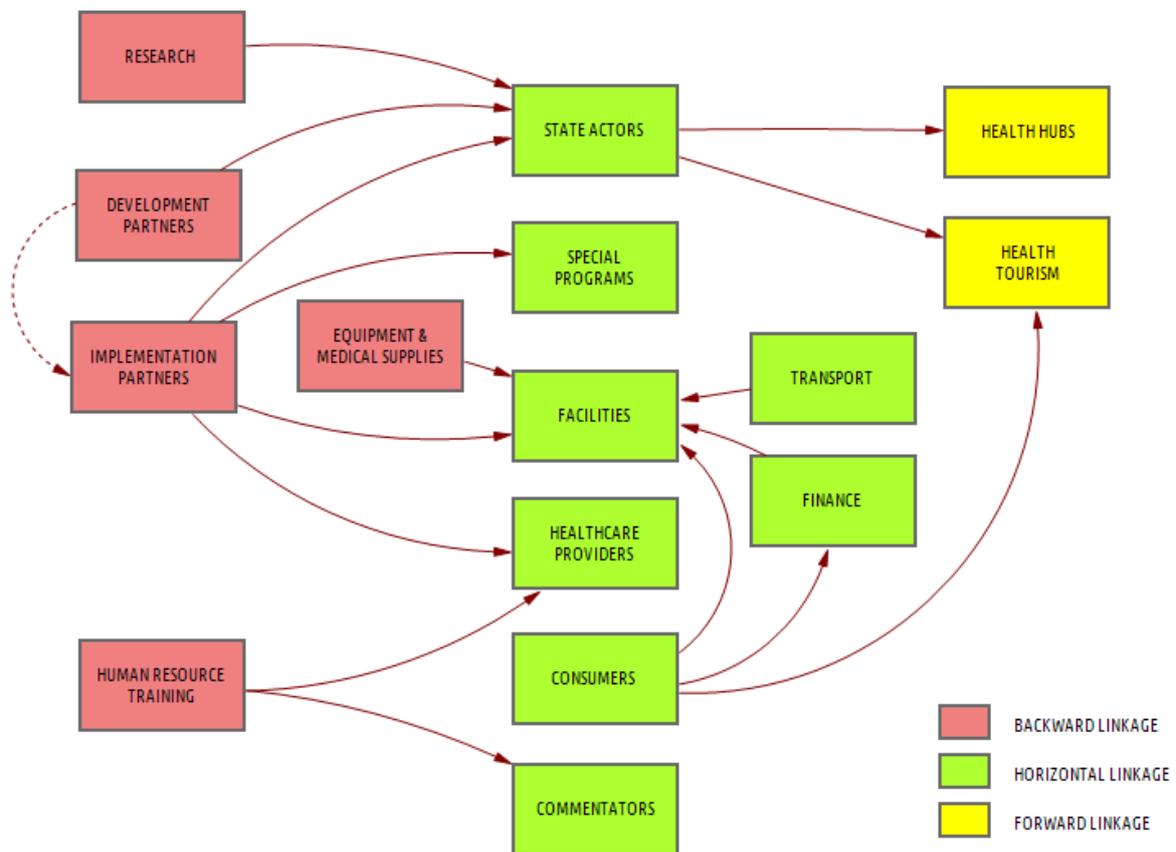
A health sector stakeholder can be defined as any organisation, group or individual defined as an actor who can affect or is affected by the outcome of the delivery of a health service.<sup>3</sup>

The health sector has various stakeholders. Some of the stakeholders provide input into the sector; others provide, consume or manage services, while others are

<sup>3</sup> <http://stakeholdermap.com/stakeholder-definition.html>. Accessed on 30 Oct 2015

beneficiaries of a robust health sector. The Kenya health sector stakeholders, their roles and relationships are illustrated in Figure 4.

Figure 4. Stakeholder Map



### 1.5.2 Classification of Stakeholders

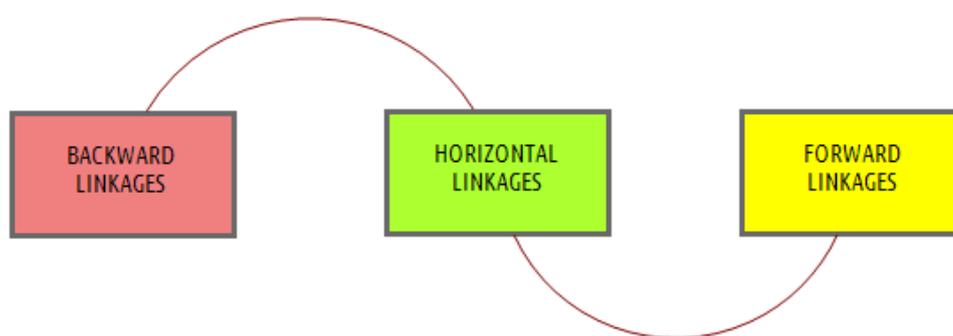
Borrowing from the Systems Thinking<sup>4</sup>, here we seek to recognise the basic *inputs*, *processes* and *outputs* of the health sector, which translate into a classification of backward, horizontal and forward linkages within the sector:

- i. **Backward linkages:** Organisations, groups or individuals providing inputs to the health sector
- ii. **Horizontal linkages:** Organisations, groups or individuals involved in the process of providing the health product within the health sector
- iii. **Forward linkages:** Industries, organisations, groups or individuals that are a resultant output of the health sector

An organisation (industry, etc.) might fall into more than one of these groups. Also note that an organisation is a generic grouping of entities ranging from entire sectors or industries to single individuals. This taxonomy therefore establishes a meta-model of stakeholders, represented in Figure 5.

<sup>4</sup> "Systems thinking" refers to a process that converts inputs into outputs

Figure 5. Stakeholder Classification



### 1.5.3 Stakeholder Identification

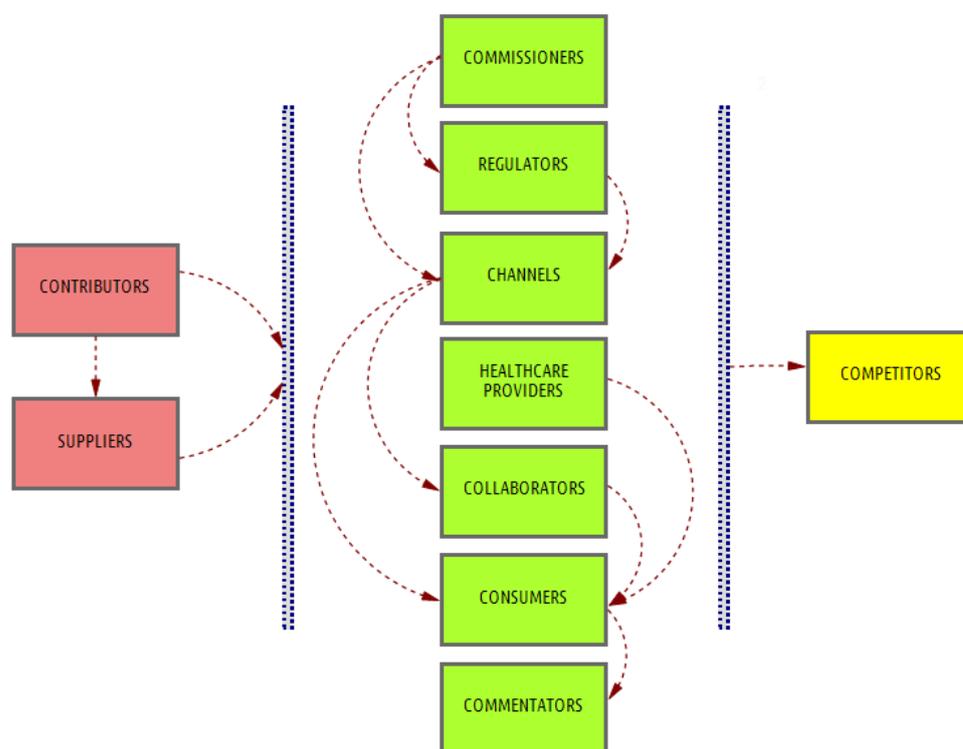
The health sector activities affect everyone and as such have many stakeholders. Many a time, the stakeholders are known but are seldom documented. The KHEA provides a general framework of stakeholder identification and management.

Table 1. Stakeholder Identification

Relationship Type	Identity	Role	Example (Domain)
Backward linkages	Contributors	Supply of finances, human resources and knowledge	Development partners, implementation partners, research, human resource training
	Suppliers	Supply of health related commodities such as drugs and medical equipment	Equipment suppliers, drugs and medical supplies
Horizontal linkages	Commissioners	Leaders appointed within the sector	State actors:- National, county, sub-county, community
	Regulators	State and sector empowered regulatory bodies and organisations	State actors:- Standards bodies
	Channels	Providers of medical services to consumers	Facilities:- Hospitals, special programmes
	Healthcare providers	Human resources providing healthcare	Trained healthcare providers:- Administrators, doctors, nurses, clinicians, pharmacists
	Collaborators	Supporting activities involved in assisting the delivery of healthcare	Other collaborating sectors:- Insurance, transporters
	Consumers	The end user of the health service	General population:- community, households, individuals

Relationship Type	Identity	Role	Example (Domain)
	Commentators	Non-state actors commenting on and influencing service	Non-state actors, labour associations, consumer associations
Forward linkages	Competitors	Industries or sectors that leverage and sell the established health product	Health tourism, health developer hubs

Figure 6. Stakeholder Interactions



This allows us to identify the following as the linkages of stakeholders within Kenya's health sector:

I. Backward linkages

- Contributors - Development partners, implementation partners, human resource trainers, researchers
- Suppliers - Equipment and medical suppliers

II. Horizontal linkages

- Commissioners - State actors
- Regulators - State actors
- Channels - Facilities - Hospitals, special programmes
- Healthcare providers - Trained healthcare providers

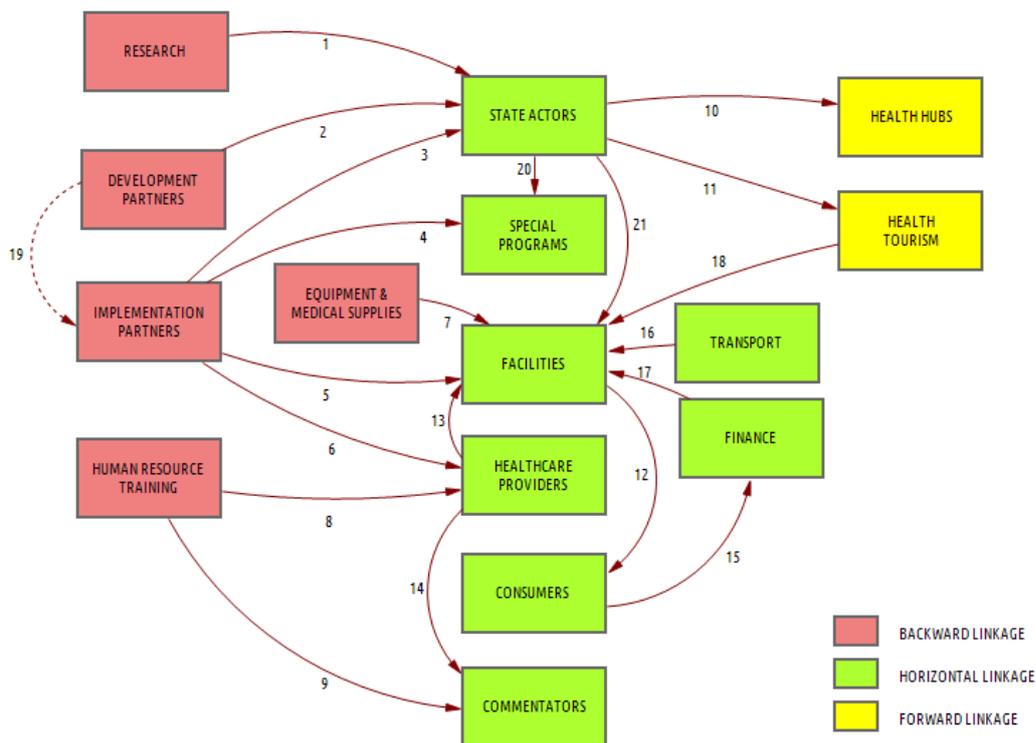
- Collaborators – Finance/Insurance, transport
- Consumers – General population
- Commentators – Non-state actors

### III. Forward linkages

- Competitors – Health tourism, Health hubs

The figure below illustrates linkages above in the health sector.

**Figure 7. Stakeholder Linkages**



#### 1.5.4 Analysis of Stakeholder Relationships

According to Joseph M. Sussman “different types of links can be identified based on what ‘goods’ they carry from one component/actor to another”. These include:

- Informational – Shows information/decision flow between two actors and/or two components
- Financial – Shows flow of financial resources between two actors or components
- Control – Regulatory, advisory or hierarchical flow between two actors or components
- Mass transfer – Flow of material goods between two actors or components

- v. Efficiency transfer - Shows the transfer of activity improvement information
- vi. Constitutive - Shows the contribution of one component in the makeup of another

**Table 2. Analysis of Stakeholders**

	<b>From</b>	<b>To</b>	<b>Characteristics and Magnitude</b>	<b>Link Type</b>
1.	Development partners	State actors	Development partners finance a number of state projects	Financial
2.	Implementation partners	State actors	Implementation partners together with their respective development partners execute projects for the State actors	Efficiency transfer
3.	Implementation partners	Special programmes	Implementation partners provide support that makes the execution of special programmes more effective	Efficiency transfer
4.	Implementation partners	Facilities	Implementation partners provide support that makes the services at the facility level more effective	Efficiency transfer
5.	Implementation partners	Healthcare providers	Implementation partners provide support that makes the services of health providers more effective	Efficiency transfer
6.	Equipment and medical supplies	Facilities	Equipment and medical supplies including drugs are supplied to facilities	Mass transfer
7.	Human resource training	Healthcare providers	Human resource training provides services that make health providers more effective	Efficiency transfer
8.	Human resource training	Commentators	Human resource training through its students forms part of the associations of health providers	Constitutive

	From	To	Characteristics and Magnitude	Link Type
9.	State actors	Health hubs	State actors exert legislative control on the involvement of externals within the sector	Control
10.	State actors	Health tourism	State actors exert legislative control on the involvement of externals within the sector	Control
11.	Facilities	Consumers	Facilities offer health services (curative) to patients for effective recovery	Efficiency transfer
12.	Healthcare provider	Facilities	Health care providers form part of the health facility to run certain services	Constitutive
13.	Healthcare provider	Commentators	Health care providers form associations that are part of sector commentators	Constitutive
14.	Consumers	Finance	Consumers pay for their healthcare through cash or insurance	Financial
15.	Transport	Facilities	Transport sector offers services that make the transfer of patients at facilities more effective	Efficiency transfer
16.	Finance	Facilities	Financial institutions submit finances for services by consumers to the facilities	Financial
17.	Health tourism	Facilities	Effective facility services can be used to support patients who are not residents of a country	Efficiency transfer
18.	Development partners	Implementation partners	Development partners finance and staff their implementation partners locally	Financial/ Efficiency transfer
19.	State actors	Special programmes	State actors exert legislative control on the special programmes run within the sector	Control
20.	State actors	Facilities	State actors exert legislative control and allocate funding to health facilities within the sector	Control/Financial

### **1.5.5 Stakeholder Registry**

A stakeholder registry keeps an updated and authoritative list of stakeholders in the health sector. Each level of governance (national and county) and type of service delivery sites (facility and community units) should develop and maintain a stakeholder registry that provides information of each stakeholder, their roles and responsibilities, jurisdiction, and types of relationships. The stakeholder registry will later be translated into a Partner Registry as described in the DRM. Please refer to Appendix 3 for a complete description of stakeholders.

### **1.5.6 Stakeholder Engagement Plan**

As noted above, a stakeholder engagement plan is one deliverable of this exercise. Four phases of stakeholder engagement are proposed: Phase I - Stakeholder introduction to KHEA (dissemination) - 3 months

- Governance team
- County level
- Phase II - Setup of the KHEA implementation work plan by the KHEA Taskforce
- Phase III - Engagement with special groups
- Phase IV - Individual organisation, agency or institution on-boarding to the enterprise platform (follow migration plan)

## 2.0 Approach and Methodology

### 2.1 Justification

#### 2.1.1 Overview

The design and execution of the KHEA blueprint is based on the TOGAF architecture framework, an architecture development method (ADM) and supporting tools for developing an enterprise architecture (Open Group 2009, 2011). The U.S. Federal Enterprise Architecture Framework (FEAF) has been used as the framework to describe each architecture domain; for KHEA, these are Business, Data, Applications and Technology. FEAF, developed by the U.S. Office of Management and Budget's Office of E-Government (E-Gov) and Information Technology (IT) as a model, offers a comprehensive business-driven blueprint of the entire U.S. Federal Government and has been adopted by several other countries. The justification for choice of these two approaches is found in the findings of research by the independent IT and Telecoms research company Ovum, and illustrated in Figure 8.

Figure 8. Analysis of Architecture Methodologies

### TOGAF, Pragmatic EA Framework, and Essential Project have gained a reasonable degree of traction

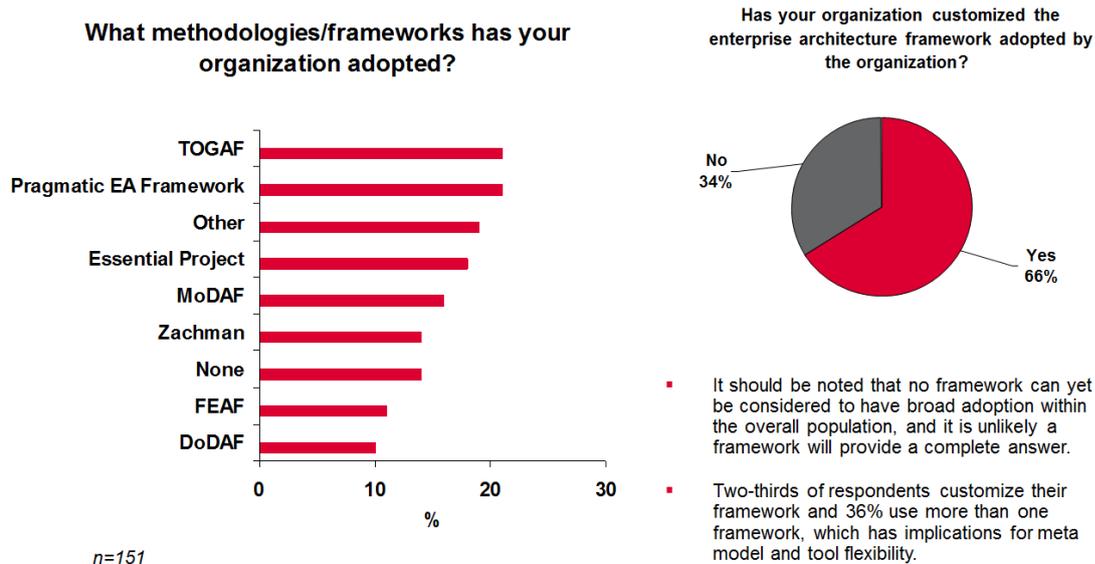


Figure 9. Customised TOGAF ADM to KHEA Design

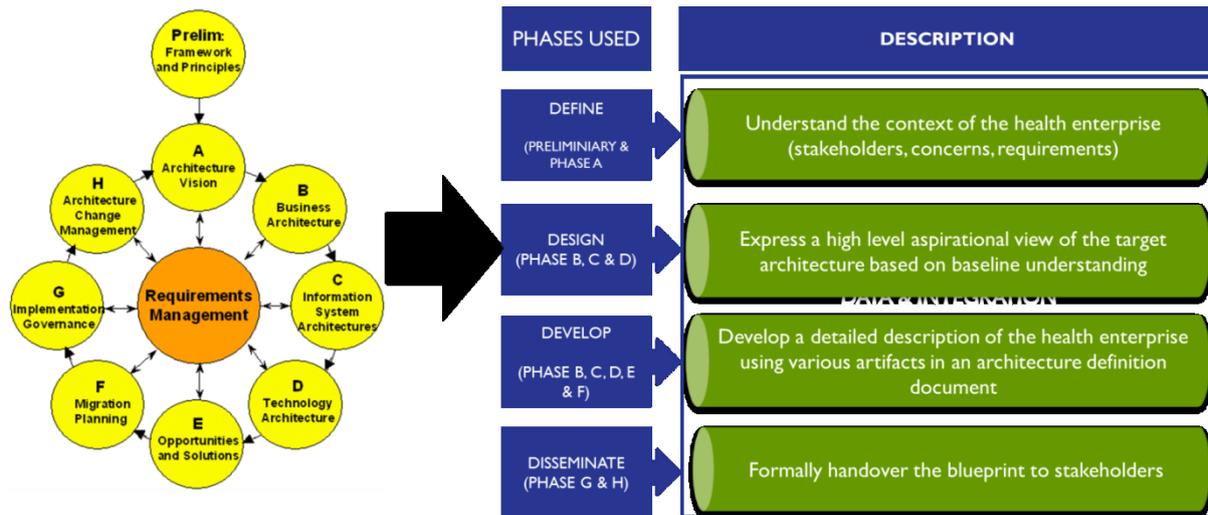
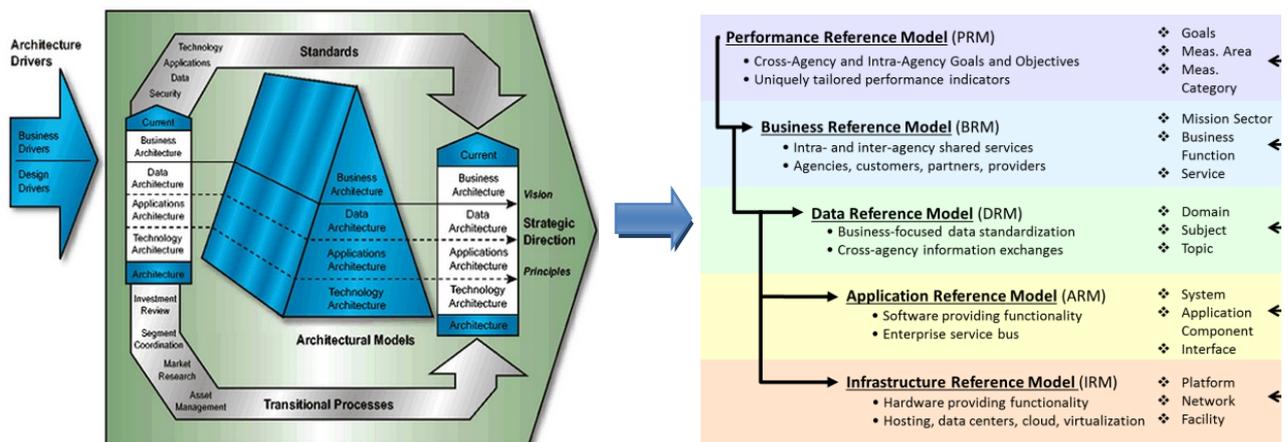


Figure 10. FEAF Domain Modelling Process



A customised approach to the use of the frameworks is illustrated in the next sections.

### 2.1.2 Introduction of the Federated Model

A federated model is a system of cooperating models that all adhere to common rules such as stewardship principles and a common metamodel. Each cooperating model can be updated independently, including relationships to objects in other models in the federation. Participating governments implement the attributes and properties of the federated model that are relevant to their operation.

There are two basic approaches to federated architecture development as defined by the Open Group:<sup>5</sup>

<sup>5</sup> <http://pubs.opengroup.org/architecture/togaf8-doc/arch/chap03.html>

- The overall enterprise is divided up "vertically" into enterprise "segments", each representing an independent business sector within the overall enterprise, and each having its own enterprise architecture with potentially all four architecture domains (Business, Data, Applications, Technology). These separate, multi-domain architectures can be developed with a view to subsequent integration, but they can also be implemented in their own right, possibly with interim target environments defined, and therefore represent value to the enterprise in their own right. (Ref. sub-system approach in business reference model)
- The overall enterprise architecture is divided up "horizontally" into architectural "superdomains", in which each architecture domain (Business, Data, Applications, Technology) covering the full extent of the overall enterprise is developed and approved as a major project independently of the others, possibly by different personnel. For example, a Business Architecture for the complete overall enterprise would form one independent architecture project, and the other domains would be developed and approved in separate projects, with a view to subsequent integration.

The FEAF allows critical parts of the overall federal enterprise, called "architectural segments", to be developed individually, while integrating these segments into the larger enterprise architecture. "It is critically important that enterprise architecture development be approached in a top-down, incremental manner, consistent with the hierarchical architecture views that are the building blocks of proven enterprise architecture frameworks. ... In doing so, it is equally important that the scope of the higher-level business views of the enterprise architecture span the entire enterprise or agency. By developing this enterprise-wide understanding of business processes and rules, and information needs, flows, and locations, the agency will be positioned to make good decisions about whether the enterprise, and thus the enterprise architecture, can be appropriately compartmentalised<sup>6</sup>.

## 2.2 Work Plan

**Table 3. KHEA Architecture Design Work Plan**

Sub-activity	#	Tasks	Deliverable
<b>DEFINE</b> <b>Understand the context of enterprise architecture for the health sector in Kenya</b>	1	Project document organisation	Documented understanding of the baseline health sector architecture
	2	Submit list of required documents for review	
	3	Avail all documents as requested in task 2	
	4	Desktop document review to understand health sector	
	5	Stakeholder identification, concerns and business requirements (conduct interviews)	
	6	Document the current baseline health sector architecture along with target architecture value	

<sup>6</sup> <http://www.hhs.gov/ocio/ea/documents/hhseaframeworkpdf.pdf>

Sub-activity	#	Tasks	Deliverable
		propositions	
	7	Engage stakeholders in reviewing and validating the architecture vision and value propositions	
<b>DESIGN</b> <b>Design a high level aspiration view of the target health sector architecture</b>	1	Select reference models, viewpoints and tools	Design of high level health enterprise architecture
	2	Design the business architecture of the health enterprise in terms of: <ul style="list-style-type: none"> <li>• Functions</li> <li>• Business services</li> <li>• Roles</li> <li>• Interactions</li> <li>• Business objects</li> <li>• Triggers</li> <li>• Actors</li> </ul>	
	3	Design the information architecture of the health enterprise in terms of: <ul style="list-style-type: none"> <li>• Application functions</li> <li>• Application services</li> <li>• Application components</li> <li>• Application interfaces</li> <li>• Application interactions</li> <li>• Data objects</li> </ul>	
	4	Review gaps and refine the design	
	5	Present revised design to stakeholders for discussion	
	6	Consolidate feedback and update the high level design	
	7	Present the summary version of the design at the e-health conference	
<b>DEVELOP</b> <b>Develop detailed architecture definition of the target health sector architecture</b>	1	Populate the business architecture with detailed information for the views, matrices and diagrams	Final Health Enterprise Architecture Definition Document
	2	Populate the data architecture with detailed information for the views, matrices and diagrams	
	3	Consolidate gaps and identify roadmap components	
	4	Present the detailed architecture blue print for discussion with stakeholders	
	5	Update the blue print from stakeholder inputs	
	6	Finalise the architecture blueprint and roadmap	
<b>DISSEMINATE</b> <b>Operationalise the architecture blueprint</b>	1	Prepare a presentation for the architecture blueprint	Summary Health Enterprise Architecture Definition Presentation
	2	Hold a workshop/ briefing to present the architecture blueprint	
	3	Conduct lessons learnt and update the project repository	
	4	Close the design and development phase of the project	Project close out report

## 2.3 Compliance with Standards

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### 2.3.1 Architecture Principles

This section provides a list of the high level principles that are defined in this document as well as adopted principles that are in main Government Enterprise Architecture (GEA) blueprint. GEA relates to the practice of business strategy, efficiency and effectiveness. A principle is a basic rule that guides choices and actions to be taken toward a goal or objective. Here, the enterprise architecture must lead to meeting the health sector strategy/aspirations and KHEA objectives. Principles will make the arguments and decisions more explicit and traceable, so they guide decision making and aid in the structuring of services. It captures, documents, classifies and analyses all aspects of an enterprise in order to make the information relevant for different types of decision makers.

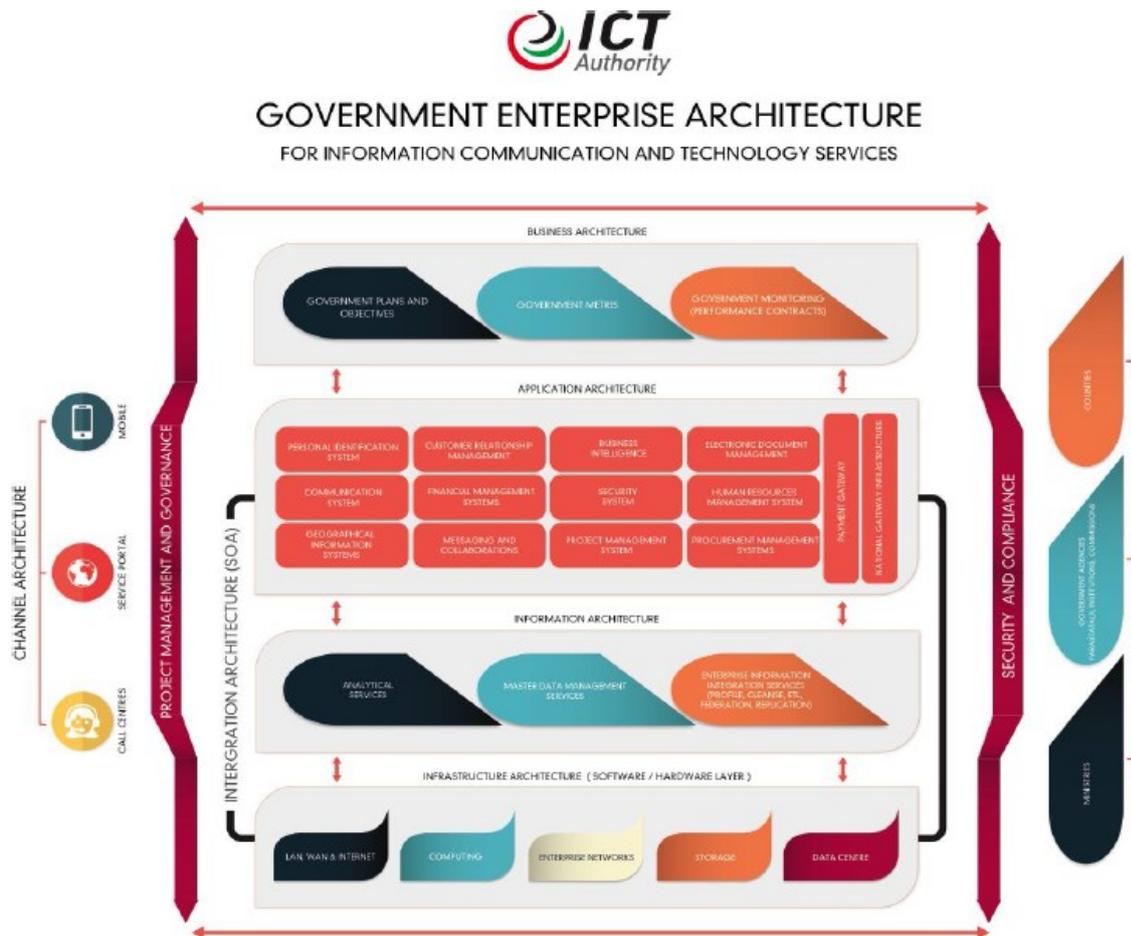
#### 2.3.1.1 About GEA

The GEA is a means of organising a government's resources i.e. its services, processes, information, applications and technology infrastructure as well as supporting human resources. The GEA establishes a set of policies and technical choices to achieve desired business outcomes, technical standardisation and integration.

Effective enterprise architecture requires the application of a comprehensive and rigorous method for describing a current and future structure and behaviour for the aforementioned government resources. This will enable alignment with current strategic directions.

The Ministry of ICT and ICT Authority (Figure 11) together constitute the governing body for ICT in Kenya. They govern government-wide ICT plans and programmes through the GEA. Development of the GEA was guided by the principles and values of ICT.

Figure 11. GEA Reference Model



Source: ICT Authority: <http://standards.icta.go.ke/index.php/2-uncategorised/200-government-of-kenya-enterprise-architecture>

The GEA Framework supports enterprise architecture activity within the Government of Kenya by defining:

- Architecture practices to help drive business management improvements across the government;
- The agreed standard architecture abstraction levels across the government;
- A means to establish a standard and coherent set of classification or domain models of the whole-of-government enterprise architecture;
- A set of common artifact types in the form of strategies, principles, policies, standards, requirements and other artifacts used to form the basis of the whole-of-government target enterprise architecture;
- A framework within which traditional enterprise architecture artifacts can be accommodated;
- The means to describe the whole-of-government target enterprise architecture;
- Mechanisms and tools for alignment with the whole-of-government target enterprise architecture;

- The governance and contribution process for the development, use and update of enterprise architecture artifacts.

The KHEA principles are justified in that they are architecture imperatives derived from various documents about the health sector or with implications for the health sector.

### 2.3.1.2 Overall Principles

- Shared Services:** Agencies should select reusable and sharable services and products to obtain mission or support functionality. The central government should become a coordinator and consumer rather than a producer of products and services. Standardisation on common functions and customers will help implement change in a timely manner.
- Interoperability Standards:** eHealth promotes standards for aligning strategic direction with business activities and technology enablement. Agencies should assure that enterprise architecture covering solutions conform to standards whenever possible.
- Security and Privacy:** KHEA shall help to secure information against unauthorised access. The government must be aware of security breaches and data compromise and the impact of these events. Appropriate security monitoring and planning, including an analysis of risks and contingencies and the implementation of appropriate contingency plans, must be completed to prevent unauthorised access to information.

Specific domain principles are enumerated in the introductory sections of the target architecture of each domain in chapter 6 of this document. Detailed documentation of principles is in Appendix 3.

### 2.3.2 Policies and Standards

The design of the target KHEA makes reference to the policies and standards in Table 4.

**Table 4. Architecture Alignment to Policies and Standards**

Source	Adoption
MoH Data/System Governance and Change Management	Design of the actor / role matrix for Architecture Governance Structure
HIS Policy	Design and development of Architecture Principles
MoH Standards and Guidelines for E-Health Systems Interoperability	<ul style="list-style-type: none"> <li>• Design and development of Architecture Principles</li> <li>• Design and development of data architecture artefacts showing how the standards have been adopted.</li> </ul>

Source	Adoption
The global OpenMRS Community	Design and development of data architecture artefact <ul style="list-style-type: none"> <li>• OpenMRS Information Model was used to design the top level data sets and data definitions</li> <li>• OpenMRS data model was used to develop the data definitions in a logical relational model</li> </ul>
The OpenHIE Global Community	Reference to the OpenHIE Architecture Framework to deepen business / application and data capabilities for integrated information exchange.
Health Level Seven International (HL7)	Reference to the HL7 framework for the exchange, integration, sharing and retrieval of electronic health information in the design of data architecture.
Ontario eHealth Architecture Blueprint	<ul style="list-style-type: none"> <li>• Design and development of architecture principles</li> <li>• Design of service patterns</li> <li>• Development of the business vision diagram</li> </ul>
Jembi Health Systems	Reference to Rwanda Health Information Exchange to develop the health actor / Health Service and Health Infrastructure Information Service Framework
Canadian Institute for Health Information	Reference to Health Human Resources Minimum Data Set Guide was used to describe the information requirements for health actors
Ministry of Health and Social Welfare, Tanzania.	Reference to the Health Facility List Data Specification Draft to help define information requirements for health infrastructure
Federal Health Information Model (FHIM)	Reference FHIM to provide a semantic information basis for information exchange, traceability and alignment into industry information models and standards
ICT Authority GEA	The GEA organises an enterprise's resources i.e. its services, processes, information, applications and technology infrastructure. It establishes a set of policies and technical choices to achieve desired business outcomes, technical standardisation and integration.
The National Assembly	Data Protection Bill 2012

### 2.3.3 Documents Reviewed

Content to develop the KHEA architecture vision has been extracted from the documents listed in Table 5.

**Table 5. Documents Reviewed**

Type of Document Request	Document Received
<p>Organisational model impacted by the assignment, in particular:</p> <ul style="list-style-type: none"> <li>• Any health sector strategy documents specifically on e-health</li> <li>• Full list of organisations that consume data and the kind of data they consume</li> <li>• Any prior assessment and gaps that have been done on the adequacy of data for the health enterprise</li> <li>• List of stakeholders to be involved in this project and their responsibility for production, consumption or value addition of data</li> </ul>	<ul style="list-style-type: none"> <li>• Kenya E-Health Strategy 2015-2020</li> <li>• KHSSP July 2014–June 2018</li> <li>• Systems Assessment Report, Sept 2013</li> <li>• NHIS Infrastructure Assessment Report, Feb 2013</li> <li>• USAID Kenya: Assessment of national monitoring and evaluation and health management information systems, August 2010</li> <li>• Draft eHealth Strategy / Policy Stakeholder Engagement Plan, March 2015</li> <li>• MoH Organogram, Dec 2014</li> <li>• Health Sector Monitoring and Evaluation Framework 2014-2018</li> <li>• County Government Health Strategic Plans</li> </ul>
<p>Any existing documented policies on data</p>	<ul style="list-style-type: none"> <li>• Draft data / system governance and change management, June 2015</li> <li>• Health Information Systems Policy</li> <li>• Kenya Standards and Guidelines for E-Health Systems Interoperability, Jan 2015</li> <li>• Kenya Health Sector Data Quality Assurance Protocol</li> <li>• 2nd Edition Indicators and Standard Operating Procedure Manual</li> </ul>
<p>Any documented detailed requirements / expectations (functional and technical) of what is expected of the architecture assignment.</p>	
<p>Draft architecture documents for the ongoing business process definition workstream (if it has started)</p>	<ul style="list-style-type: none"> <li>• ISO Administration Procedures Manual</li> <li>• ISO Communication Procedures</li> <li>• ISO DSRS Procedure Manual</li> <li>• ISO Environmental Health Procedure Manual</li> <li>• ISO ICT Procedure Manual</li> <li>• ISO Mass Casualty Incident</li> <li>• ISO Policy and Planning Procedures</li> <li>• ISO Supply Chain Management Procedures Manual</li> <li>• Health Infrastructure Norms and Standards Guidelines</li> </ul>
<p>Any functional description of existing capabilities (applications and databases) that provide data to various stakeholders showing which stakeholders use which tools to access which data and what kind of reports they generate from what application.</p>	<ul style="list-style-type: none"> <li>• USAID Kenya: Assessment of national monitoring and evaluation and health management information systems, August 2010</li> <li>• Systems Assessment Report 2013</li> </ul>

Type of Document Request	Document Received
Any technical description of existing capabilities (applications and databases) that provide data to various stakeholders including how the data are stored, accessed and backed up and the deployment architecture of the applications and data	<ul style="list-style-type: none"> <li>• Afya House Data Centre Final Audit Report</li> <li>• NHIS Infrastructure Assessment Report, Feb 2013</li> </ul>

## 3.0 ASSESSMENT OF BASELINE ARCHITECTURE

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### 3.1 Why Assess

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Health sector stakeholders recognise the need to improve the processes they have to manage change, but many of them don't know how to do this. There has been significant investment in process improvement but most of these efforts have been fragmented and/or duplicative, and have had limited success.

Capability Maturity Models are an effective and proven method that the health sector can use to gradually gain control over and improve its change processes. Architecture maturity models offer the following benefits:

- A clear description of the practices that the health sector must perform in order to improve its processes.
- A yardstick against which to periodically measure improvement in the key investment pillars as highlighted in the KHSSP.
- A framework within which to manage the improvement efforts in a holistic and coherent manner across the health sector.
- Organisation of the various health sector practices into levels, each level representing an increased ability to control and manage the development of tools and capabilities to improve that domain.

An evaluation, or “assessment”, of health sector practices against a Capability Maturity Model determines the level at which the sector currently stands. It indicates the sector's ability to execute and the measures that need to be taken in order to see the greatest improvement and the highest return on investment for each of five architecture domains that have been assessed. The five align with the FEAF architecture domains, and partially mirror Kenya's devolved system of government. These are:

1. ***The Strategy Reference Model (SRM):*** This domain links government strategy, internal business and IT capabilities, and investments, providing a means to measure the impact of those investments on strategic outcomes. In the health sector, this would translate to the KHSSP as well as county governments' investment plans within the health sector.
2. ***The Business Reference Model (BRM):*** This domain describes the health sector through classification of business services, business functions and business processes that are client facing or non-client facing, cross-cutting governments or specific within a particular government and a particular line of service. The model is the basis of downstream rationalisation of technology capabilities to enable execution of such services
3. ***The Information Reference Model (IRM):*** This domain facilitates the discovery of data holdings residing in many forms and in different locations and enables understanding the meaning of the data, how to access the data, and how to leverage the data to support service delivery in a secure environment.

4. **The Applications Reference (ARM):** This domain categorises the system and application related standards and technologies that support the delivery of health service capabilities, allowing actors to share and reuse common solutions and benefit from economies of scale.
5. **The Technology Reference Model (TRM):** This domain categorises the network/cloud related standards and technologies to support and enable the delivery computing, storage, voice, data, video and mobile service components and capabilities.

Figure 12 illustrates model layering, showing how it cascades from top to bottom in terms of level of detail and domain.

**Figure 12. Anatomy of KHEA**

<b>KHEA Domain Reference Models</b>	Strategy & Legal Reference Model	Desired Outcomes	Available Healthcare		Affordable Healthcare		Quality Healthcare			
			Legislation		Policy		Strategy			
			Preventive		Curative		Administrative			
	Business Reference Model	Business Services	<b>Health Investment Pillars</b>							
			Service Delivery	Leadership & Governance	Products & Tech	Infrastructure	Health Info	Health Research	HR	Finance
			Serve Citizens		Support Service Delivery			Manage Resources		
			<b>Health Data Domains</b>							
	Information Reference Model	Technical Services	National Level Registries		County Level Registries		Community Level Registries			
			<b>Health Applications Domains</b>							
	Applications Reference Model	Technical Services	Vertical Applications	Horizontal Applications	Productivity Applications	Interoperability, Services and Components				
<b>Health Technology Domains</b>										
Technology Reference Model	Technical Services	Computing and Storage		Communication and Network		End User Devices	Security			
		Baseline (As Is) / Legacy			TO-BE / Target / Modernization					
IT Governance										

## 3.2 Maturity Model

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The five architecture domains were assessed on the following levels of maturity. Adopted from the IT Architecture Capability Maturity Model (ACMM)

### **Level 0: None**

*No domain architecture exists.*

### **Level 1: Initial**

*Informal (isolated) domain architecture exists.*

1. Processes are ad hoc and localised. Some enterprise architecture processes are defined. There is no unified architecture process across technologies or business processes. Success depends on individual efforts.
2. Enterprise architecture processes, documentation and standards are established by a variety of ad hoc means and are localised or informal.
3. Minimal or implicit linkage to business strategies or business drivers.
4. Limited stakeholder awareness or involvement in the domain architecture process.
5. Limited sector-wide acceptance of the architecture process.
6. No explicit governance of architectural standards.

### **Level 2: Under Development**

*Formal enterprise architecture is under development.*

1. Basic domain architecture process is documented. The architecture process has developed clear roles and responsibilities.
2. Vision, principles, business linkages and Baseline and Target Architecture are identified. Architecture standards exist, but not necessarily linked to Target Architecture.
3. Explicit linkage to business strategies.
4. Stakeholder awareness of architecture effort.
5. Responsibilities are assigned and work is underway.
6. Governance of a few architectural standards and some adherence to existing standards profile.

### **Level 3: Defined**

*Formally defined and adopted enterprise architecture.*

1. The domain architecture is well defined and communicated to all stakeholders. The process is largely followed.
2. Gap analysis and Migration Plan are completed. Fully developed standards profile.
3. Enterprise architecture is integrated with investment planning and control.

4. Stakeholders fully aware of and supportive of the sectorwide architecture process. Sector actively supports architectural standards.
5. Most elements of enterprise show acceptance of or are actively participating in the enterprise architecture process.
6. Architecture documents updated regularly.
7. Explicit documented governance of domain architecture investments.

#### **Level 4: Managed**

##### *Managed and measured enterprise architecture.*

1. Domain architecture process is part of the culture. Quality metrics associated with the architecture process are captured.
2. Enterprise architecture documentation is updated on a regular cycle to reflect the updated enterprise architecture. Business, Data, Application, and Technology Architectures defined by appropriate standards.
3. Capital planning and investment control are adjusted based on the feedback received and lessons learned from updated enterprise architecture. Periodic re-examination of business drivers.
4. All stakeholders team directly involved in the architecture review process.
5. The entire sector accepts and actively participates in the enterprise architecture process.
6. Explicit governance of all domain architecture investments. Formal processes for managing variances feed back into enterprise architecture.

#### **Level 5: Optimising**

##### *Continuous improvement of enterprise architecture.*

1. There are concerted efforts to optimise and continuously improve architecture process.
2. A standards and waivers process is used to improve architecture development process.
3. Architecture process metrics are used to optimise and drive business linkages. Business is involved in the continuous process improvements of enterprise architecture.
4. Stakeholders are actively involved in optimising process improvements in architecture development and governance.
5. Feedback on architecture process from all domain architecture elements is used to drive architecture process improvements.
6. Architecture documents are used by every decision-maker in the organisation for every architecture impacting business decision.
7. Explicit governance of all domain architecture investments. A standards and waivers process is used to make governance-process improvements.

### 3.3 Baseline Health Sector Architecture

The baseline Kenya Health sector Architecture presents the situational status of the health sector enterprise as at the initial assessment of the sector. The following table provides the summary of findings.

#### 3.3.1.1 Summary Assessment Results

**Table 6. Baseline Architecture Summary Assessment**

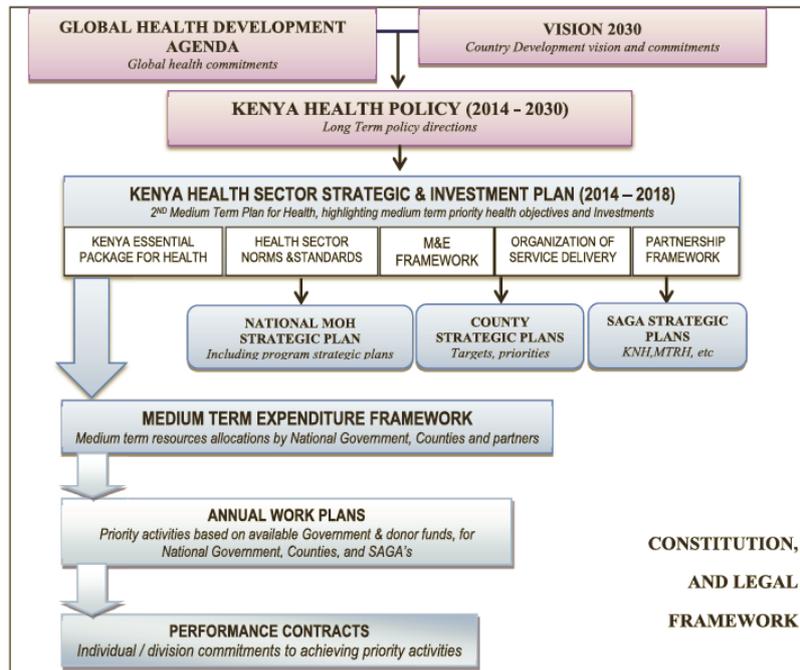
Domain		Assessment Rating
Strategy Model		<i>Level 4.</i> The strategy architecture domain is well managed in terms of documentation, dissemination and revision.
Business Model	Service Delivery	<i>Level 2.</i> The business architecture domain for Service Delivery is documented; it is disseminated but not fully utilised. There are implementation challenges on adoption of policies and guidelines at facility levels.
	Human Resources for Health (HRH)	<i>Level 2.</i> The business architecture domain for HRH is documented; it is disseminated but not fully utilised. There are implementation challenges on attraction and retention, placement and equitable distribution, performance management and training.
	Health Infrastructure	<i>Level 2.</i> The business architecture domain for Health Infrastructure is documented; it is disseminated but not fully implemented and managed. There are implementation challenges to building new facilities, equipping existing ones and matching infrastructure needs with other co-dependent investment pillars such as HRH and health products and technologies.
	Health Leadership	<i>Level 3.</i> The business architecture domain for Health Leadership is documented; it is disseminated but not fully implemented and managed. There are implementation challenges in health partnership arrangements.
	Health Products and Technologies (HPT)	<i>Level 3.</i> The business architecture domain for Health Products is documented; it is disseminated but not fully implemented and managed. There are implementation challenges in accessibility, availability and affordability of health commodities.
	Health Financing	<i>Level 3.</i> The business architecture domain for Health Financing is documented; it is disseminated but not fully implemented and managed. There are implementation challenges in allocation of adequate financial resources for health as well as tracking the effectiveness and value of mobilised resources through the health programmes.

Domain	Assessment Rating
Data Model	Health Information and Research <i>Level 2.</i> The data architecture domain is partially documented; it is disseminated but not fully implemented and managed. There are implementation challenges to collecting quality data; the validation effort is spent to clean up data; and there is limited dissemination of collected data and limited use of or monitoring of the use of information.
Application Model	<i>Level 2.</i> The application architecture domain is partially documented; it is disseminated but not fully implemented and managed in terms of interoperability. In addition, there is no clear applications capability map with regards to the business architecture. There are implementation challenges in adoption of common standards for data exchange, the possibility of overlapping functionality due to the absence of mapping to the business architecture and an increase in complexity of managing the technical diversity caused by various flavours of relational database management systems and any middle tier application services that have been deployed.
Technology Model	<i>Level 2.</i> The infrastructure architecture domain is partially documented; it is disseminated but not fully implemented and managed in terms of scalability and capacity for the incoming computing requirements of various systems. A revalidation of the recommendations needs to be done to confirm if suggested measures were taken and if they are in alignment with the aspirations of the target architecture.
Overall Rating	<i>Level 2.5</i> The health sector enterprise architecture is being developed. It is partially documented with below maturity level in most of the architecture domains with the exception of the strategy model.
Target Maturity Level	<i>Level 3.5-4</i> The target maturity level should be transiting from defined to managed in order to be at par with the strategy model and for a truly holistic and coherent view that is traceable the from top to bottom and vice versa.

### 3.3.2 Strategy Model

Health investment plans exist describing for both national and county governments. They are well aligned with the existing frameworks such as the Constitution, Vision 2030, and policies and standards. The investment plans have clear goals and targets which are measurable and they have a monitoring and evaluation framework.

Figure 13. Baseline Strategy Reference Model



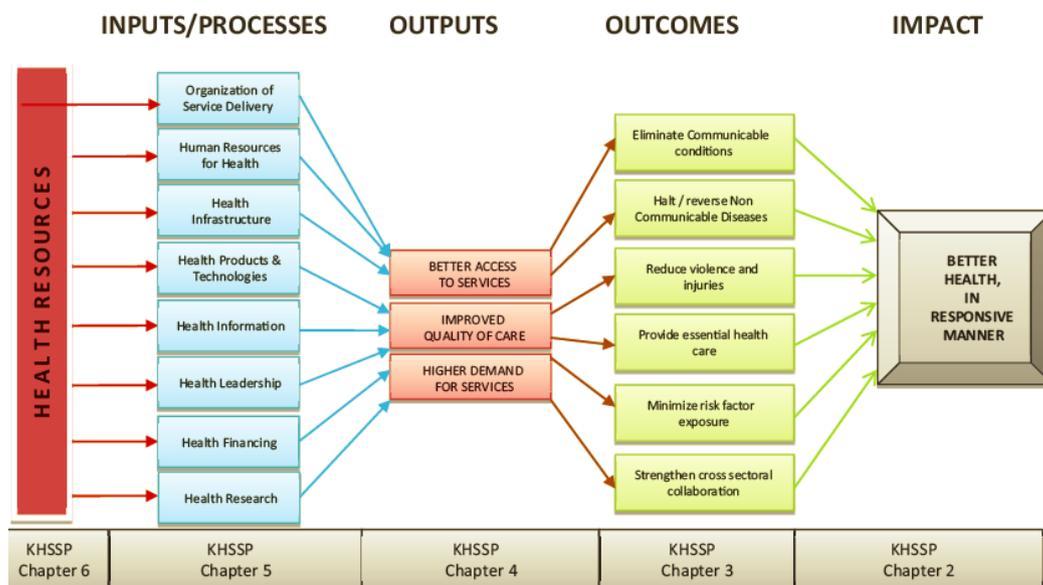
(Source: KHSSP 2014-2018)

**Assessment: Level 4.** The strategy architecture domain is well managed in terms of documentation, dissemination and revision.

### 3.3.3 Business Model

Business architecture definition is based on WHO standards and is divided into seven investment pillars which are referred to as inputs / processes to enable the delivery of the sectoral strategy.

Figure 14. Baseline Business Reference Model



(Source: KHSSP 2014-2018)

Following are assessment findings about the maturity of each of the seven pillars:-

## 1. Organisation and Service Delivery

- Although systems for supervision are designed for all levels, they are only being applied from the national to the hospital level. Supportive supervision from the national to the county level is non-existent, and needs to be established.
- Referral system capacity improvements are not coordinated, leading to different facilities having different capacities to manage different elements of the referral system. In addition, the referral between communities and facilities is still weak.
- Outreach is not uniform. Some facilities, particularly hospitals, do not do any outreach. There is lack of integrated outreach planning at the facility level. In addition, the outreach that is done is not well coordinated to assure adequate coverage of the whole population with planned services.
- Committee meetings at facilities increasingly focus on administration as opposed to management of service delivery. Tracking of facility performance is not well planned and monitored.
- Application of Standardised Clinical Guidelines and the national Essential Medicines List is not fully integrated into health facility management systems, and mechanisms are not in place to monitor their relevance and impact on clinical practice.

**Assessment: Level 2.** The business architecture domain for Service Delivery is documented; it is disseminated but not fully utilised. There are implementation challenges to adoption of policies and guidelines at facility levels.

## 2. Human Resources for Health

**Table 7. HRH Assessment Findings**

Assessment Area	Current Status
Equitable distribution of health workforce	<ul style="list-style-type: none"> <li>• Inadequate numbers of health workers in-post</li> <li>• Lack of skills inventory</li> <li>• Skewed distribution of workers, with significant gaps in Northeastern and Northern Rift provinces</li> <li>• Lack of budgetary support to enhance recruitment</li> </ul>
Attraction and retention	<ul style="list-style-type: none"> <li>• High level of attrition</li> <li>• Unfavourable terms and conditions of work</li> <li>• Lack of incentives for hard-to-reach areas</li> <li>• Improved but disharmonised remuneration</li> <li>• Lack of equity in remuneration</li> <li>• Low employee satisfaction level</li> <li>• Stagnation due to unfavourable career guidelines</li> </ul>

Assessment Area	Current Status
<b>Institutional and health worker performance</b>	<ul style="list-style-type: none"> <li>• Lack of adequate functional structures to support performance</li> <li>• Weak staff performance appraisal</li> <li>• Leadership and management capacities not institutionalised in all service delivery posts</li> <li>• Lack of functional Performance Monitoring Systems for recruited staff</li> <li>• Weak regulatory framework</li> </ul>
<b>Training capacity building and development of health workers</b>	<u>Pre-service training</u> <ul style="list-style-type: none"> <li>• Lack of mechanism to link training institutions with services needed</li> <li>• Skills inventory lacking</li> <li>• Training policy for health sector not developed</li> <li>• Inadequate facilities</li> </ul>
	<u>In-service Training</u> <ul style="list-style-type: none"> <li>• Lack of policy guideline on competencies and skills required for specific cadres</li> <li>• Skills inventory of health workers not available</li> <li>• Inadequate continuous professional development (CPD) guidelines</li> <li>• Inadequate facilities for training</li> <li>• Lack of internship policy</li> <li>• Lack of training funds</li> <li>• Skewed allocation of training funds amongst different cadres</li> </ul>

(Source: KHSSP 2014-2018)

Existing staff represent only 17% of the minimum staffing requirements are to be attained.

**Assessment: Level 2.** The business architecture domain for Human Resources for Health is documented; it is disseminated but not fully utilised. There are implementation challenges on attraction and retention, placement and equitable distribution, performance management and training.

### 3. Health Infrastructure

According to the KHSSP, the health infrastructure service readiness index is 57%. This means that 57% of all health facilities are ready to provide Kenya Essential Package for Health (KEPH) services. Of these, 47% have the basic amenities to provide services, 67% have the basic equipment required, 41% have essential medicines and 73% have the standard precautions.

**Table 8. Health Infrastructure Assessment Findings**

Assessment Area	Current Status
<b>Physical infrastructure</b>	<ul style="list-style-type: none"> <li>• Significant ongoing projects, focusing on establishment of 201 model health centres, and expansion of hospital infrastructure in 80 hospitals</li> <li>• 43% of the primary care facilities are not ready to offer comprehensive package of primary care services as evidenced by the statistics above.</li> <li>• Lack of a holistic approach to facility investments to match other dependent investment pillars such as HRH or HPT which leads to affecting functionality after completion of investments</li> <li>• Limited investment in maintenance of physical infrastructure</li> </ul>
<b>Communication and ICT equipment</b>	<ul style="list-style-type: none"> <li>• ICT equipment supplied to all public / faith-based organisation (FBO) facilities</li> <li>• Communication equipment (telephones) available in all hospitals</li> <li>• Radio equipment provided to all facilities in arid / semi arid areas of the country</li> <li>• Limited investment in maintenance of communication equipment</li> </ul>
<b>Medical equipment</b>	<ul style="list-style-type: none"> <li>• Investments in medical equipment ongoing in selected hospitals</li> <li>• Lack of comprehensive, coordinated investment, with gaps in some facilities still existent</li> <li>• Limited investment in maintenance of medical equipment</li> </ul>
<b>Transport</b>	<ul style="list-style-type: none"> <li>• Purchase of ambulances ongoing, at hospitals, and model health centres</li> <li>• Still significant gaps in utility vehicle availability (some ambulances also used as utility vehicles as a result)</li> <li>• Transport enhancement measures in the sector have been considered. Such measures include outsourcing of certain activities to the private sector e.g. courier companies to collect/deliver stocks/specimens, taxi companies for referral in very rural areas with appropriate reimbursement and ambulances for bigger hospitals</li> <li>• Limited maintenance investment</li> </ul>

(Source: KHSSP 2014-2018)

**Assessment: Level 2.** The business architecture domain for Health Infrastructure is documented; it is disseminated but not fully implemented and managed. There are implementation challenges in build of new facilities, equipping of existing ones and matching infrastructure needs with other co-dependent investment pillars such as HRH and HPT.

#### 4. Health Leadership

**Table 9. Health Leadership Assessment Findings**

Assessment Area	Current Status
<b>Strengthened health stewardship</b>	<ul style="list-style-type: none"> <li>• The Kenya Health Policy 2012–2030 has been developed, in line with the health sector obligations as outlined in the 2010 Constitution and the Vision 2030</li> <li>• Comprehensive Planning and Monitoring Framework is in place at all sector levels</li> <li>• Capacity building programme for mid level managers in Health Systems and Services Management is ongoing</li> <li>• Establishment of management structures in line with the 2010 Constitution is underway</li> </ul>
<b>Improved health governance</b>	<ul style="list-style-type: none"> <li>• A draft Kenya Health Law developed</li> <li>• Multiple health legislation exist, relating to different health functions</li> <li>• National referral institutions are in the process of being handed over to county governments in accordance with the Constitution</li> <li>• Guidelines for Health Governance structures at all implementation levels have been developed, and structures established – Community Health Committees, Health Facility Committees, District and Hospital Boards</li> </ul>
<b>Consolidated health partnership arrangements</b>	<ul style="list-style-type: none"> <li>• Health sector partnership is in place, the Norms and Standards and Code of Conduct</li> <li>• A Joint Financing Agreement is in place to facilitate joint funding arrangements</li> <li>• Guidelines for establishment and functioning of sector coordination structures at all levels have been put in place. These include Community Dialogue Days; District and Provincial Health Stakeholders fora; and Health Sector Coordinating Committee</li> <li>• Adherence to the sector partnership obligations is monitored annually by all sector actors</li> <li>• Many key stakeholders are still outside of the Code of Conduct. Some key funders see no need / have no capacity to engage at this depth with other health actors, and prefer to play a peripheral role</li> <li>• The engagement of the private sector in the sector coordination process is still weak. In spite of the presence of the Sector Code of Conduct, there are efforts to define a parallel Public Private Partnership for Health (PPPH) instrument that is not in line with the code</li> <li>• Interagency Coordinating Committees are too numerous, and not aligned to the sector policy / strategic direction. Their interlinkages, and linkages with the code are weak and not adhered to</li> <li>• There are no reward / punishment mechanisms to influence behaviour of different actors towards desired actions</li> <li>• There is still limited movement away from a project mode of operation in the sector. Many partners still fund through a project, even though common plans, budgets</li> </ul>

Assessment Area	Current Status
	<p>and monitoring processes have been put in place. Multiple Project Implementation Units still exist, some of which are embedded too deeply in the Ministry and are affecting duties of Ministry staff</p> <ul style="list-style-type: none"> <li>• There is still overlap of coordination bodies and initiatives. Non-state actors were represented by coordination bodies that overlapped in membership and mandate. In addition, the role of the emerging PPPH process within the overall sector coordination process was not clear.</li> <li>• Level of engagement of different actors was also varied. Some actors, though formally signatory to the partnership Code of Conduct, were not actively engaged in sector processes.</li> </ul>

(Source: KHSSP 2014-2018)

**Assessment: Level 3.** The business architecture domain for Health Leadership is documented, disseminated but not fully implemented and managed. There are implementation challenges in health partnership arrangements.

## 5. Health Products and Technologies

According to the KHSSP, current levels of investment in the HPTs represent a major under-investment in the health sector.

Key quality gaps in service provision include;

- frequent stock outs;
- inappropriate prescribing, dispensing and use;
- risk of substandard and counterfeit products; and
- high out-of-pocket expenditure on medical products.

**Table 10. Health Products Assessment Findings**

Assessment Area	Goal	Current Status
Availability	Households should regularly access the medicines they need at a facility close enough to where they live	<p>a) Basic medicines are highly available in public, private and Faith Based Organizations facilities; but the broader range of essential medicines is less available (66% in public and FBOs).</p> <p>b) Less than half (47%) of patients treated in public facilities report receiving all the medicines prescribed, compared to 71% of patients in FBHS.</p> <p>c) Two thirds of households are dissatisfied with the level of medicines availability in the public facility nearest to them.</p>

Assessment Area	Goal	Current Status
<b>Affordability</b>	The products should be affordable at the point of care. Preferably no out-of-pocket payment should be required for essential HPTs	<p>a) Patients accessing medicines from public facilities face low or no financial barriers. About 89% of basic medicines are issued for free in public facilities; 15% in FBHS facilities.</p> <p>b) However for priced medicines in both public and FBHS facilities, patient prices are generally 4 times higher than the central procurement prices.</p> <p>c) Patients often pay out-of-pocket for other health technologies (e.g. diagnostics, devices etc.) and the associated procedures; often these are more expensive than the medicines.</p>
<b>Efficacy, Effectiveness, Quality &amp; Safety</b>	When accessing medicines from any approved provider, households should have the assurance (from a competent National Regulatory Authority) that:	
	a) Efficacy: the medicines availed to them are efficacious when used as intended	Medicines registered by the Pharmacy and Poisons Board (PPB) are deemed to be efficacious. In collaboration with disease programmes, there is some efficacy monitoring of anti-microbials, but this does not cover all products. There is widespread, prescribing, sale and use of antimicrobials within the population, posing risks of antimicrobial resistance.
	b) Effectiveness: medical devices and other health products are effective in performing their intended function; new technologies are objectively assessed before introduction into the healthcare system	<p>a) Systems for assessing effectiveness of medical devices and diagnostics are weak and fragmented.</p> <p>b) The Health Policy provides for a comprehensive regulatory system, which is being implemented by the PPB to address this gap.</p> <p>c) There is no mechanism to objectively assess new technologies against health system needs and priorities, with the attendant risk of irrational investment in new technologies</p>
	c) Quality: The HPTs meet international standards of quality, as established and enforced by the Authority	Post-market surveillance studies of antiretroviral (ARV), antimalarial and anti-TB products indicate that the majority meet quality specifications. More investment is required in market surveillance, inspection and quality control to continuously enforce compliance.
	d) Safety: The benefit of using the medicines outweigh any potential harm to the patient; patients and health workers are adequately advised on health products' safety	A pharmacovigilance system is in place to monitor the safety of medicines and medical products. Appropriate regulatory actions are taken for products that do not comply with safety and quality standards. Autonomy of the PPB is critical for independence in enforcement.

Assessment Area	Goal	Current Status
Cost-effectiveness	Within the context of the national healthcare system, costs of accessing the medicines should be reasonable (to the patient and the system)	Centralised bulk procurement by Kenya Medical Supplies Agency (KEMSA) and Mission for Essential Drugs and Supplies (MEDS) is price efficient. They procure generics almost exclusively, at, respectively, prices 44% and 61% below international reference prices (IRPs). However, poor patients spend more time travelling and queuing to access affordable medicines from public facilities

(Source: KHSSP 2014-2018)

**Assessment: Level 3.** The business architecture domain for Health Products is documented, disseminated but not fully implemented and managed. There are implementation challenges in accessibility, availability and affordability of health commodities.

## 6. Health Financing

According to KHSSP, government health expenditures have been 4-7% of total government expenditure, which is less than half of the Abuja Declaration target of 15% and the Economic Recovery Strategy (ERS) target of 12% of total government allocations. 63.3% of total health expenditure is funded publicly, including external (donor) support and health insurance, the latter being responsible for 11% of total health expenditure. The remaining 36.7% is funded privately, with out-of-pocket payment at the point of service being predominant. Private health insurance is limited.

**Table 11. Health Financing Assessment Findings**

Assessment Area	Current Status
Assuring resource adequacy	<ul style="list-style-type: none"> <li>Lack of sectorwide mechanism to provide comprehensive financing information on health funding. A lot of resources, particularly donor resources and private expenditures, are unknown</li> <li>Absence of a strategic approach to guide resource mobilisation efforts has been a major hindrance. The efforts to develop a Social Protection Strategy that focuses health financing on pre-payment mechanisms (taxation, insurance) is ongoing</li> <li>There has been no costing information to guide resource mobilisation efforts</li> </ul>
Assuring equity in resource use	<ul style="list-style-type: none"> <li>Resource allocation criteria exist for allocating resources. However, these are limited in impact as they are</li> <li>Limited to only financing for operations, with allocations of other resources are primarily based on historical patterns</li> <li>Limited primarily to on budget resources, with off budget resources not subject to similar rational resource allocation criteria</li> <li>Lack of regular monitoring of effects of health financing particularly on the vulnerable populations. A household expenditure survey was last carried out in 2007, with no follow up.</li> </ul>

Assessment Area	Current Status
Assuring efficiency in resource use	<ul style="list-style-type: none"> <li>• Health Sector Services Fund has been rolled out to all primary care facilities (Hospital Medical Services Fund for hospitals) to make available direct financing from the national level</li> <li>• Available direct financing allocations not adequate to facilitate management functions, particularly at district level. How this is aligned to county functions is not yet clear</li> <li>• There are no value for money assessments carried out for health programmes</li> <li>• Expenditure tracking to follow management and use of funds not regularly carried out</li> <li>• Annual Public Expenditure Reviews are carried out, though these are primarily focused on public (and on budget donor) resource's, as opposed to all sector resources</li> <li>• Innovative financing techniques linked to performance, such as Output Based Financing, are being piloted in some regions, with need for scale up</li> <li>• No sectorwide efficiency assessments are carried out to provide regular information on allocative and technical efficiency in resource utilisation</li> </ul>

(Source: KHSSP 2014-2018)

**Assessment: Level 3.** The business architecture domain for Health Financing is documented; it is disseminated but not fully implemented and managed. There are implementation challenges in allocation of adequate financial resources for health as well as tracking the effectiveness and value of mobilised resources through the health programmes.

### 3.3.4 Data Model

#### 7. Health Information and Research

**Table 12. Health Information Assessment Findings**

Assessment Area	Current Status
Information generation and warehousing	<ul style="list-style-type: none"> <li>• Health Management Information System (HMIS) Technical Working Group formed, bringing together different sources of information for health in one forum</li> <li>• Weak legal framework to coordinate and manage health related information generation across sectors, and different actors</li> <li>• Data for the health sector are held in different databases such as HRH, Commodity and Logistics Supply systems, District Health Information System (DHIS) 2, financial systems, Master Facilities List (MFL), surveillance systems, community health information systems, vital registration system, Kenya National Bureau of Statistics (KNBS) and electronic health records (EHRs)/ electronic medical records (EMRs). The systems are not interoperable. This creates a situation with much data redundancy and time wasted on data collection.</li> </ul> <p><b>Routine HMIS</b></p> <ul style="list-style-type: none"> <li>• Electronic DHIS has been launched and rolled out nationally</li> <li>• At facility level, routine health data are collected manually</li> </ul>

Assessment Area	Current Status
	<p>using paper registers and other tools. Other data are collected through mobile technologies (m-Health) and EHR/ EMR. The number of EMR in the country is however still minimal and not well coordinated.</p> <ul style="list-style-type: none"> <li>• Weak HIS from non-state facilities (NGO/FBOs and private sector)</li> <li>• Is regular updating / changing of indicators by programmes leading to varying capacities for data collection?</li> <li>• Adequate data storage capacity has been established, to facilitate national and county data storage of HMIS information</li> <li>• Many partners support generation of routine HMIS information but are not well coordinated, leading to duplication of efforts (e.g. purchase of hardware)</li> <li>• Limited capacity of primary care facilities to utilise electronic system</li> </ul> <p><b>Vital events</b></p> <ul style="list-style-type: none"> <li>• Still paper based, with significant delays in registration of vital events</li> <li>• Ongoing pilot to develop IT based monitoring of vital events in the country</li> <li>• Still in the process of linking Vital Events information with HMIS</li> </ul> <p><b>Disease Surveillance</b></p> <ul style="list-style-type: none"> <li>• Capacity built across the country for collection of information on notifiable conditions</li> <li>• Application of 2005 International Health Regulations (IHR) is ongoing</li> </ul> <p><b>Surveys</b></p> <ul style="list-style-type: none"> <li>• Demographic and Health Survey (DHS), Kenya AIDS Indicator Survey (KAIS) and Malaria Indicator Acquisition Survey (MIAS) carried out regularly because funding is available</li> <li>• Other surveys not carried out regularly because financing is not budgeted</li> <li>• No / limited regular information on different investment areas – service availability and / or readiness information not collected</li> </ul> <p><b>Research</b></p> <ul style="list-style-type: none"> <li>• Significant amount of research done in country, by multiple research institutions</li> <li>• Limited linkages of research generated information, with decision making processes</li> </ul>
<b>Information validation</b>	<p><b>Routine HMIS</b></p> <ul style="list-style-type: none"> <li>• No data validation / audit processes are regularly carried out. One exercise of verification has been conducted (2010)</li> <li>• Eyeball validation checks are done and outliers are isolated. EMRs and DHIS2 have inbuilt validation checks.</li> </ul> <p><b>Vital events</b></p> <ul style="list-style-type: none"> <li>• Data verification is late, due to delays in data entry and processing of the manual systems</li> </ul>

Assessment Area	Current Status
	<p><b>Surveys</b></p> <ul style="list-style-type: none"> <li>• Extensive data verification and validation are done through established mechanisms for the respective surveys</li> <li>• Process delays data analysis and sharing of information</li> </ul> <p><b>Disease surveillance</b></p> <ul style="list-style-type: none"> <li>• Information regularly are followed up, by phone or email, to validate information. Field visits further validate emerging information</li> </ul> <p><b>Research</b></p> <ul style="list-style-type: none"> <li>• Comprehensive data verification is done as part of the established research protocols</li> <li>• National Scientific Committee carries out ethical approvals for most biomedical and systems research. Assessment includes comprehensive methodology assessments to assure emergent information is representative and addresses research objectives</li> <li>• Limited capacity of the scientific committee to comprehensively assess research protocols</li> </ul>
<b>Information analysis</b>	<ul style="list-style-type: none"> <li>• No comprehensive information analysis systems in place</li> <li>• Attempt to establish Health Observatory to facilitate comprehensive health information analysis ongoing, but not yet in place</li> </ul> <p><b>Routine HMIS</b></p> <ul style="list-style-type: none"> <li>• No information analysis regularly carried out. Information is presented as reported</li> </ul> <p><b>Vital events</b></p> <ul style="list-style-type: none"> <li>• No analysis is carried out on information on vital events</li> </ul> <p><b>Disease surveillance</b></p> <ul style="list-style-type: none"> <li>• Information analysis is immediate on receipt</li> </ul> <p><b>Surveys</b></p> <ul style="list-style-type: none"> <li>• Limited analysis of information is carried out on survey information; most information is presented as produced</li> </ul> <p><b>Research</b></p> <ul style="list-style-type: none"> <li>• Little systematic review of existing research</li> <li>• Analysis is done for specific research carried out</li> </ul>
<b>Information dissemination</b>	<ul style="list-style-type: none"> <li>• Annual Health Summits planned, to disseminate sector information</li> </ul> <p><b>Routine HMIS</b></p> <ul style="list-style-type: none"> <li>• Some facilities are disseminating health information at source, through health stakeholder fora, or Community Dialogue Days</li> <li>• Limited comprehensive dissemination outside of the health system is carried out. clients to aware of progress made</li> </ul>

Assessment Area	Current Status
	<p><b>Vital events</b></p> <ul style="list-style-type: none"> <li>No information dissemination currently done</li> </ul> <p><b>Disease surveillance</b></p> <ul style="list-style-type: none"> <li>Weekly Integrated Disease Surveillance and Reporting (IDSR) reports are produced on notifiable conditions, though are not always complete</li> </ul> <p><b>Surveys</b></p> <ul style="list-style-type: none"> <li>Dissemination through public events carried out upon completion of surveys</li> </ul> <p><b>Research</b></p> <ul style="list-style-type: none"> <li>Annual research / policy meetings held, coordinated by Kenya Medical Research Institute KEMRI and some programmes (e.g. Reproductive Health)</li> <li>Information regularly published in peer reviewed scientific journals</li> </ul>
<b>Information utilisation</b>	<ul style="list-style-type: none"> <li>No comprehensive systems in place for ensuring and monitoring evidence based policy making being practiced</li> <li>Absence of systems to generate data demand, and knowledge management</li> </ul> <p><b>Routine HMIS</b></p> <ul style="list-style-type: none"> <li>Information use primarily at source, to guide planning for activities</li> </ul> <p><b>Vital events</b></p> <ul style="list-style-type: none"> <li>Limited use of information on vital events to guide decision making</li> </ul> <p><b>Disease surveillance</b></p> <ul style="list-style-type: none"> <li>Information guides surveillance response actions directly</li> </ul> <p><b>Surveys</b></p> <ul style="list-style-type: none"> <li>Strategic focus guided by trends from surveys, particularly DHS. Current reproductive health focus guided by evidence of lack of progress in this area, for example</li> </ul> <p><b>Research</b></p> <ul style="list-style-type: none"> <li>Limited understanding of how it is informing decision making processes</li> </ul>

**Assessment: Level 2.** The data architecture domain is partially documented; it is disseminated but not fully implemented and managed. There are implementation challenges in collection of quality data, validation effort is spent to clean up data, limited dissemination of collected data and limited use or monitoring the utilisation of information.

### 3.3.5 Applications Model

According to the Ministry of Health (2013) Systems Assessment Report, applications are classified into two categories namely:-

- **Facility based systems:** Applications that collect and process data directly from the facilities.
- **Population based systems:** Applications that collect and process data about the general population in the country.

These two categories are further divided into the sub-categories listed in Table 13.

**Table 13. Applications Assessment**

Main Category	Sub-category	Systems
Facility based systems	<b>Routine systems:</b> Collect health data from health facilities on a periodic basis.	Include DHIS2, Master Facility List (MFL), Community Based Program Activity Reporting (COBPAP), Kenya Program Monitoring System (KePMS) and other Community Health Information Systems (CHIS).
	<b>Financial systems:</b> Manage health facility financial data.	Include HSSF, IFMIS and FIS
	<b>Human resource management systems:</b> Collect and manage data about health personnel working in health facilities.	Include iHRIS, GHRIS and Kenya Nursing Workforce Information system
	<b>Logistics management systems:</b> Collect and process data related to the supply and demand of health commodities to health facilities.	KEMSA-ERP, DRH Logistics - MIS.
Population based systems	<b>Survey and surveillance systems:</b> Collect and process population data on a periodic basis.	Include DHS, Malaria Information Acquisition System
	<b>Census information system:</b> Processes data collected as part of the nationwide population census, done every 10 years.	Based at the KNBS and known as Population Census Information System

Mapping of the baseline applications to various information needs as per the KHSSP investment pillars.

**Table 14. Mapping Applications to Information Needs**

KHSSP Investment Pillar	Information	Description	Current System(s)	Outputs
Health service delivery, infrastructure, leadership	Routine health data	Health data collected from the facilities on a periodic basis.	DHIS2 MFL COBPAP KePMS CHIS	No information
Health financing	Financial data	Financial data in health facilities	HSSF IFMIS FIS	No information

<b>KHSSP Investment Pillar</b>	<b>Information</b>	<b>Description</b>	<b>Current System(s)</b>	<b>Outputs</b>
HRH	Health personnel data	Data about the health personnel working in the health facilities	iHRIS, GHRIS Kenya Nursing Workforce Information system	No information
HPT	Health commodities data	Data about the supply and demand of health commodities to the health facilities	KEMSA-ERP DRH Logistics - MIS	No information
Research	Demographic data	population at a about the	Kenya DHS Malaria Information Acquisition System Population Census Information System	No information

#### Key findings of the 2013 systems assessment:-

- 62% were web-based applications, meaning they could be accessed via a web browser.
- 50% have application programme interfaces (APIs) or plug-ins that can be used for data exchange with other systems.
- 50% support inbound and outbound data exchanges.
- 25% have in-built data quality engine to process incoming feeder data from external systems.
- Only one system (KEMSA ERP) in the sample was ready to reconcile Online Analytical Processing (OLAP) and Online Transaction Processing (OLTP) databases i.e. readiness for sending data to a data warehouse.
- 87% have audit logging capabilities to track who accessed what data when.
- Data submission modes at various level of NHIS are Excel, website, mobile and paper based.
- The frequency of data transmission is mostly monthly.
- The most used relational databases to store aggregated data are MS SQL Server, Postgres SQL and MySQL.
- The standards used for data exchanges are SDMX, HL7, XML and Simple Object Access Protocol (SOAP).
- Only the DHIS had implemented HL7.

- 50% of the systems assessed did not meet minimum requirements for integration.

**Assessment: Level 2.** The application architecture domain is partially documented; it is disseminated but not fully implemented and managed in terms of interoperability. In addition, there is no clear applications capability map with regards to the business architecture. There are implementation challenges in the adoption of common standards for data exchange, the possibility of overlapping functionality due to absence of mapping to the business architecture and increased complexity of managing the technical diversity caused by various types of relational database management systems and any middle tier application services that have been deployed.

### 3.3.6 Technology Model

#### 1. Personal Computing Devices

In 2013 a countrywide cross-sectional National Health Information System (NHIS) Infrastructure Assessment was undertaken to establish the current status of existing ICT infrastructure, the proportion of IT-literate staff amongst the Kenya health workforce, availability of tools and storage facilities and availability of other physical infrastructure such as electricity.

The findings, contained in the NHIS ICT Infrastructure Assessment Report 2013, revealed that;

- Functional ICT equipment at all levels consisted of:
  - 91% of desktops,
  - 89% of printers,
  - 76% of mobile devices, and
  - 2% of laptops.
- Network connectivity was as follows:-
  - Mobile data at the hospital level (61%) and management unit level (75%)
  - Over 75% of Internet connectivity was via mobile data network across all levels.
- IT literacy levels were as follows:-
  - Administrative staff (over 65%).
  - Data management staff (over 90%), and
  - Clinical and support staff (below 50%).
- Access to power was as follows:-
  - Over 50% of units had access to the main power grid, a generator, or solar power.
  - 6% on average of community units had power.
  - Generators were reported to have been more reliable over the previous two weeks than the electricity grids.

## 2. Physical Computing and Storage Infrastructure

Findings of a data centre audit at Afya House, MOH (2012) included the following<sup>7</sup>;

- **Hardware:** The HP servers currently deployed are not adequate for the large scale processing capability that the sector is looking for.
- **Skills:** Personnel to manage the data centre are inadequate especially in numbers but also in specialized data center management skills. This need for skilled personal will grow as more and more computing demand is placed on existing infrastructure.
- **Internet Connectivity:** There is only one Internet service provider. This is risky; there is a need for redundancy in case the link goes down. For near to real time access of applications and data services at the data centre, there is need for redundant links.
- **Scalability:** The limited space of the physical facility will make it difficult to scale up when there is need to bring more equipment.

**Assessment: Level 2.** The infrastructure architecture domain is partially documented, disseminated but not fully implemented and managed in terms of scalability and capacity for the incoming computing requirements of various systems. A revalidation of the recommendations needs to be done to confirm if suggested measures were taken and if they are aligned with the aspirations of the target architecture.

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<sup>7</sup> Afya House Data Centre Audit Report, Dec 2012

## 4 Description of Target Architecture

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### 4.1 Introduction of the Target Architecture

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The key aim of the target architecture is transition from the “facility” driven architecture which exists today to a more “client” driven architecture as articulated in the architecture vision (see section 3.4.3). The target architecture covers the following four of the five domains:-

- Business Reference Model (BRM)
- Information Reference Model (IRM) or Data Reference Model (DRM)
- Applications Reference Model (ARM)
- Technology Reference Model (TRM)

The Strategy Reference Model is outside the scope of this assignment but an assessment of the baseline was carried out to understand how it drives the other architecture domains.

Besides describing the “what will happen”, use cases have been used to provide a viewpoint of the target architecture based on the various perspectives described below.

It is envisioned that the stakeholders will have perspectives based on the level of interest in the domain under description. Those viewpoints are grouped into the following four levels.

#### 4.1.1 Contextual Level

This is the “30 thousand feet above sea level view” that places the target architecture in the wider context of things outside the architecture domain. For example, one KEPH policy objective is to eliminate conditions that propagate transmission of communicable diseases. The objective is broad and related to all the target domains in some way but is not restricted by the target architecture. This level of view is appropriate for strategic stakeholders who need the bigger picture of the architecture along with considerations that do not have direct bearing on the architecture.

#### 4.1.2 Conceptual Level

This is the “15 thousand feet above sea level view” that provides a general understanding of the target architecture bound by the wider context of the target architecture domains. For example, the KEPH’s policy objective to eliminate communicable conditions has service delivery implications such as providing immunisations. Service is a concept within the target architecture because it is described in registries, accessed via channels and rules of its execution managed in applications. This level of view is appropriate for strategic / tactical stakeholders who wish to have a high level view.

### 4.1.3 Logical Level

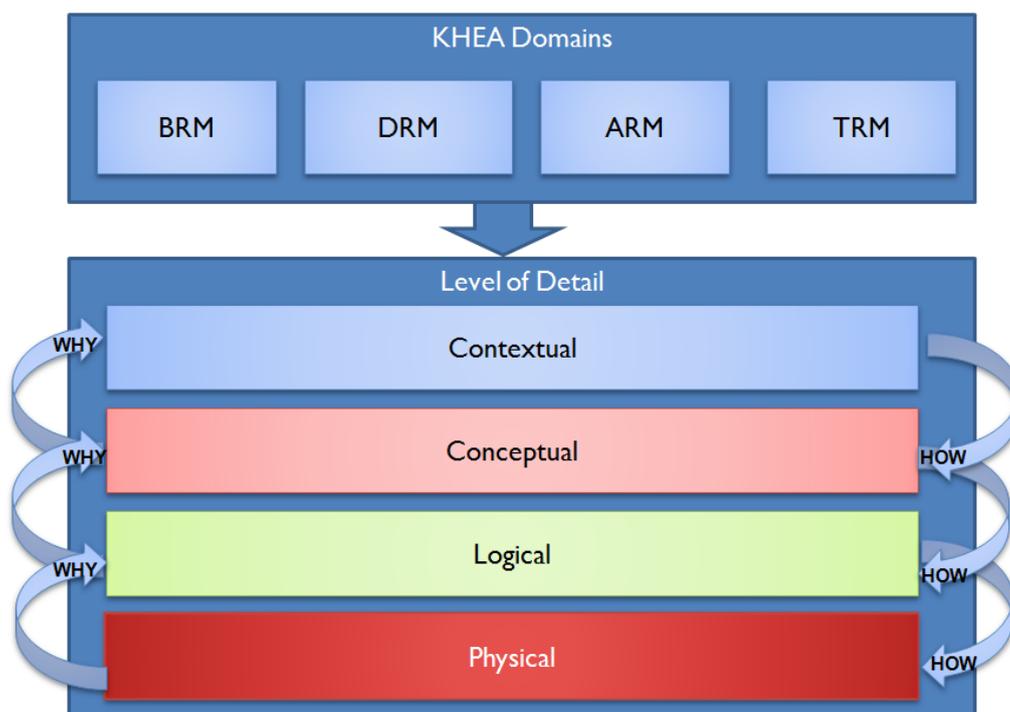
This is the “5 thousand feet above sea level view” that provides a deeper arrangement of concepts in describing the target architecture bound by the wider context of the target architecture domains. For example, the immunisation service is bound by cohorts which implies some rules of identification and profiling of the subjects. It also implies product implication in terms of the demand and supply of vaccine stocks and monitoring of the effectiveness of the immunisation service. This level of view is appropriate for the operational / tactical stakeholders such as developers, analysts and users.

### 4.1.4 Physical Level

This is the “ground zero view” that provides a real-life actualisation the logical view in describing the target architecture. For example, whereas the logical view will know there is an immunisation service in the service registry that is provided on a periodic basis to a particular set of cohorts, the physical level will break that down into something like which vaccine was used on which day for which visitors at which health facility. This level of view is appropriate for the operational stakeholders that are directly involved in delivery of service either as providers or managers.

The domains are illustrated in Figure 15. Moving down (as shown by the arrows on the right), the view looks at the “how” of doing things. The farther down one moves, the more detailed is the level of how to do things. Moving up (as shown by the arrows on the left), the view looks at the motivation (why) of doing things. The further one moves up, the bigger the picture of motivation gets.

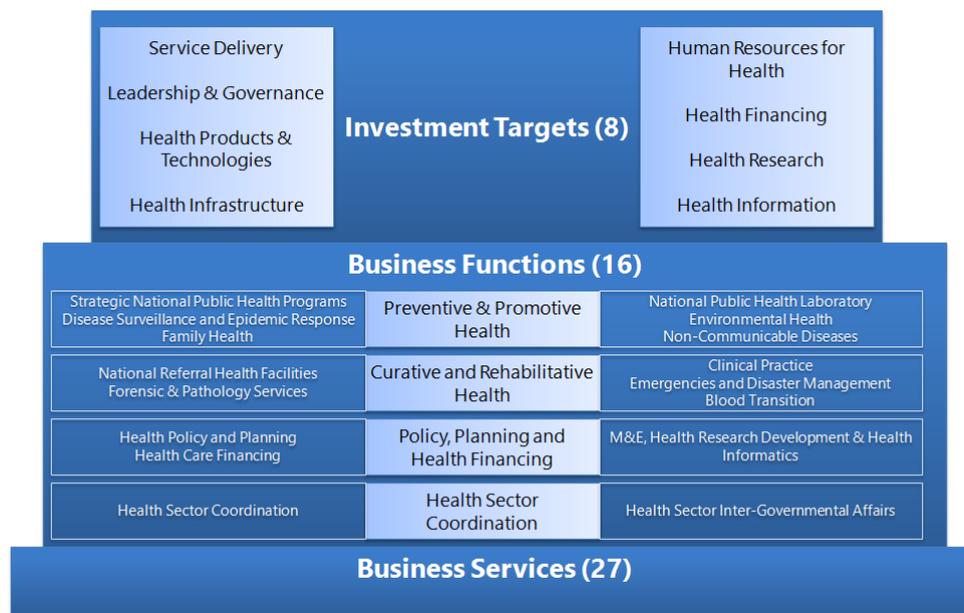
Figure 15 KHEA Viewpoints



## 4.2 Business Reference Model

The purpose of this section is to define the target business architecture. The BRM has been used to describe the type of business functions, services and processes that are performed in the health sector underpinned by the seven investment pillars. By describing the health sector using business functions rather than an organisational view, the BRM promotes cross-sectoral collaboration as described in the stakeholder analysis in section 3.5. The BRM describes the “What we do” of the health enterprise through the definition of outcome-oriented and measurable functions and services.

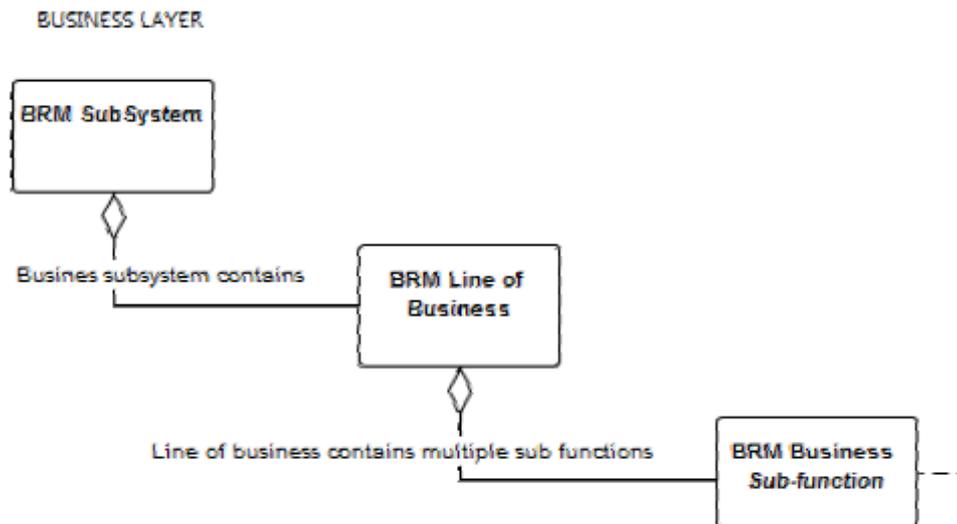
Figure 16. Target BRM



The services catalogue disaggregates the sub-systems identified as investment pillars in the KHSSP into respective lines of business. These lines of business are further disaggregated into business sub-functions.

Essentially, the exercise establishes the relevance of a business service by qualifying such business services through the filter of an investment pillar. In so doing, actors engaging in the business process are also identified; the process itself is later defined as a business sub-function.

Figure 17. BRM Metamodel



#### 4.2.1 Business Architecture Principles

The Government of Kenya has set out a GEA. The architecture principles relevant to the BRM that shall guide the KHEA and the principles shall be inherited from the GEA. The principles as set out within the GEA are:

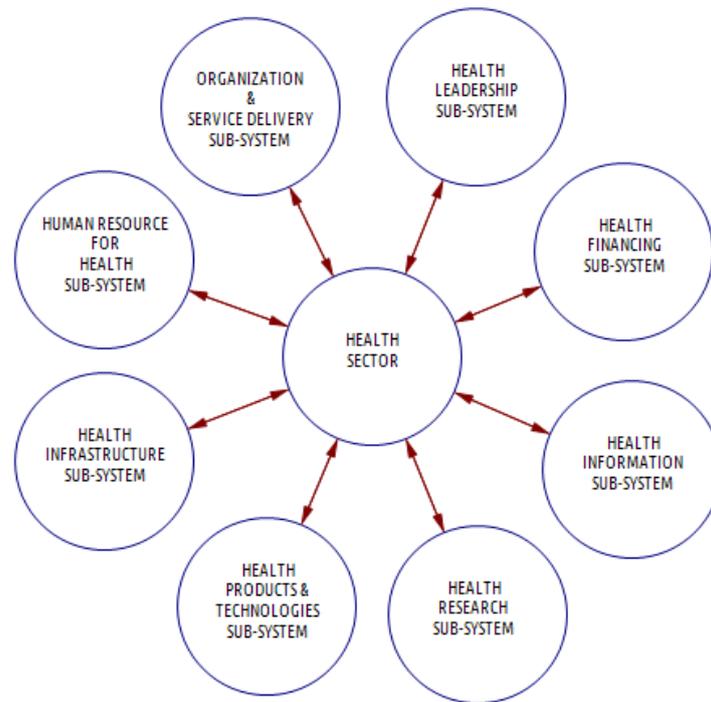
- BAP 1: Business planning
- BAP 2: Common vocabulary
- BAP 3: Simple and flexible
- BAP 4: Technology agnostic
- BAP 5: Public and private collaboration improves public service
- BAP 6: Operations are optimised and simplified
- BAP 7: Systems are designed to assure business continuity

Proposed architecture principles guiding the business architecture are:

- Strategic
- Simple and flexible
- Technology neutral (technology agnostic)

Unifying of actors and goals within the different action areas of investment are highlighted by the KHSSP

**Figure 18. Health Sector sub-systems (Mission Sectors):  
(KHSSP Investment Areas)**



#### 4.2.2 Channel Structure

Business services are delivered via service channels. A service channel is the point of contact between the recipient of service and the provider. Service channels can take a physical or non-physical form. Table 15 describes the types of channels in the target architecture.

**Table 15. Channel Structure**

Channel Interaction Type	Description	Example
Provider-Client (B2C)	Channels that clients use to access the health services	Patients could visit a health facility, use their mobiles to access mhealth, use a phone to talk to a health worker, or be an emergency case brought to facility by ambulance
Provider-Partner (B2B)	Channels that partners use to access non-clinical services	Biometric readers to authenticate patient identity, information exchange portals for billing and collection reconciliation between a provider and a health insurance provider
Provider-Provider (B2B)	Channels that providers use to cross share both clinical and non-clinical services	Ambulances to transfer of patients for referral cases.

Channel Interaction Type	Description	Example
Government-Government (G2G)	Channels governments use to interact in matters that affect the health sector	Stakeholder meetings to discuss governance
Provider-Government (B2G)	Channels that providers use to interact with different health sector regulators	For example, registration of a health facility may require a visit to the certifying authority or access to a website to upload requisite information
Client-Government (C2G)	Channels that government uses to interact with the end client. They may be interactive or informational.	Mass media campaigns on immunisation etc.

#### 4.2.2.1 Channel structure use case

The use cases of the channels provide information on actions or events and the expected outcomes. The table below provides possible use cases (indicators), provide the view levels, managerial interests stakeholders and the possible scenario.

**Table 16. Channel Use Case**

Use Case	Improve access to KEPH by at least 90%	
View Level	Interest	Scenario
Contextual	Strategic stakeholders	What is the percentage of B2C interactions compared to the total needs for health service?
Conceptual	Strategic / tactical stakeholders	What is the spread of B2C interactions in relation of the types of various service channels (physical and non-physical)?
Logical	Tactical stakeholders	What is the mix of B2C channel interactions in terms of effectively dealing with health needs? For example, how many hoops does a patient go through in order to finally access service? Does the patient move from facility to facility via a cycle of referrals?
Physical	Operational stakeholders	What is the effectiveness of the service delivery through particular channels? For example, how many patients use the call centre to make inquires vis a vis visiting the health facility?

## 4.2.3 Organisation of Service Delivery

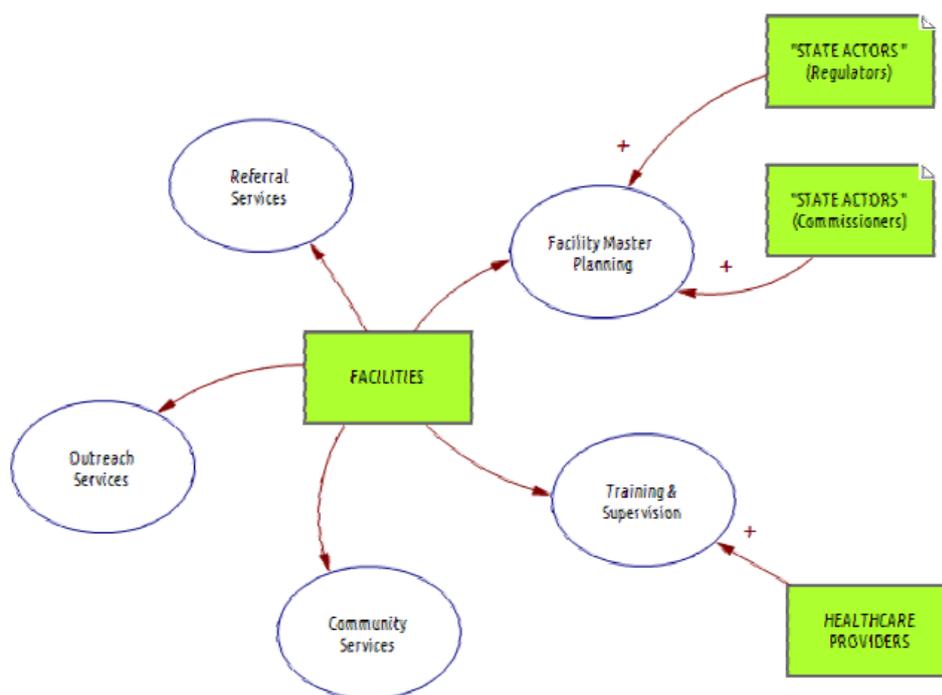
### 4.2.3.1 Summary of key services

**Table 17. Summary of Business Services**

Service	Description
Community services	How communities are able to engage in improving their health
Referral services	How services are planned and delivered across different types of facilities. The focus is on ensuring holistic delivery of services
Outreach services	How services (preventive and curative) are supplied to communities as per their needs
Supervision	How health workers are mentored and supported to continually improve their skills and expertise in providing quality services
Organisation of services within facilities	How the facilities organise themselves internally to provide and manage care delivery

The services are illustrated in Figure 19.

**Figure 19. Organisation and Service Delivery Subsystem**

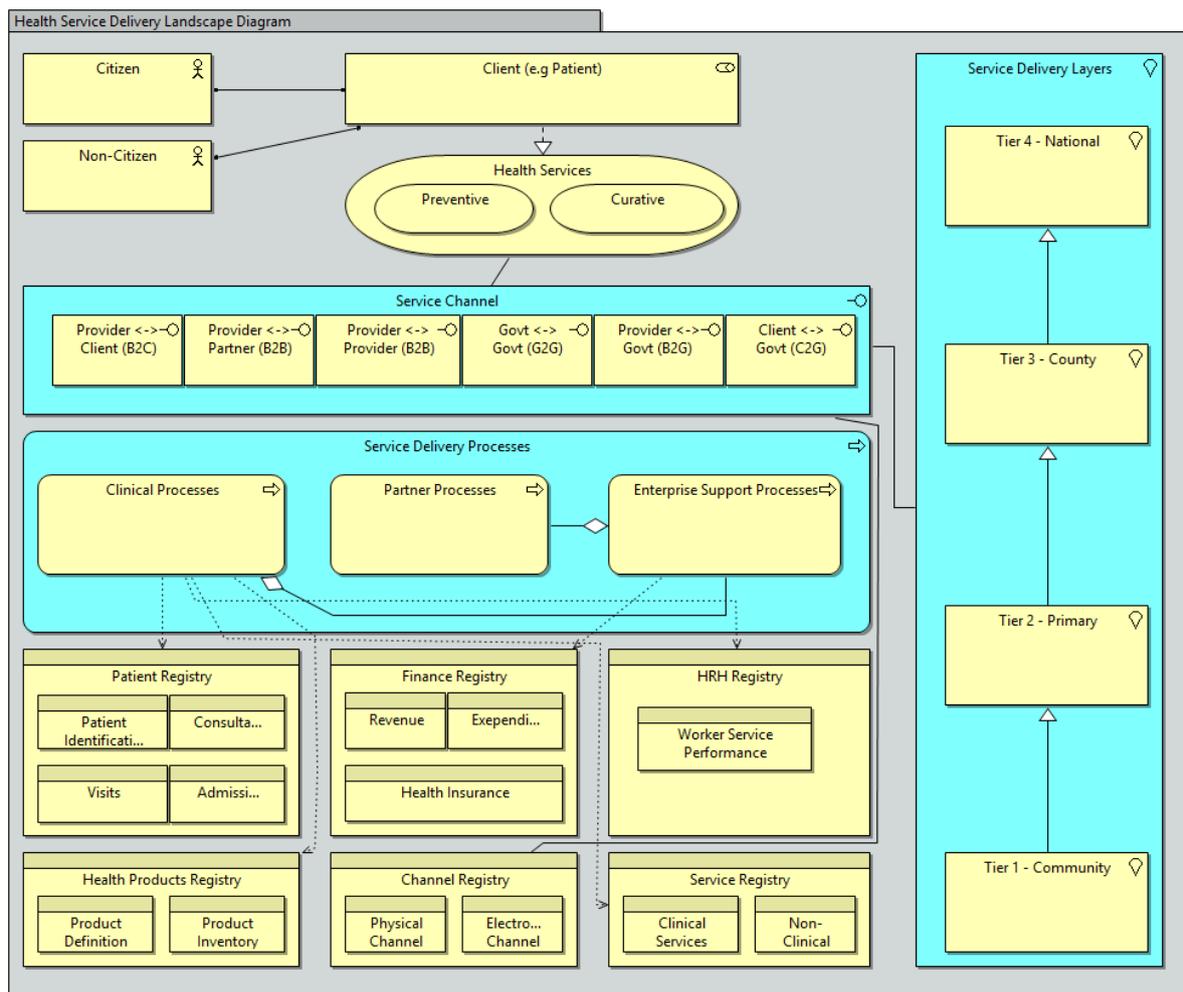


### 4.2.3.2 Envisioned process flow

A **client**<sup>8</sup>, whether a citizen or non-citizen, will be able to access health services through **service channels**. The health sector will need to define which services should be accessible through which channels for which clients. For example, how will an e-health information service for patient inquiries

<sup>8</sup> A client is a recipient of service in the health enterprise.

Figure 20. Service Delivery Process Model



A channel that is enabled to access a service will activate the business process required for that service. For example, a client’s entry into a facility immediately triggers clinical and non-clinical processes. The client is identified, a medical file is opened if it is the first visit and an initial observation is performed before the client is allowed to see a clinician. At this moment, it is critical for the sector to consider every detail about the client as vital because this is the base collection point of routine health data which ultimately populate several registries. An outpatient visit will likely hit six registries, namely:

1. Patient Registry
2. Finance Registry
3. HRH Registry
4. Service Registry
5. Channel Registry
6. Health Products Registry

Refer to the section on IRM to understand the purpose, structure and content of each information registry.

#### 4.2.3.3 Service delivery use case

**Table 18. Service Delivery Use Case**

Use Case	Improve by 50% the quality of service delivery at all levels of the system through innovative mechanisms	
View Level	Interest	Scenario
Contextual	Strategic stakeholders	What is the overall percentage score of service delivery in the sector?
Conceptual	Strategic / tactical stakeholders	Which types of services are below 50% and what levels do they occur?
Logical	Tactical stakeholders	What types of services are being offered and at what levels. Do these levels have adequate capacity to deliver the services?
Physical	Operational stakeholders	What is the average time it takes to provide general outpatient service?

#### 4.2.3.4 Graphical representation at logical level

**Figure 21. Use Case Model (0)**

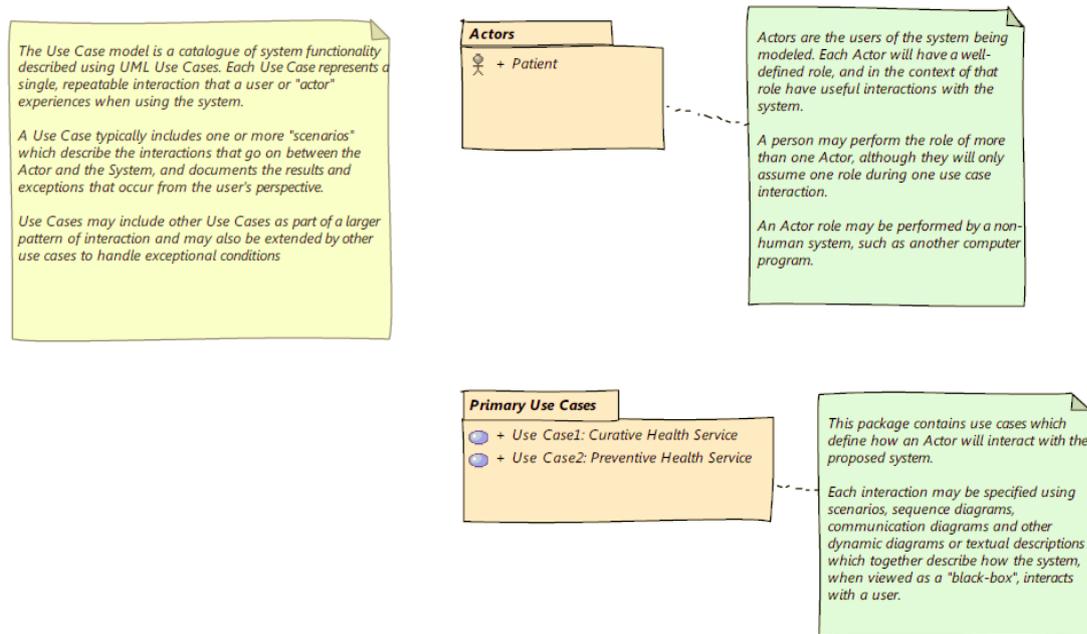


Figure 22. Use Case Model (1)

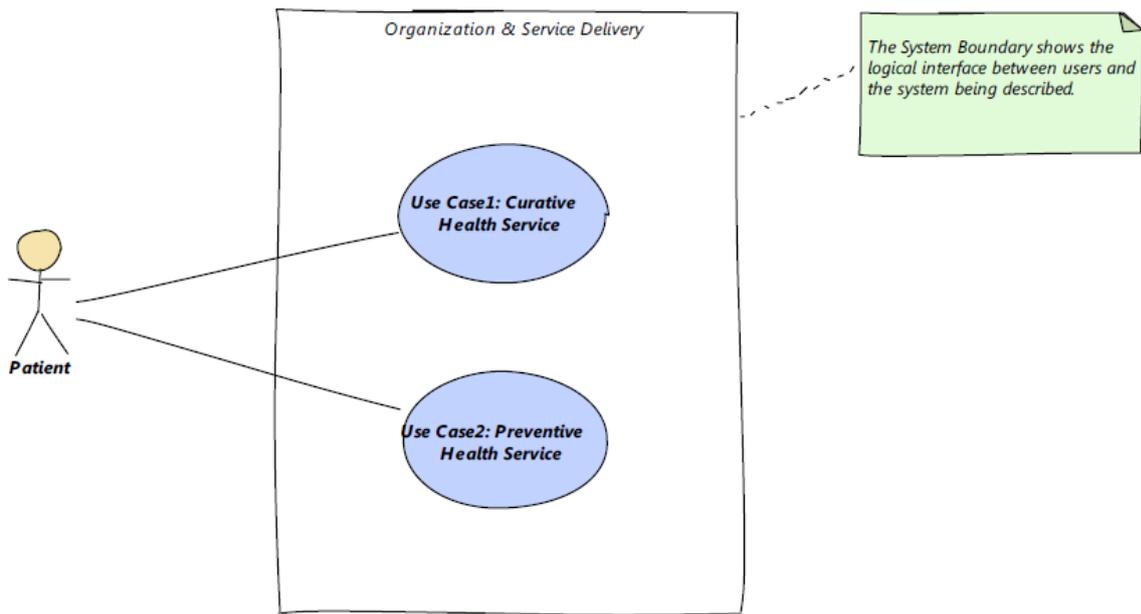
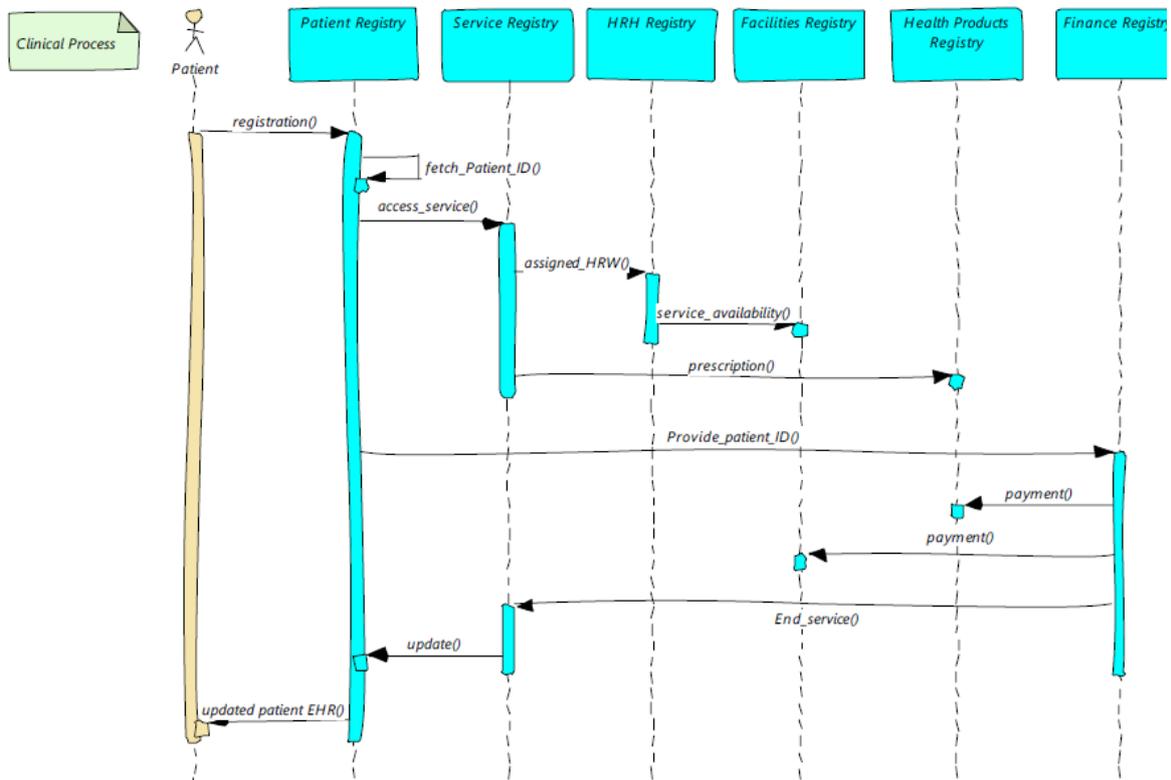


Figure 23. Use Case Model (2)



## 4.2.4 Human Resources for Health

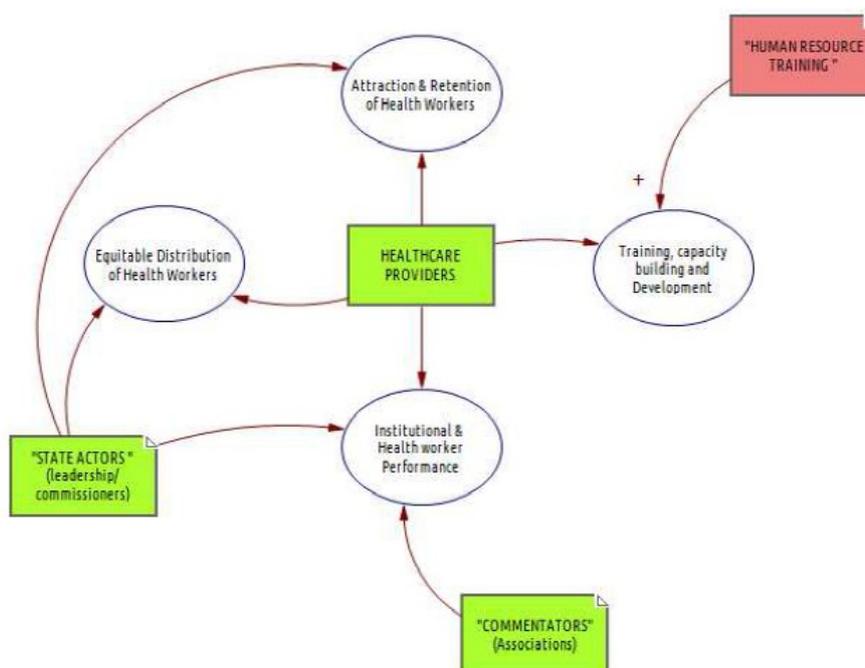
### 4.2.4.1 Summary of key services

Table 19. HRH Services

Service	Description
HRH sourcing	Attraction and retention of health workers
HRH distribution	Health worker placement in line with demand and equity
HRH performance management	Improvement of institutional and health worker performance
HRH training and capacity development	Development of the health workforce knowledge and skills

The services are illustrated in Figure 24.

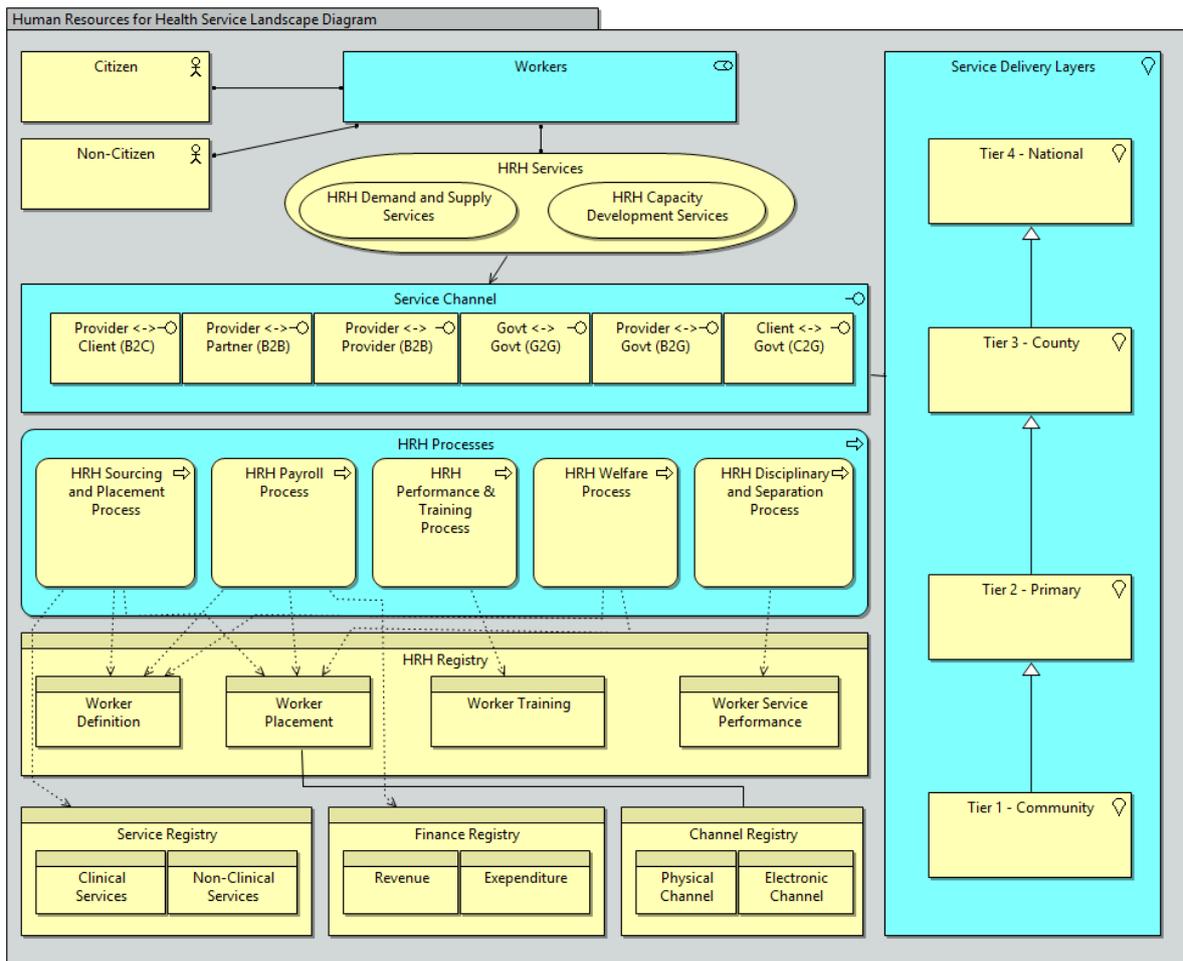
Figure 24. Human Resource for Health Sub-system



#### 4.2.4.2 Envisioned process flow

A worker / potential worker will access HRH services via service channels. A health worker might participate in the recruitment process under **HRH sourcing and placement** by submitting an application via a physical or non-physical channel. The candidate is evaluated and once he or she is recruited, the records are created in the right system.

Figure 25. HRH Process Model



A health worker recruitment process is likely to hit four registries, namely;

1. HRH Registry
2. Finance Registry
3. Service Registry
4. Channel Registry

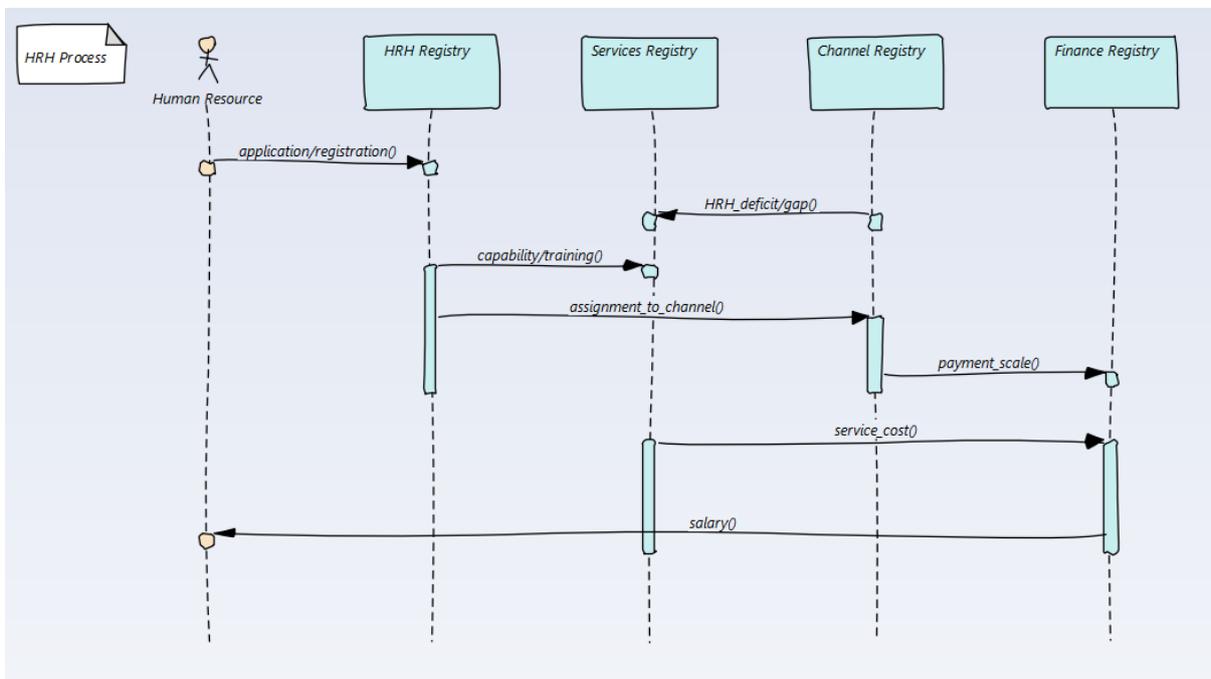
Refer to the section on the IRM to understand the purpose, structure and content of each information registry.

### 4.2.4.3 HRH use case

Table 20. HRH Use Case

Use Case	Appropriate and equitably distributed health workers	
View Level	Interest	Scenario
Contextual	Strategic stakeholders	What is the overall skill gap ratio of the health workers?
Conceptual	Strategic / tactical stakeholders	What is the supply of skills and rate of absorption in the various facilities at various levels?
Logical	Tactical stakeholders	Does the distribution of health workers within a facility adequately address the needs of that community?
Physical	Operational stakeholders	What is the turnaround time to deploy a health worker in a facility?

Figure 26. HRH Example Use Case Model



## 4.2.5 Health Products and Technologies

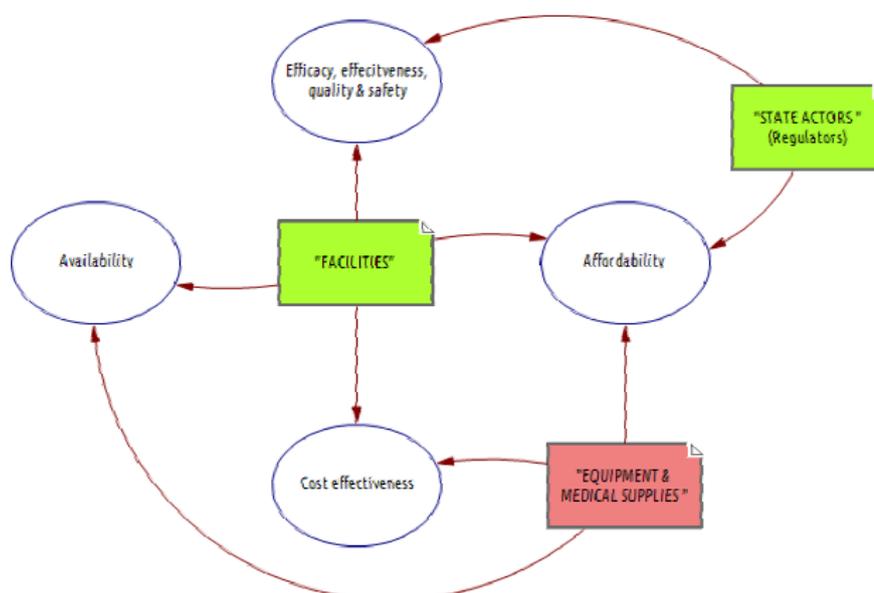
### 4.2.5.1 Summary of key services

**Table 21. Health Products Services**

Service	Description
Regulatory	Ensuring that all HPTs meet the established standards of quality, safety and efficacy/performance. Investments will focus on the ongoing restructuring of the medicines regulatory system, which comprises the PPB and the National Quality Control Laboratory, into a full-fledged Food and Drugs Authority.
Assessment	Assessment of clinical effectiveness in the context of the national healthcare system, including cultural and ethical considerations. Health technologies assessment provides evidence-based guidance (guidelines, protocols, lists, etc.) on appropriate technologies for specific levels of care and clinical settings. Investments will focus on strengthening the Essential Medicines List and Clinical Guidelines and establishing an assessment system for medical devices (medical supplies, diagnostics, etc.).
Supply chain management	Procurement and supply (at all levels of the system); prescribing and dispensing of the products in accordance with established guidelines and protocols; monitoring and educating consumers on appropriate use. Investments will primarily target the ongoing reform of KEMSA, and mechanisms will be created to link to the supply systems of non-state actors (FBO, NGO and private) through accreditation and effective monitoring

The services are graphically represented in Figure 27.

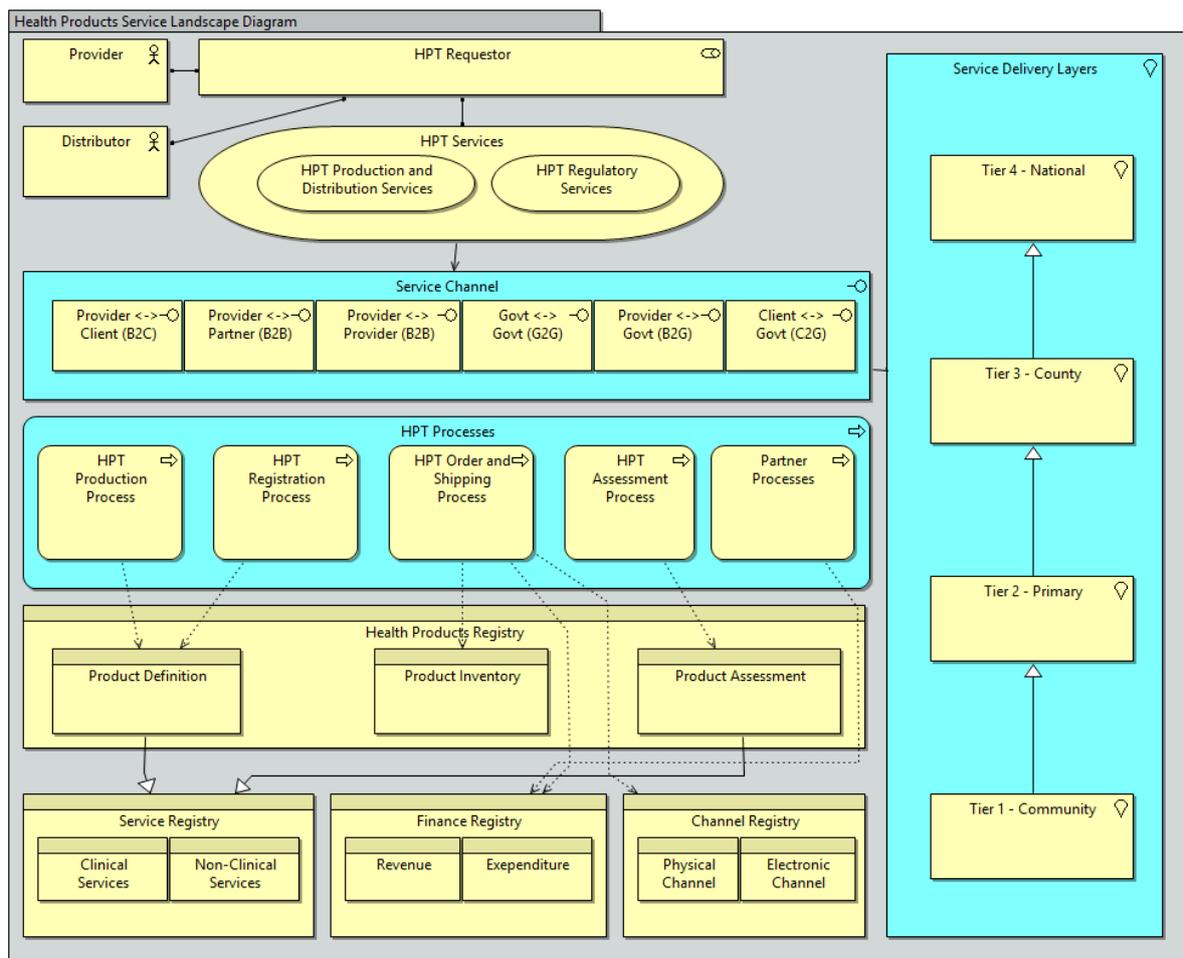
**Figure 27. Health Products Technologies Sub-system**



#### 4.2.5.2 Envisioned process flow

A HPT requestor (either a distributor such as KEMSA or a provider such as a facility) will access HPT services via service channels. The stock requisition might flow through any of the service channels, physical or non-physical, for which HPT business services has been enabled. Upon order fulfilment, a number of information registries will be updated with the order information.

Figure 28. Health Products Process Model



A HPT order fulfilment process is likely to hit four registries, namely;

1. Health Product Registry
2. Finance Registry
3. Service Registry
4. Channel Registry

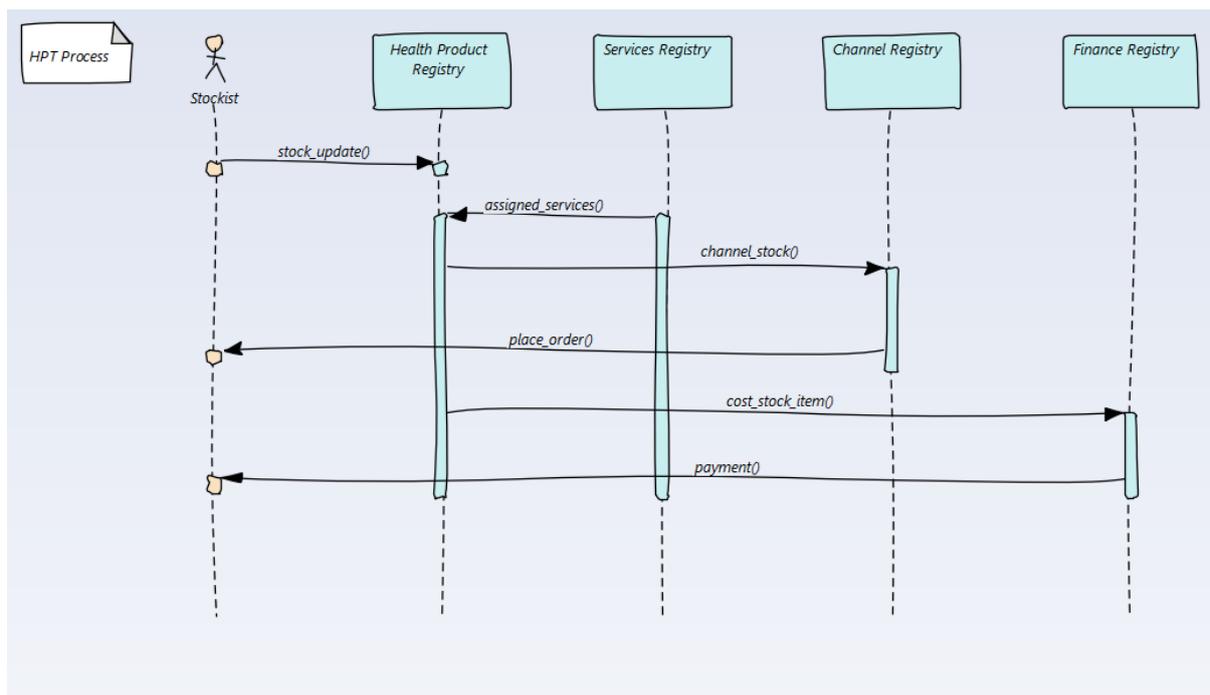
Refer to the section on the IRM to understand the purpose, structure and content of each information registry.

### 4.2.5.3 HPT use case

**Table 22. HPT Use Case**

Use Case	Assuring up to 80% of the Health Product supply needs are addressed	
View Level	Interest	Scenario
Contextual	Strategic stakeholders	What is the overall demand / supply gap ratio of the health products?
Conceptual	Strategic / tactical stakeholders	What are the types of linkages between the supply side of products and the rate of absorption in the various facilities at various levels?
Logical	Tactical stakeholders	Is the approach to inventory management of health products similar amongst the facilities at various levels? What are the gaps? How do these gaps impact supply?
Physical	Operational stakeholders	Is there a universal and generally accepted coding standard for health product for ease of ordering, stocking and dispensing?

**Figure 29. HPT Example Use Case Model**



## 4.2.6 Health Infrastructure

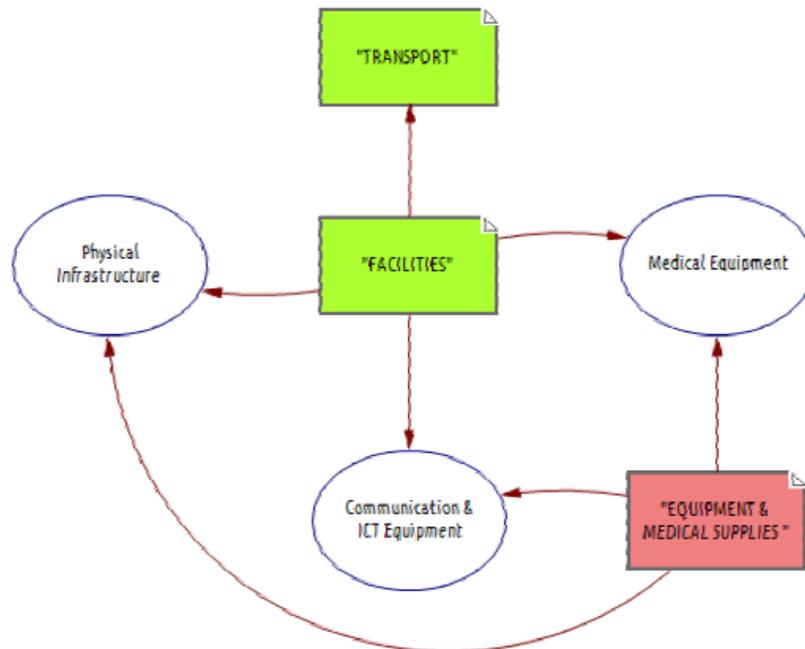
### 4.2.6.1 Summary of key services

- Physical infrastructure
- Medical equipment
- Communication and ICT

- Transport

Summary of services is graphically illustrated in Figure 30.

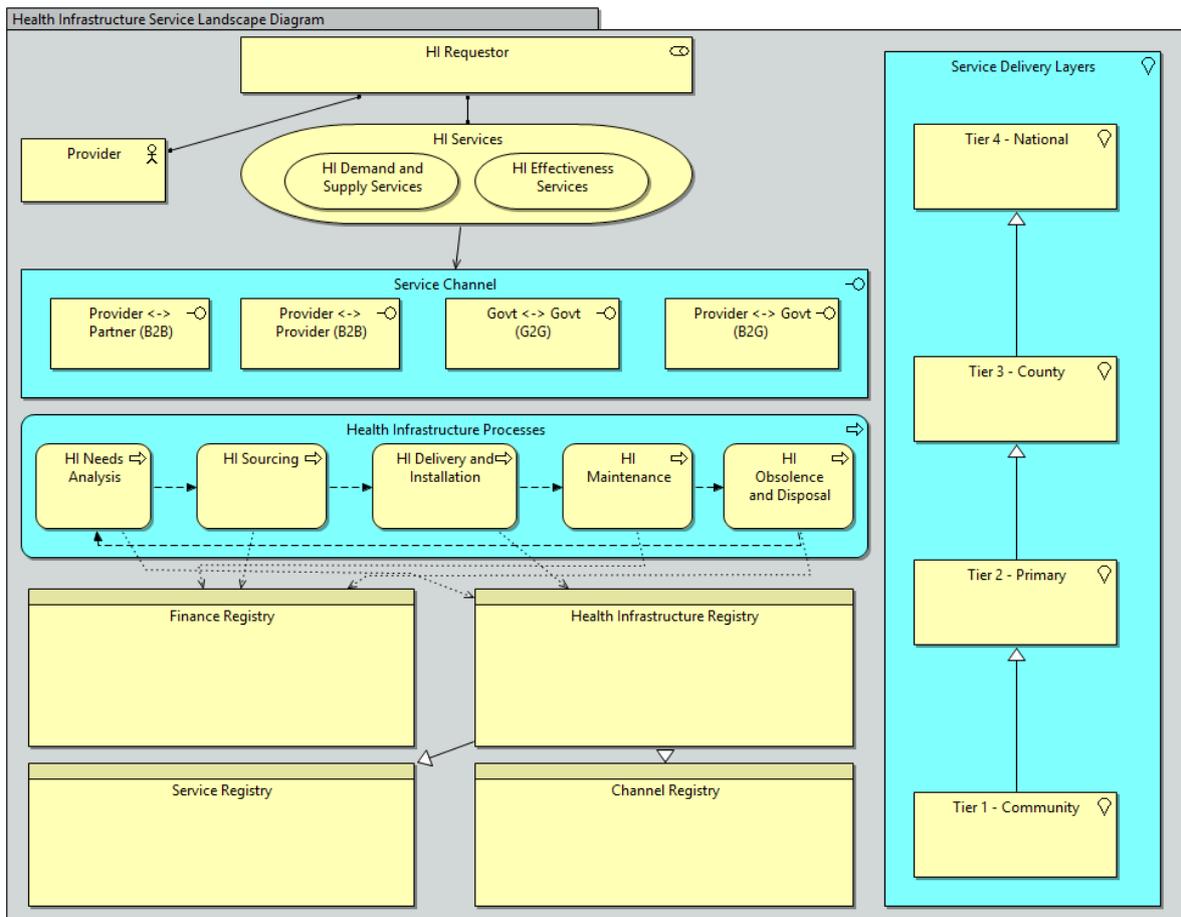
**Figure 30. Health Infrastructure Sub-system**



#### 4.2.6.2 Envisioned process flow

A health infrastructure requestor (a provider, e.g. a facility) will access health infrastructure services via service channels as they are described in section 5.2.1. A requestor may be making a purchase or medical equipment through any of the service channels for which health infrastructure business services has been enabled. This could be a physical or non-physical channel. Upon completion of the equipment acquisition and installation in the facility, and a few registries will be updated with the asset information.

Figure 31. Health Infrastructure Process Model



A health infrastructure medical equipment purchase process is likely to hit four registries, namely:-

1. Health Infrastructure Registry
2. Finance Registry
3. Service Registry
4. Channel Registry

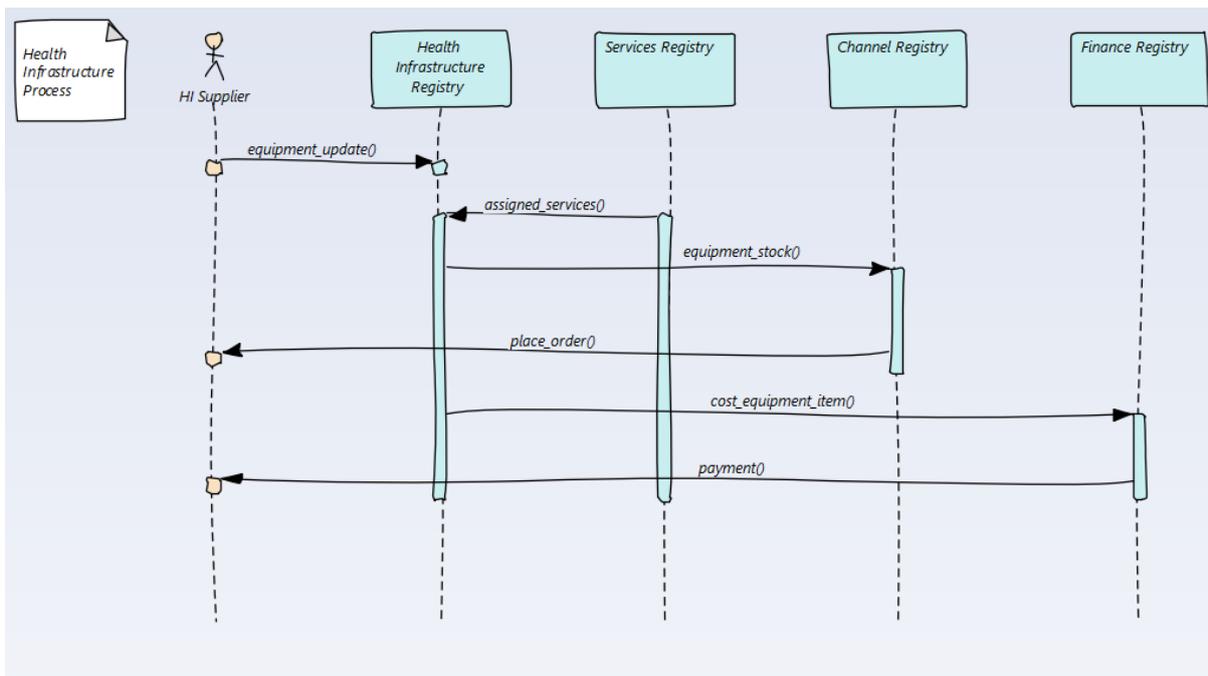
Refer to the section on the IRM to understand the purpose, structure and content of each information registry.

### 4.2.6.3 Health Infrastructure use case

**Table 23. Health Infrastructure Use Case**

Use Case	Improve geographical access of the population to the KEPH to at least 90% of the population	
View Level	Interest	Scenario
Contextual	Strategic stakeholders	What is the ratio of population to available functional physical infrastructure that provide health care?
Conceptual	Strategic / tactical stakeholders	How is the geographic distribution of functional health facilities by level and by type of services provided?
Logical	Tactical stakeholders	Which facilities don't meet the minimum requirement of the level of rating?
Physical	Operational stakeholders	What is the life in years of the critical medical equipment within a facility?

**Figure 32. Health Infrastructure Example Use Case Model**



## 4.2.7 Health Leadership and Governance

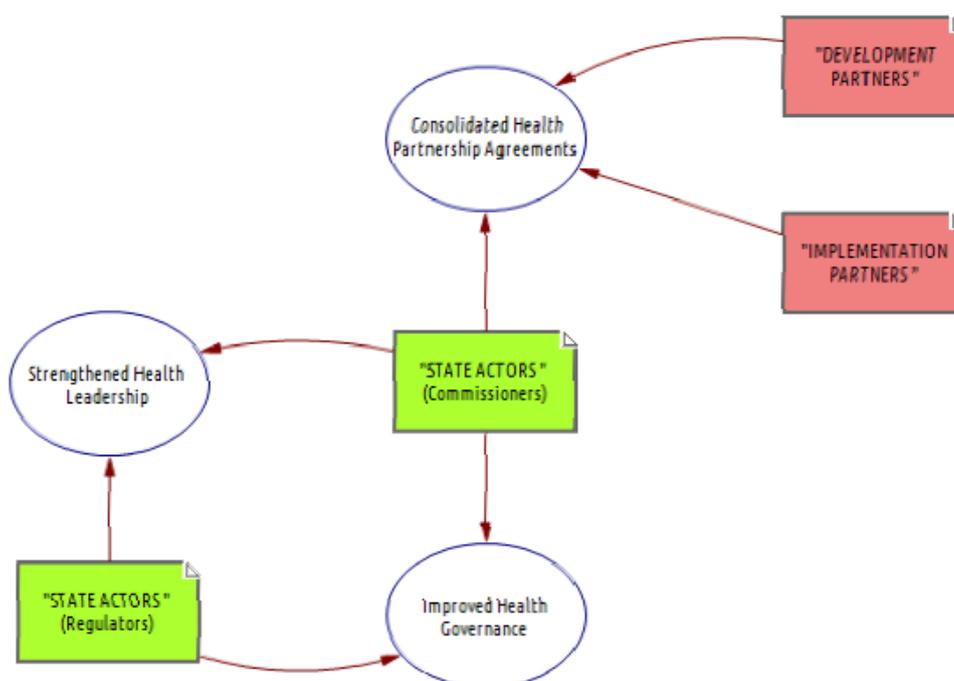
### 4.2.7.1 Summary of key services

**Table 24. Leadership Services**

Service	Description
Health stewardship	Stewardship relates to the management function of the government, through the MoH and is built around implementation of the mandate of that Ministry.
Health governance	Governance relates to the functioning of the institutions by which the authority of the State of Kenya is exercised. These address the regulatory and legal functions to which all actors in the sector must adhere, and are built around the sector legal and regulatory framework.
Health partnership	Partnership relates to the interrelations and coordination of different actors working towards the same goals, and is built around the adherence to the sector partnership Code of Conduct.

The services are graphically represented in Figure 33.

**Figure 33. Health Leadership Sub-system**

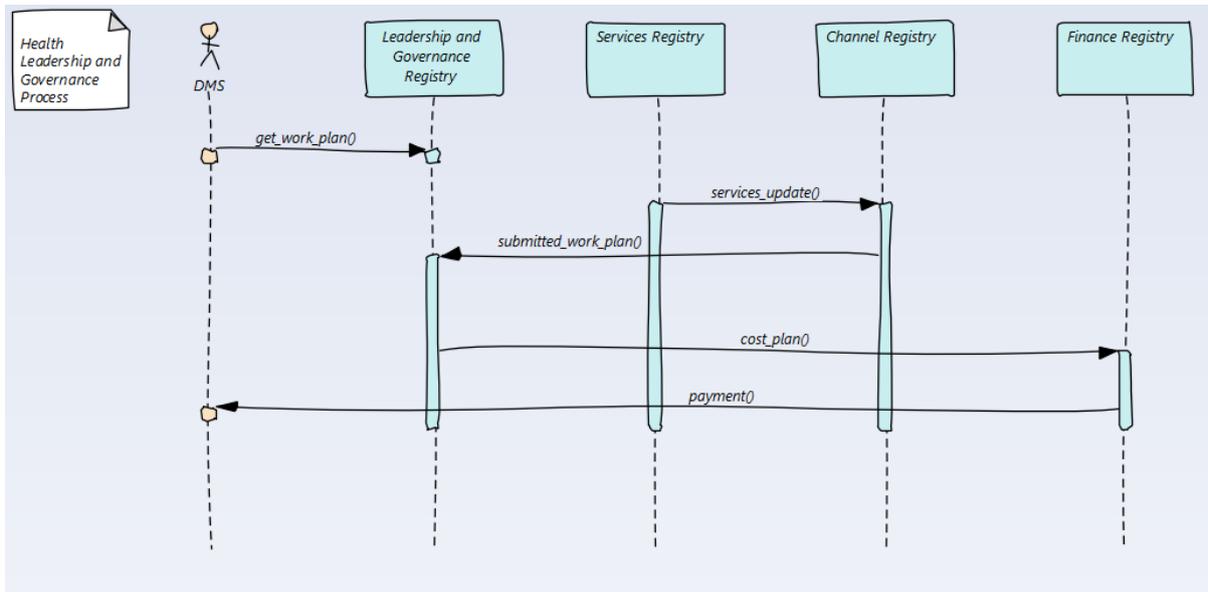


#### 4.2.7.2 Health leadership use case

**Table 25. Health Leadership Use Case**

Use Case	Consolidated Health Partnership arrangements	
View Level	Interest	Scenario
Contextual	Strategic stakeholders	What does the partner network currently look like with regards to execution of national and county health strategic plans?
Conceptual	Strategic / tactical stakeholders	Which partner linkages are similar yet run in a fragmented way? What is the quality of partner agreements?
Logical	Tactical stakeholders	How does the partner engagement / disengagement process work?
Physical	Operational stakeholders	How many agreements are still in force at various levels? What is the stage of execution of each?

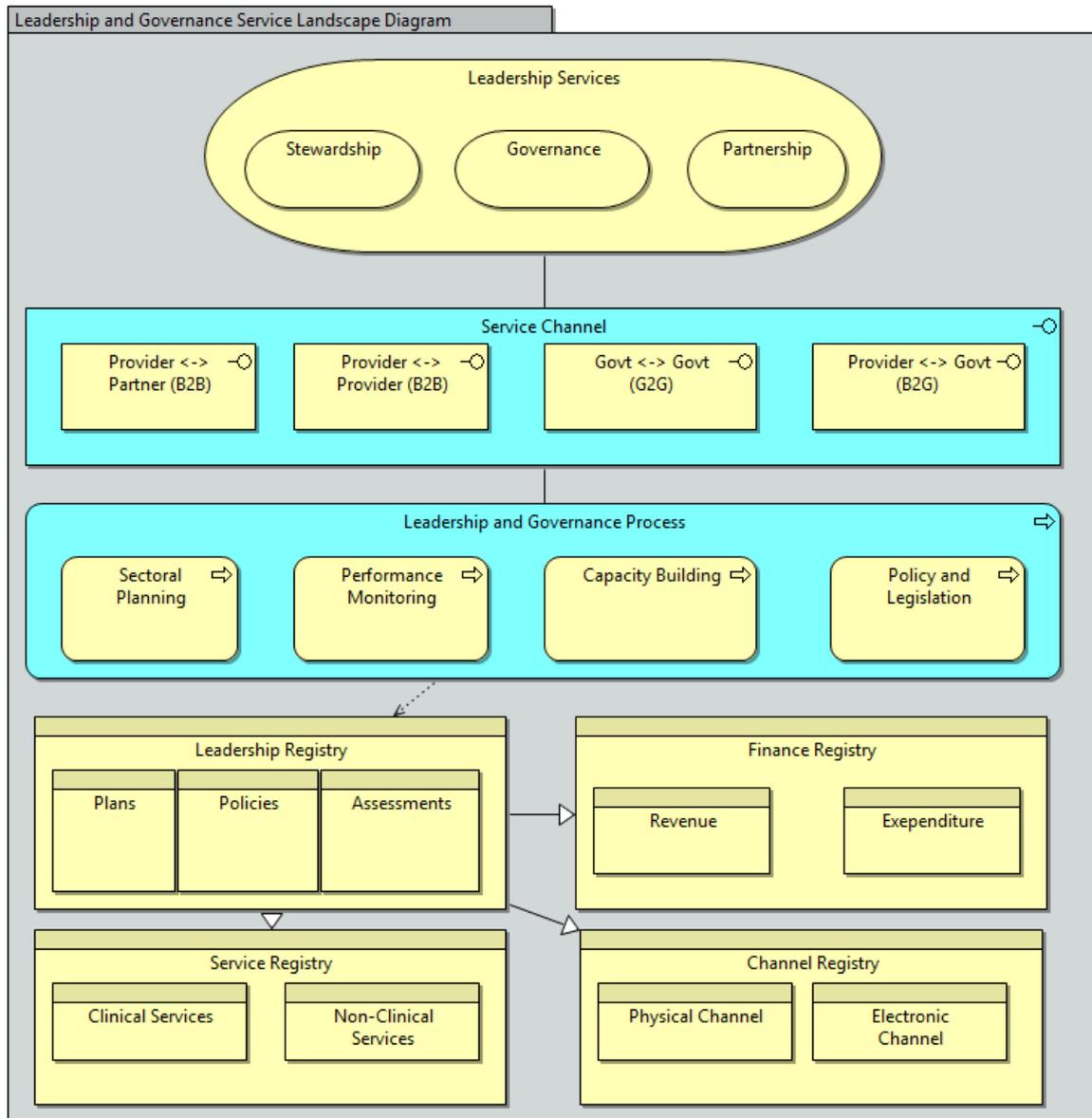
**Figure 34. Leadership Example Use Case Model**



#### 4.2.7.3 Envisioned process flow

Leadership and Governance services will be available via service channels as described in section 5.2.1. An activity such as, “Carry out Annual Work Planning to guide priority operations at all levels of the sector”, would require looking at the individual plans at various levels and harmonising common projects in order to guide implementation. The process would require an adoption of a common calendar, the required input from each of the stakeholders and how to track and measure the outcomes of each activity.

Figure 35. Leadership Process Model



A leadership and governance activity to harmonise planning is likely to hit four registries, namely:-

1. Leadership and Governance Registry
2. Finance Registry
3. Service Registry
4. Channel Registry

Refer to the section on the IRM to understand the purpose, structure and content of each information registry.

## 4.2.8 Health Financing

### 4.2.8.1 Summary of key services

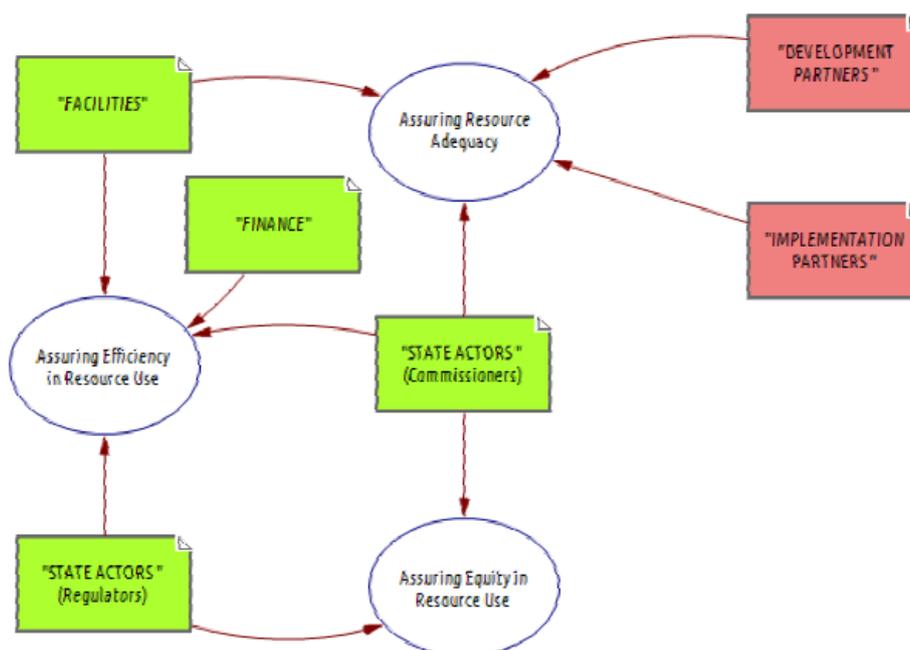
**Table 26. Health Financing Services**

These services determine how finances are generated, allocated and used in health systems for better health outcomes. The table below provides a list of services and the corresponding description.

Service	Description
Sourcing services	Availing financial resources to finance health service. This is done through various means and sources such as budget allocation, health insurance, out-of-pocket payments and donor funding
Allocation services	Apportioning the availed financial resources to finance health service in an equitable manner.
Utilisation services	Tracking the utilisation of financial resources to assure that they are efficient in providing value for money health services.

Summary of services is illustrated in Figure 36.

**Figure 36. Health Financing Sub-system**



#### 4.2.8.2 Health financing use case

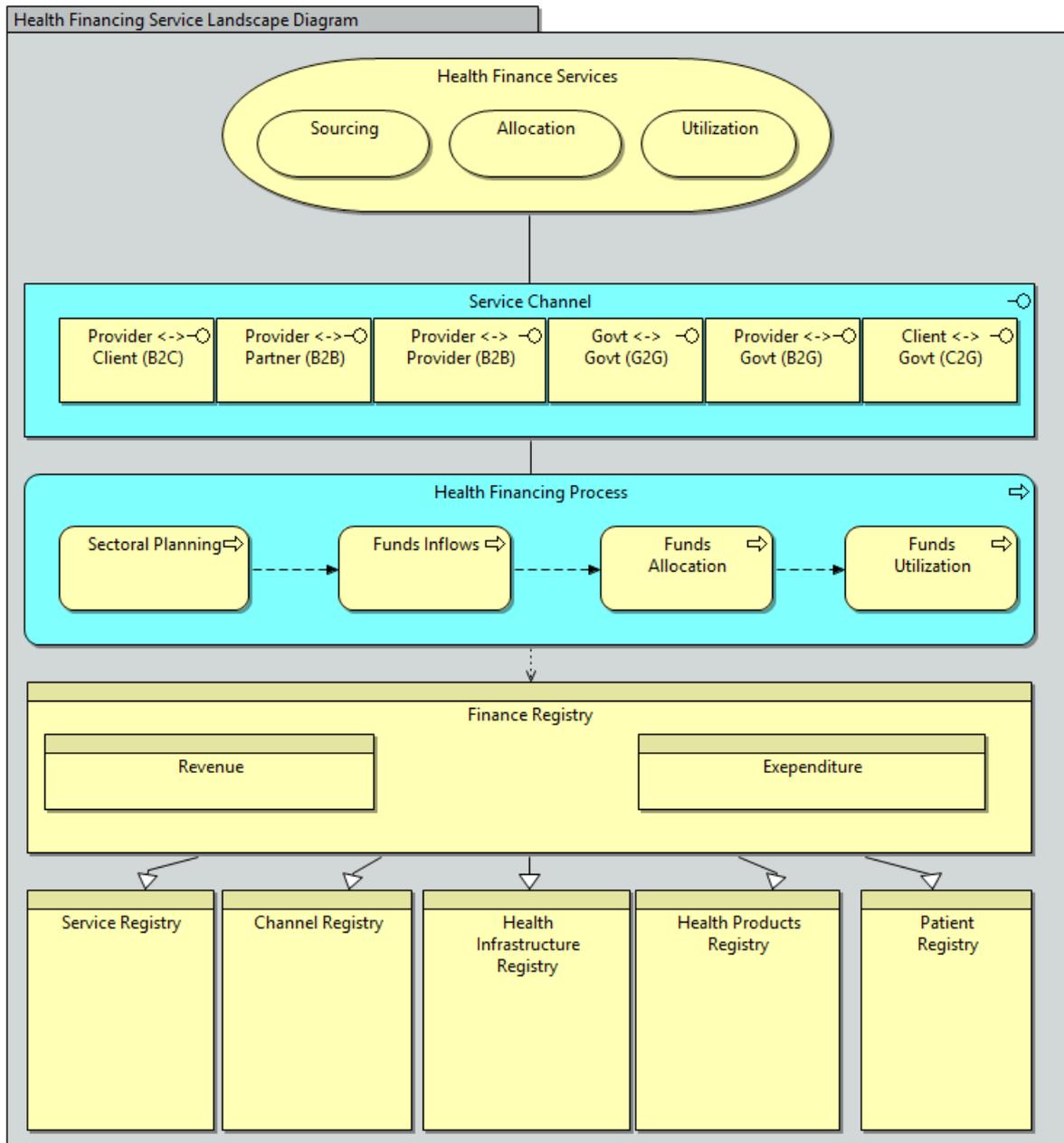
**Table 27. Health Financing Use Case**

Use Case	Equitable resource utilisation	
View Level	Interest	Scenario
Contextual	Strategic stakeholders	What is the impact of investment in health sector? Is there value for money?
Conceptual	Strategic / tactical stakeholders	What is the breakdown of investment in respect to the pillars of the health sector?
Logical	Tactical stakeholders	How is the spread of investment vis a vis the demand for investment in the pillar domains? For example, are too many facilities being opened for the number of health workers being deployed or the amount of health commodities being stocked in those facilities?
Physical	Operational stakeholders	How much of the funding allocated to a county health facility has been absorbed and how much of the absorption is actually impacting the end client? For example, in a new facility, how many of the new maternity wards actually provide service?

#### 4.2.8.3 Envisioned process flow

Health finance services are sub-classified into the three categories of sourcing, allocation and utilisation as described in section 6.2.7.1. A funds inflow might be that of an out-of-pocket payment from a patient for health services received, and might take place through a physical service channel like a health facility.

Figure 37. Health Financing Process Model



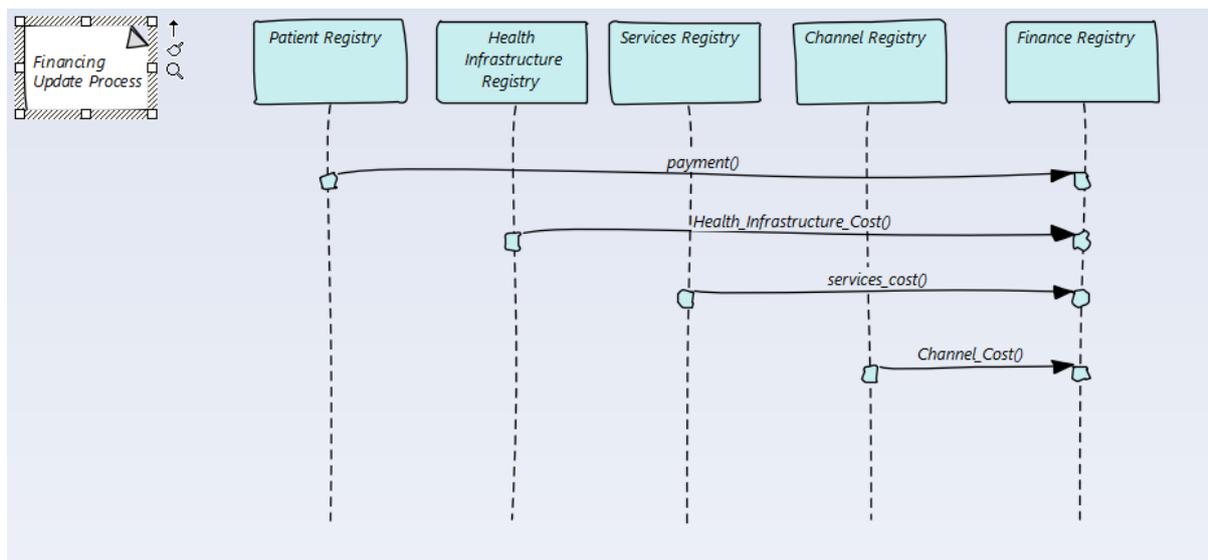
Health financing services in any of the three sub-categories will likely hit at least one, or possibly all of the six registries, namely:-

1. Finance Registry (the base registry recognising the funds )
2. Service Registry (if financing was for payment of a health service)
3. Channel Registry (if financing was for payment of a service delivered by a particular service channel)
4. Health Infrastructure (if the financing was for purposes of acquisition of infrastructure)

5. Health Products Registry (if the financing was for purposes of acquisition of health commodities)
6. Patient Registry (if financing was payment received by a patient for a particular health service)

Refer to the section on the IRM to understand the purpose, structure and content of each information registry.

**Figure 38. Financing Example Use Case Model**



## 4.2.9 Health Information and Health Research

### 4.2.9.1 Summary of key services

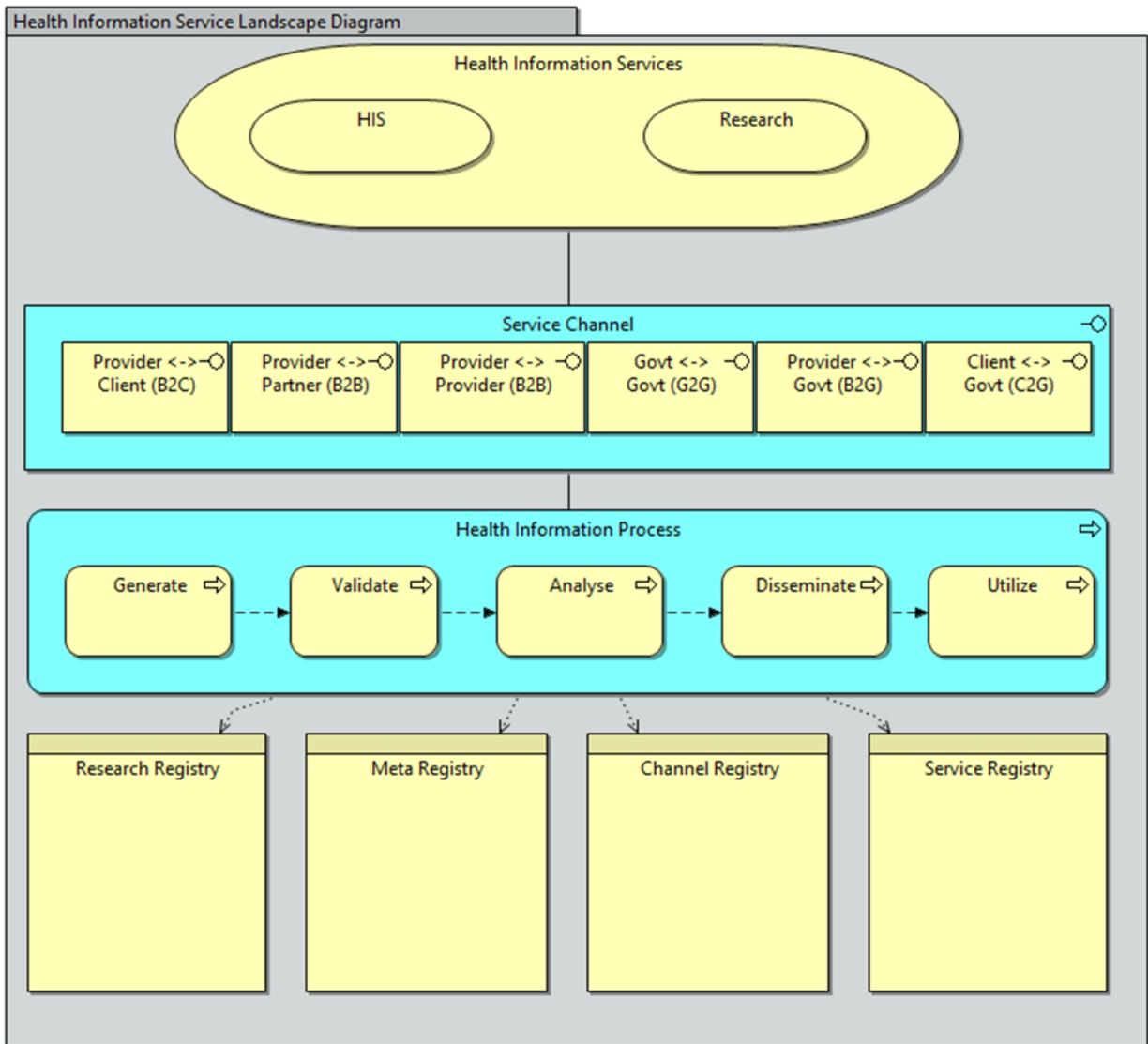
**Table 28. Health Information / Research Services**

Service	Description
Information generation	The process of collecting and storing different forms of information
Information validation	The process of reviewing the information to improve its accuracy and representativeness
Information analysis	The process of understanding what the information is saying
Information dissemination	The process of sharing the information emerging from the analysis with relevant stakeholders
Information utilisation	The process of assuring the information that is available is informing the decision making process

### 4.2.9.2 Envisioned process flow

Health information services are sub-classified into the two categories of HIS and health research as described in section 6.2.8.1. The overall processes are almost identical. From generation up to utilisation of information, the process will be via physical or non-physical service channels.

Figure 39. Health Information / Research Process Model

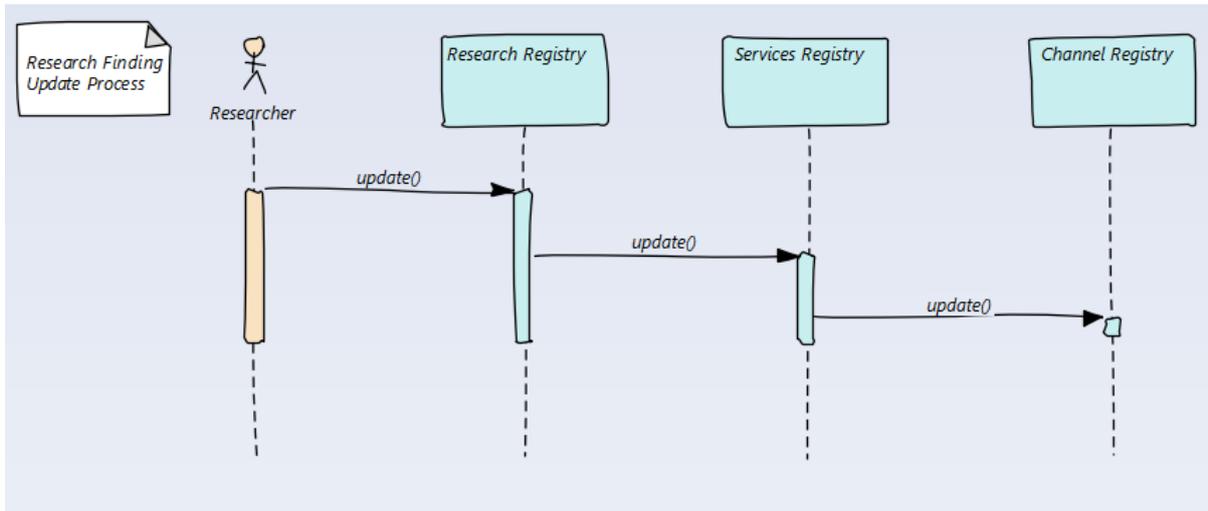


Health information services in any of the sub-categories will likely hit at least one, or possibly all of the four registries, namely:-

1. Research Registry (the base registry recording research findings based on the subject area)
2. Service Registry (reference registry for which a research project is based or a request for information service is placed)
3. Channel Registry (the channel through which information service request is to be fulfilled)
4. Meta Registry (the base directory of registries that identifies which request should be serviced by which registry)

Refer to the section on the IRM to understand the purpose, structure and content of each information registry.

Figure 40. Research Example Use Case Model



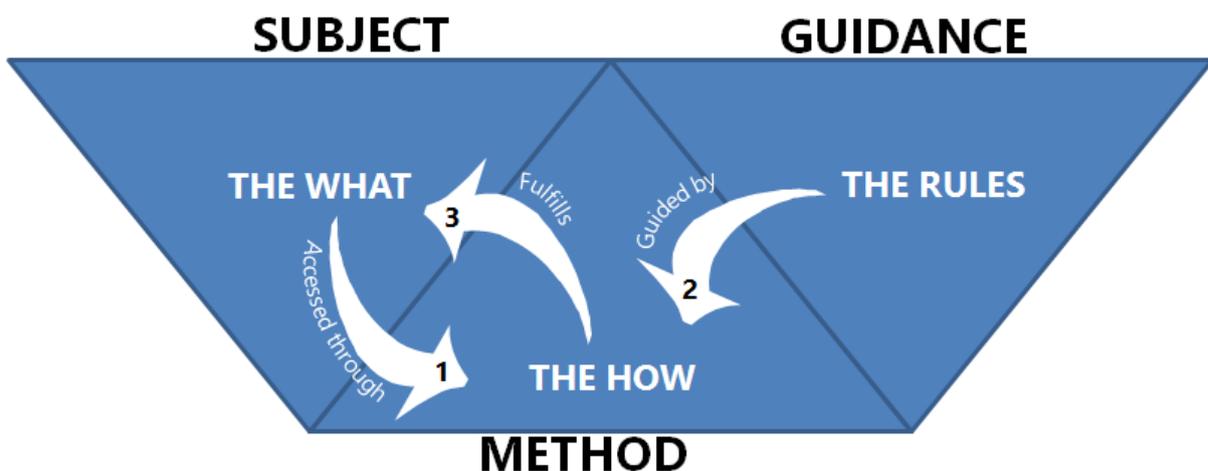
## 4.3 Information Reference Model

### 4.3.1 Introduction

The target IRM will enable discovery of data residing in registries that shall be organised in line with investment pillars of the health sector. It shall also enable the understanding the meaning of the data, how to access it, and how to leverage it to support evidence-based decision making.

In arriving at the data services and data objects definition, the design has adopted the approach shown in Figure 41.

Figure 41. Ontology of IRM



This design takes into consideration:-

- **Methods** - The means through which data are created or shared in the landscape. Methods are aligned to the business services in the investment

pillars described in the BRM. For example, *fetch patient file* is a method by which patient identification information is accessed from the Patient Registry.

- **Subjects** – Tangible items or objects of business interest. Examples are a patient, a health facility and a health product. Subjects are presented in information registries. They have been organised using the FEAF DRM Model.
- **Guidance** – A set of governance tools that determine how methods and artifacts interact. For example, a request for information from the service registry requires use of the right service catalog key; such data are protected and accessed only by authorised personnel. The enforcement of standards will be at this layer of data services.

#### 4.3.1.1 Data Principles

**Table 29. KHEA Summary Data Architecture Principles**

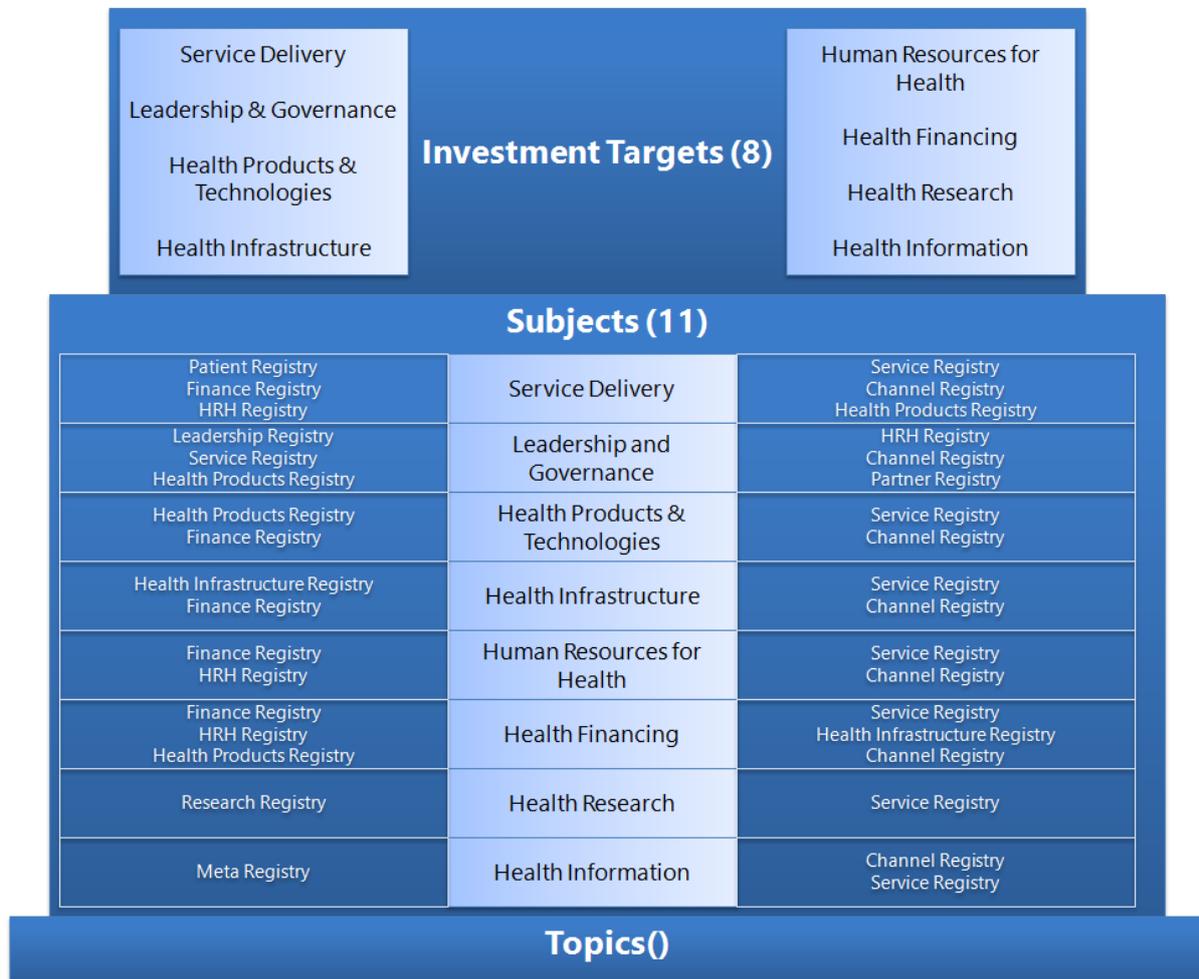
Source Document	Operational Imperative	Architecture Imperative	Principle
KHSSP, GEA	Available healthcare	Available Information	Health services are defined Health services are discoverable Health applications are fit for purpose
KHSSP, GEA	Affordable healthcare	Complete Information	Health information is consistent Health service is customer-centric
KHSSP, GEA	Quality healthcare	Quality Information	Health information is trusted Health information is secure Health systems and technologies are interoperable
Constitution of Kenya	Bill of Rights	Foundational	Primacy of principles Adherence regulation

Please refer to Appendix 1 for detailed description of the principles.

### 4.3.2 Subject

Subjects have been classified using the FEAF DRM as illustrated in Figure 42.

Figure 42. IRM Subject Hierarchy



Eleven registries have been aligned to the investment targets. They are:-

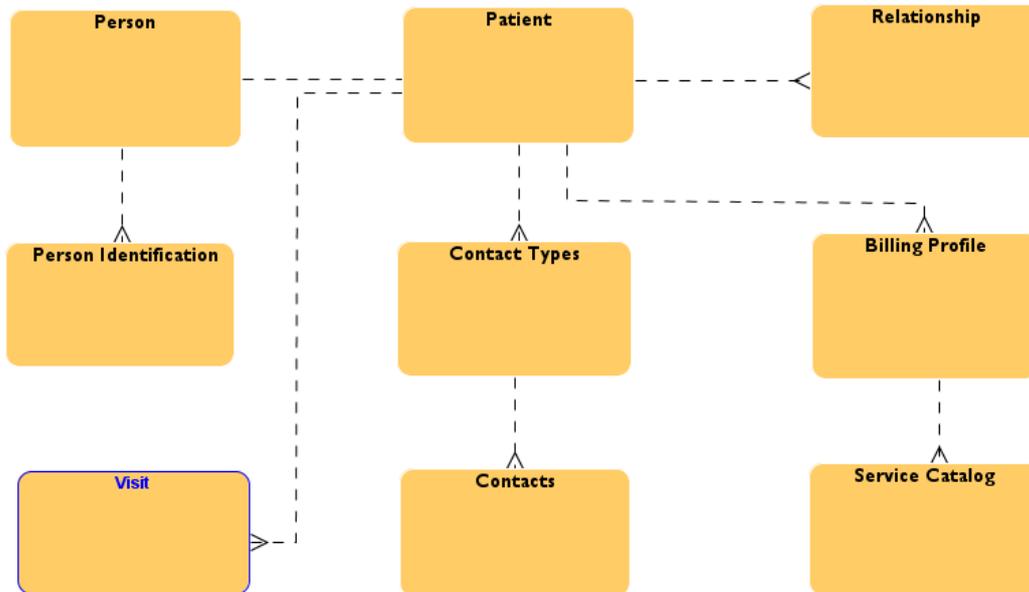
1. Patient Registry
2. Finance Registry
3. HRH Registry
4. Service Registry
5. Channel Registry
6. Health Products Registry
7. Leadership Registry
8. Partner Registry
9. Health Infrastructure Registry
10. Research Registry
11. Meta Registry

Each of these registries has what is known as topics<sup>9</sup>. A detailed description of the registries and the topics in each registry is provided in the next section. It is important to note that topics will eventually translate to programmable data models.

#### 4.3.2.1 Patient Registry

The Patient Registry will keep all information related to a patient profile at an aggregated level.

Figure 43. Patient Registry Data Model

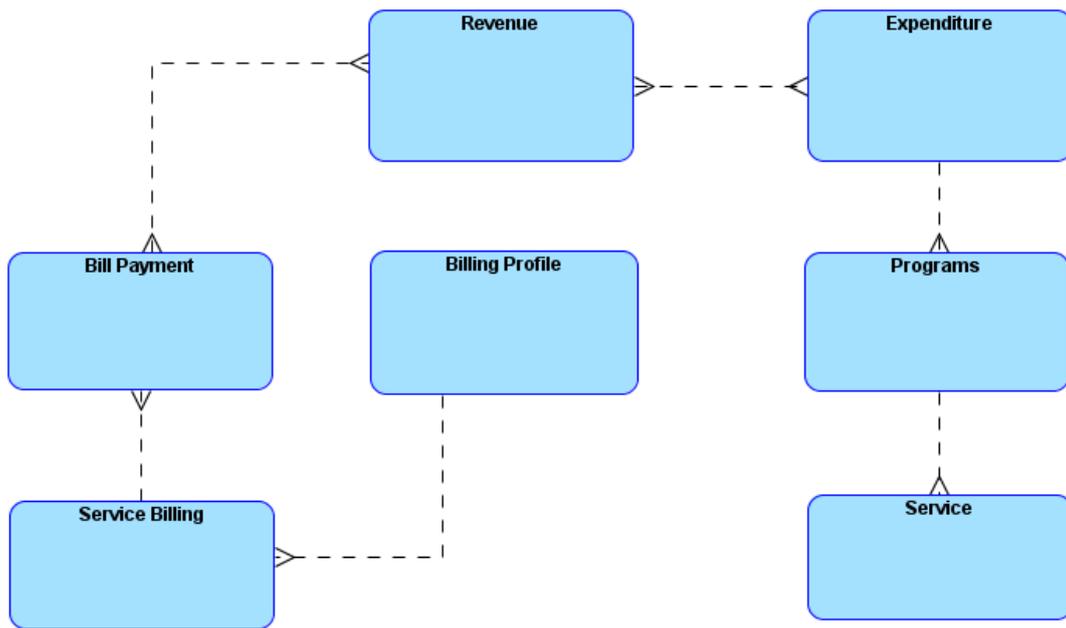


#### 4.3.2.2 Finance Registry

The Finance Registry shall keep all information related to health financing at an aggregated level.

<sup>9</sup> A topic is a sub-category of a subject that further decomposes the domain categorisation into highly cohesive sets of data entities that support business processes and services (FEAF).

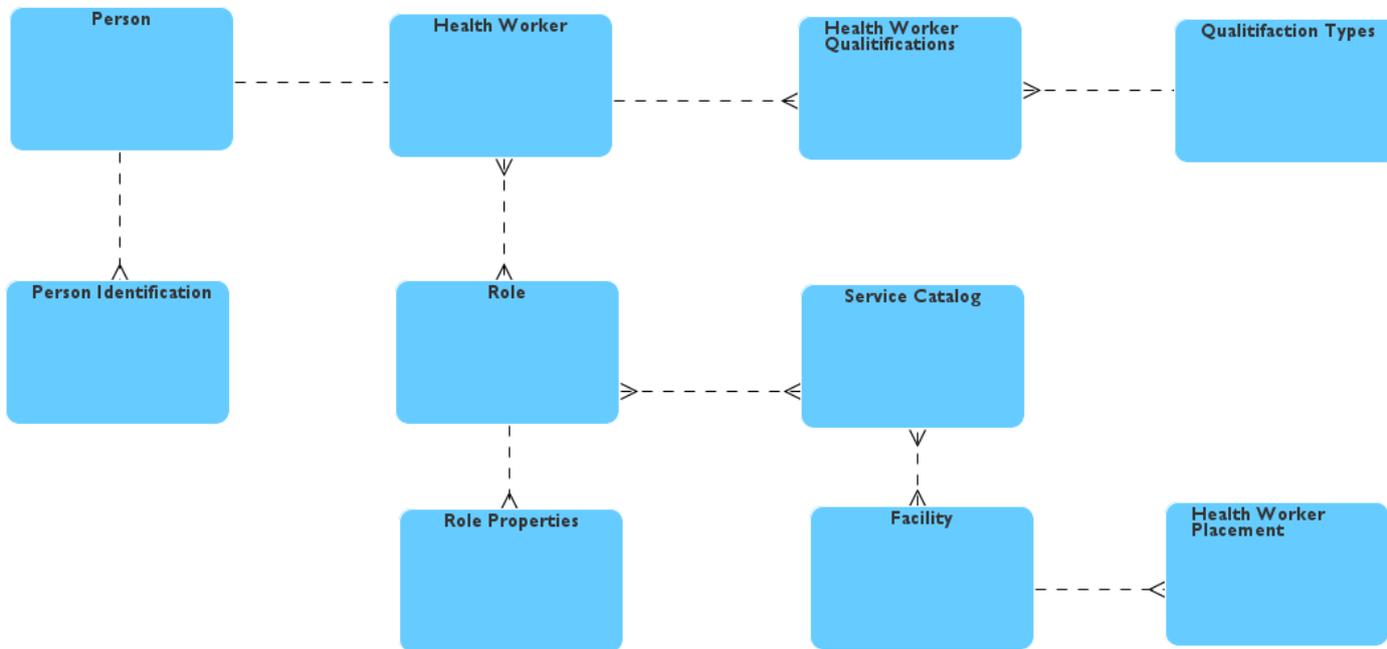
Figure 44. Finance Registry Data Model



4.3.2.3 HRH Registry

The HRH Registry shall keep all information related to HRH at an aggregated level.

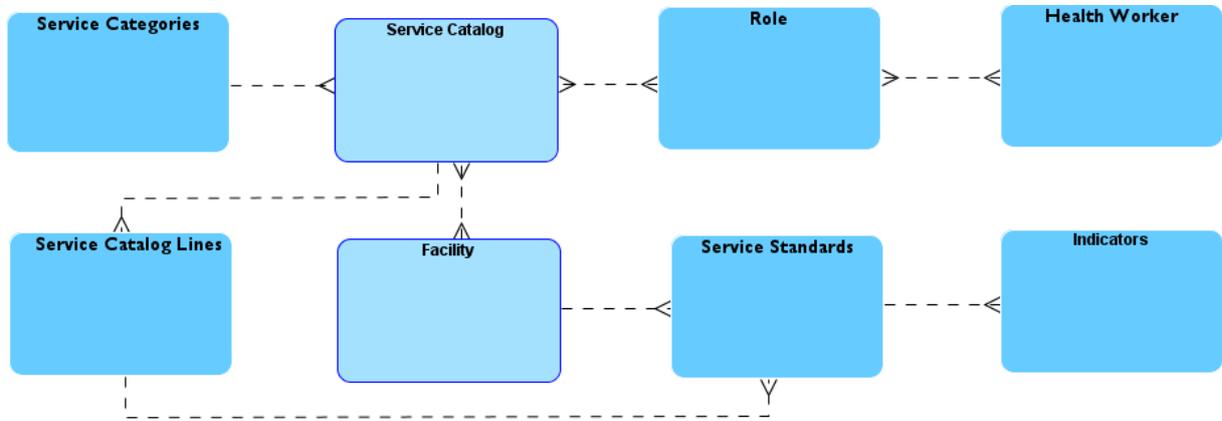
Figure 45. HRH Registry Data Model



#### 4.3.2.4 Service Registry

The Service Registry shall keep all information related to health services.

Figure 46 Service Registry Data Model

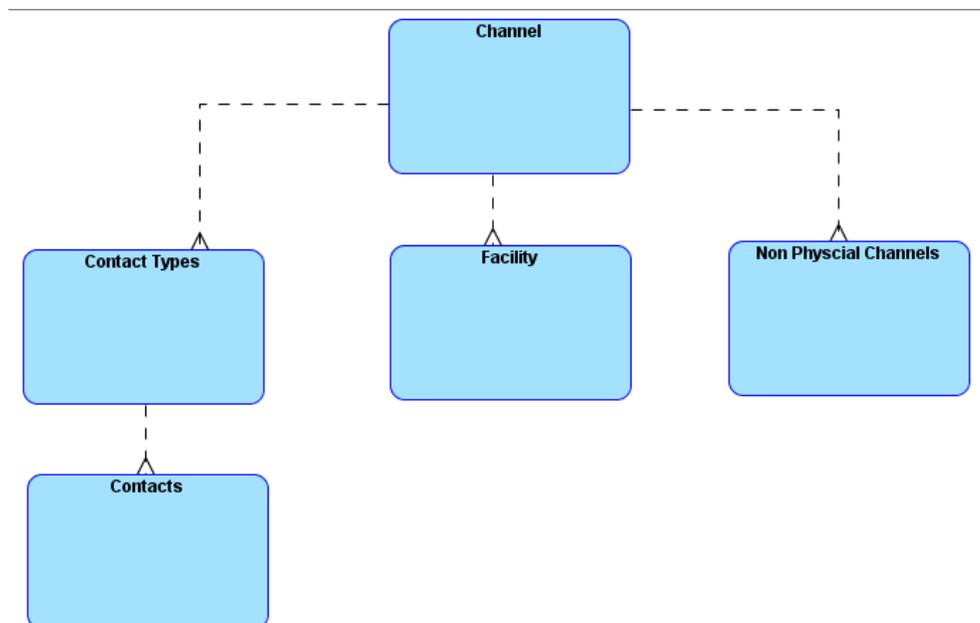


Appendix 7 provides a detailed description of indicators that were developed based on the *2<sup>nd</sup> Edition Indicators and Standard Operating Procedure Manual*.

#### 4.3.2.5 Channel Registry

The Channel Registry shall keep all information related to service channels, through which health service is provided, at an aggregated level.

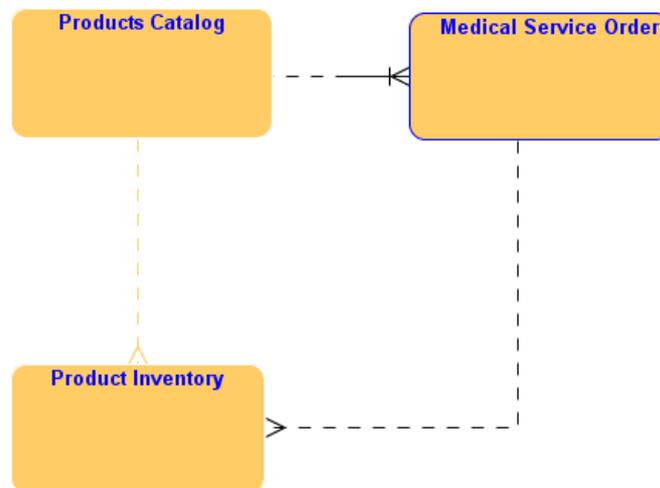
Figure 47. Channel Registry Data Model



#### 4.3.2.6 Health Products Registry

The Health Products Registry shall keep all information related to health products at an aggregated level.

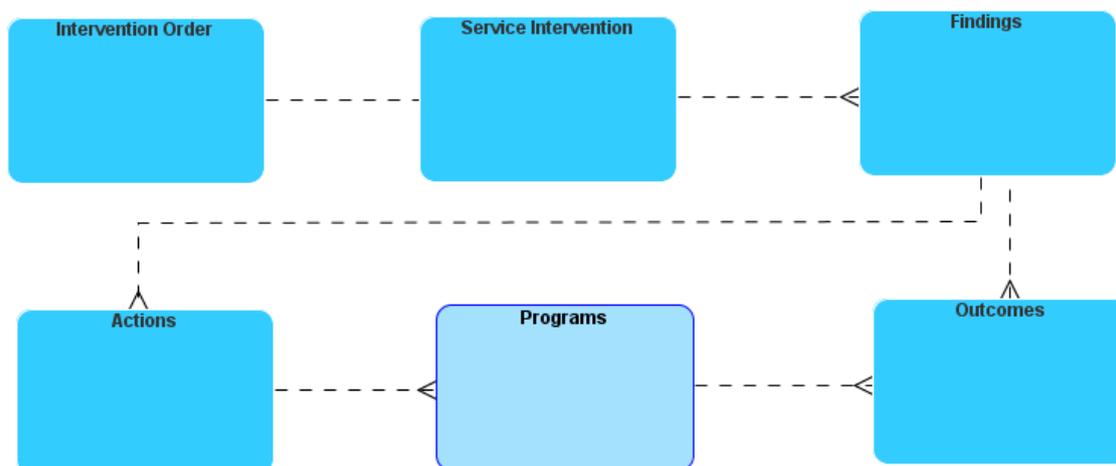
Figure 48. Health Products Registry Data Model



#### 4.3.2.7 Leadership Registry

The Leadership Registry shall keep all information related to health sector leadership and governance activities at an aggregated level.

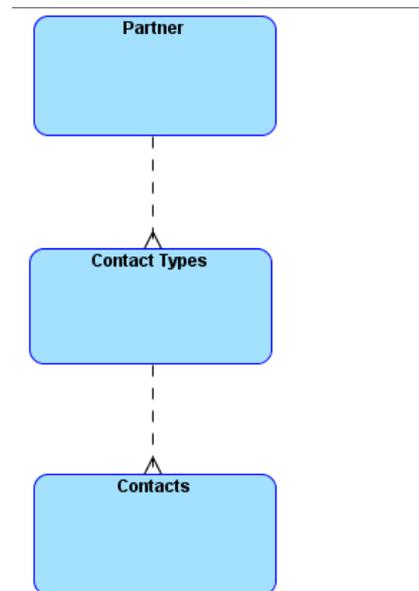
Figure 49. Leadership Registry Data Model



#### 4.3.2.8 Partner Registry

The Partner Registry shall keep all information related to health sector partners.

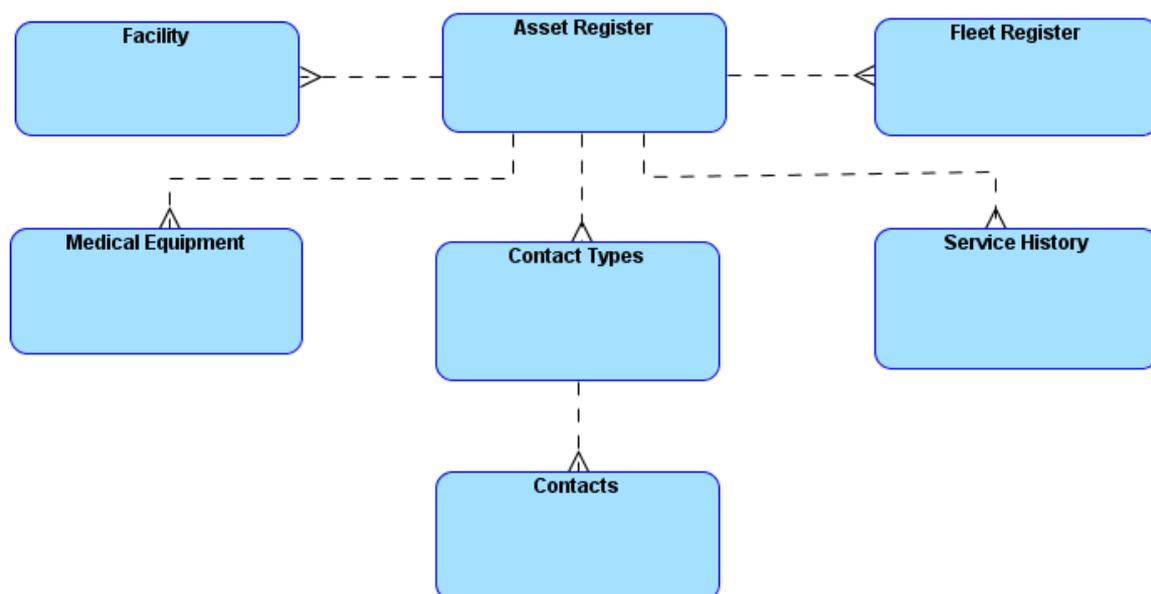
Figure 50. Partner Registry Data Model



#### 4.3.2.9 Health Infrastructure Registry

The Health Infrastructure Registry shall keep all information related to health infrastructure in terms of asset value and usefulness at an aggregated level.

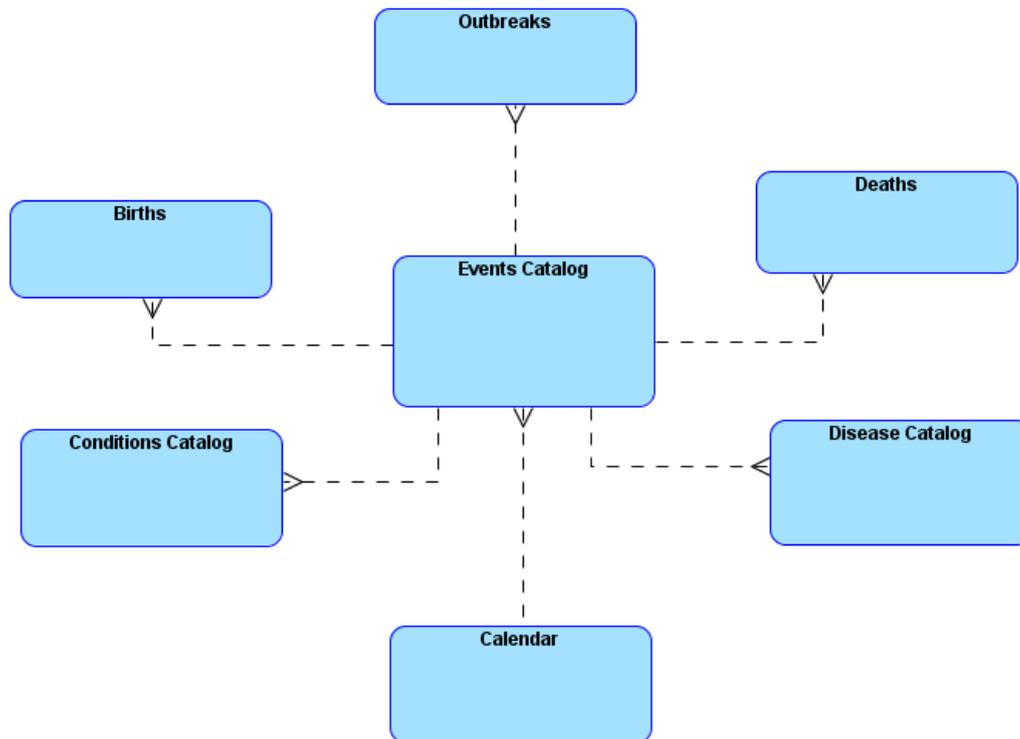
Figure 51. Health Infra Registry Data Model



#### 4.3.2.10 Research Registry

This Research Registry shall keep all information related to health research activities at an aggregated level.

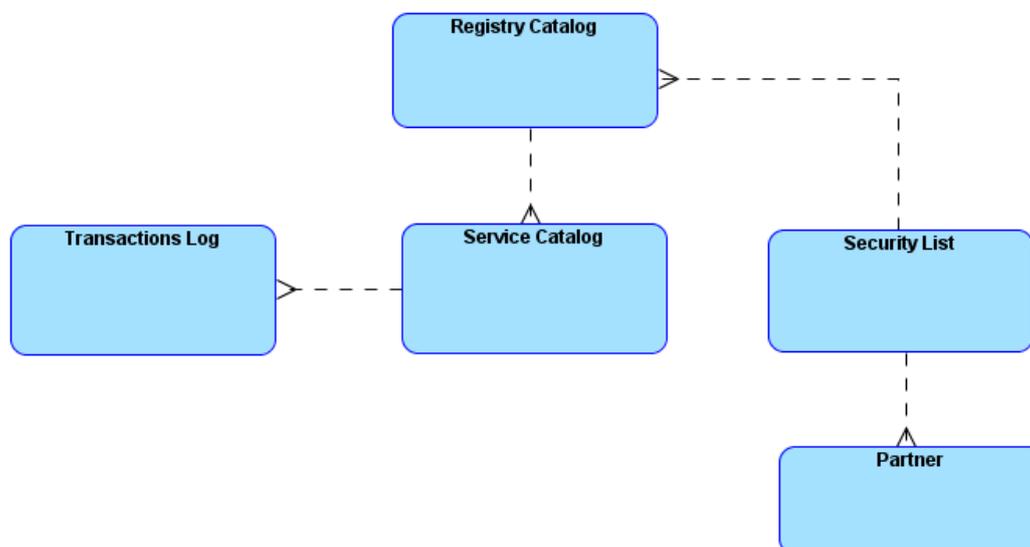
**Figure 52. Health Research Registry Data Model**



#### 4.3.2.11 Meta Registry

The Meta Registry shall keep all information related to information registries in terms of structure and content.

**Figure 53. Meta Registry Data Model**



### 4.3.3 Guidance

Guidance on access to and use of data in the information registries is bound by the standards and guidelines for e-health systems interoperability as shown in Tables 30-34.

#### 4.3.3.1 Unique Identifiers

**Table 30. Unique Identifiers**

Registry	Standards Mapping	
	Name	Definition
Patient Registry	ASTM E1714-07 Universal Healthcare Identifier	Guides the uniform patient identification in face-to-face encounters, computer-to-computer communication and recording and reporting of patient identification data. Links the right information to the right patient.
Channel Registry	ISO/TS 27527:2010 Provider Identifier Standard	Guides the creation of unique identifiers for the healthcare institution (channel) where service is provided.
HRH Registry	ISO/TS 27527:2010 Provider Identifier Standard	Guides the creation of unique identifiers for the individual health worker who provides a service.

#### 4.3.3.2 Classification of Standards

**Table 31. Classification of Standards**

Registry	Standards Mapping	
	Name	Definition
Service Registry	Clinical terms	Systemised Nomenclature of Medicine (SNOMED) guides classification of clinical terms in a hierarchical way which enables the right coding and reuse of coded data
Service Registry	Laboratory and clinical observations	Logical Observation Identifiers Names and Codes (LOINC) guides the clinical and laboratory observations.
Service Registry	Diseases	International Classification of Diseases-10 (ICD-10) guides the classification of diseases, health conditions and causes of death.
Health Products Registry	RxNorm	RxNorm guides the naming system for generic and branded drugs, and supports semantic interoperation between drug terminologies and pharmacy knowledge base systems

### 4.3.3.3 Messaging Standards

**Table 32. Messaging Standards**

Registry	Standards Mapping	
	Name	Definition
Health Infrastructure Registry	ISO 12052:2006 Digital Imaging	Digital Imaging Communications in Medicine (DICOM) guides the object definition, data structures and semantics and protocols for exchange of imaging information between health imaging equipment
Service Registry	HL7	Guides the interchange of clinical and administrative data amongst heterogeneous healthcare applications in the form of patient demographics, health insurance, clinical observation, appointment schedules and referrals.
Meta Registry	Statistical Data and Meta Data Exchange - Health Domain	SDMX-HD guides the statistical and metadata exchange for exchange of health indicator definitions. It specifies the structure and format of aggregate data for health indicators that are exchanged between HIS and monitoring and evaluation systems

### 4.3.3.4 EHR Standards

**Table 33. EHR Standards**

Registry	Standards Mapping	
	Name	Definition
Patient Registry	Standard Practice for Description of Reservation / Registration-Admission, Discharge, Transfer (RAD-T) Systems for EHR systems	Guides the definition of minimum information capabilities of RAD-T System. It describes the process of patient registration, inpatient admission, establishing demographic segments of an EHR, identifying core information elements require in the RAD-T process.
Patient Registry	ISO 13606-1:2008 EHR (part 1) reference model	Guides the specification of exchange of EHR (in part or whole) between EHR systems and a centralised EHR data warehouse.
Patient Registry	ISO 13606-2:2008 EHR (part 2) archetype interchange specification	Guides the specification of the information architecture required for interoperability in the exchange of a patient's clinical healthcare data between EHR systems.
Patient Registry	ISO 13606-3:2009 EHR (part 3) reference archetypes and term lists	Guides the definition of the list of terms and the set of values that may be held by the reference model.
Patient Registry	ISO 18308:2011 Requirements for an EHR Architecture	Guides the specification of a set of EHR requirements that meet the needs of healthcare delivery, are clinically valid and reliable, are ethically sound, satisfy legal requirements, support good clinical practice and facilitate data analysis.

### 4.3.3.5 Structure and Content Standards

**Table 34. Structure and Content Standards**

Registry	Standards Mapping	
	Name	Definition
Service Registry	ISO / HL7 27932:2009 Clinical Document Architecture	Guides the common representation of clinical documents, e.g. clinical summaries, discharge notes and radiology reports.
Service Registry	ASTM E2369-05 Continuity of Care Record	Guides the creation of patient care information and sharing amongst health providers. Enables aggregation of essential clinical data to support continuity of care e.g. in the instance of a referral service.
Patient Registry	ASTM E2436-05 2010	Guides the representation of the content and structure of human characteristics data in HIS.

### 4.3.3.6 Data Quality Protocol

The IRM recognises the existence of a Data Quality Assurance (DQA) protocol as a monitoring and evaluation tool to determine data quality issues to be addressed at each level. Given the ins and outs of data into various information registries, the DQA protocol shall be used to guide extraction, translation and loading of information from feeder sources into the registries.

The dimensions of quality in the DQA protocol are described and mapped to level of enforceability within the Extraction Transformation and Loading (ETL) cycle in Table 35.

**Table 35. DQA Mapping to IRM**

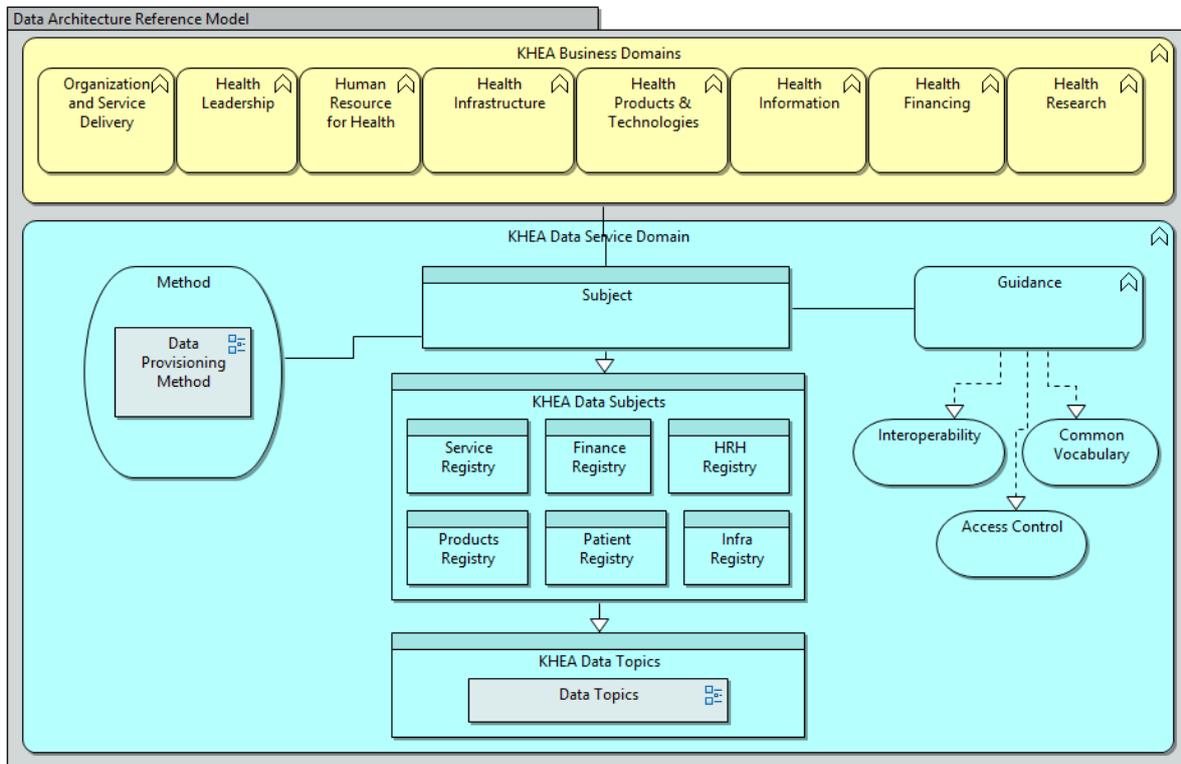
Data Quality Dimension	Operation Definition	Enforcement with IRM
<b>Accuracy</b>	The extent to which the data reflect the actual/correct information. Validity of the data is achieved by minimising capture errors	The IRM has pre-stage and stage cycles to assure that incoming data extracted from downstream system are given pre-load checks to assure their accuracy.
<b>Completeness</b>	Represents the complete list of records and the fields in each record	The pre-stage validation will check if all fields / records are supplied with sufficient detail before completing the extraction cycle from feeder systems.
<b>Reliability</b>	Data are complete and accurate and the measured indicator results are consistent, not subject to inappropriate alteration over time	At pre-stage of extraction, data are subjected to staging checks to confirm that they have not already been loaded for the same indicators for the same period.
<b>Precision</b>	Data are of sufficient detail. For example, an indicator requires the number of individuals who received HIV counseling and testing and received their test results, by sex of the individual. In this case, an information system lacks precision if it is not designed to record the sex of the individual.	The pre-stage process will accept / reject incoming data based on the indicator to be reported on. If the indicator requires information which feeder system has not provided, then the pre-stage process will reject data from this feeder system.

<p><b>Timeliness</b></p>	<p>Data are timely when they are up-to-date (current) and when the information is available on time. Timeliness is affected by:</p> <ul style="list-style-type: none"> <li>(a) the rate at which the programme's information system is updated;</li> <li>(b) the rate of change of actual programme activities; and</li> <li>(c) when the information is actually used or required</li> </ul>	<p>The pre-stage process is expected to be a scheduled process that wakes up at defined intervals (which are configurable) to collect data from feeder systems for various indicators depending on the frequency at which those indicators should be reported (again, configurable). In case of failure in the pre-stage or staging or base loading process there will be an error handling mechanism to alert the need-to-know stakeholders (also configurable) via sms or email about failure and the intervention that is required.</p> <p>On fulfilment of the request for data, the inbound request will be managed by a transaction logger to record successfully filled requests, the time it took to fill and any failed fulfilment processes. This information will be used to measure, track and improve the effectiveness of information service provisioning within the IRM to assure that timeliness is maintained.</p>
<p><b>Integrity</b></p>	<p>Data have integrity when the system used to generate them is protected from deliberate bias or manipulation for political or personal reasons</p>	<p>The IRM update of information registries will be via the pre-stage and staging process. Access to data on base registries will be in read-only mode hence no chance for direct update / manipulation of the base registry.</p>
<p><b>Confidentiality</b></p>	<p>Confidentiality means that clients are assured that their data will be maintained according to national and/or international standards for data. This means that personal data are not disclosed inappropriately, and that data in hard copy and electronic form are treated with appropriate levels of security (e.g. kept in locked cabinets and/or in password protected files)</p>	<p>The IRM anticipates a framework of managing incoming requests for data. All consumer requests will be validated via an information service registry to assure that only listed consumers can access data before provisioning is granted.</p> <p>For loading of data from feeder systems, there will be protection of pre-staged and staged areas in addition to the base registries.</p> <p>Periodically, there will be need to archive pre-stage and stage areas to free up space and minimise the risk of having multiple copies of the same data in multiple repositories. However, the archiving process shall follow standard data archiving processes that have been or shall be adopted by the stakeholders guided by legislation and industry standards.</p>

### 4.3.4 Method

Data subjects will provide the “what” that stakeholders require. The method will provide the means through which data are accessible. Each of the investment pillar domains will have an information registry as illustrated in Figure 54.

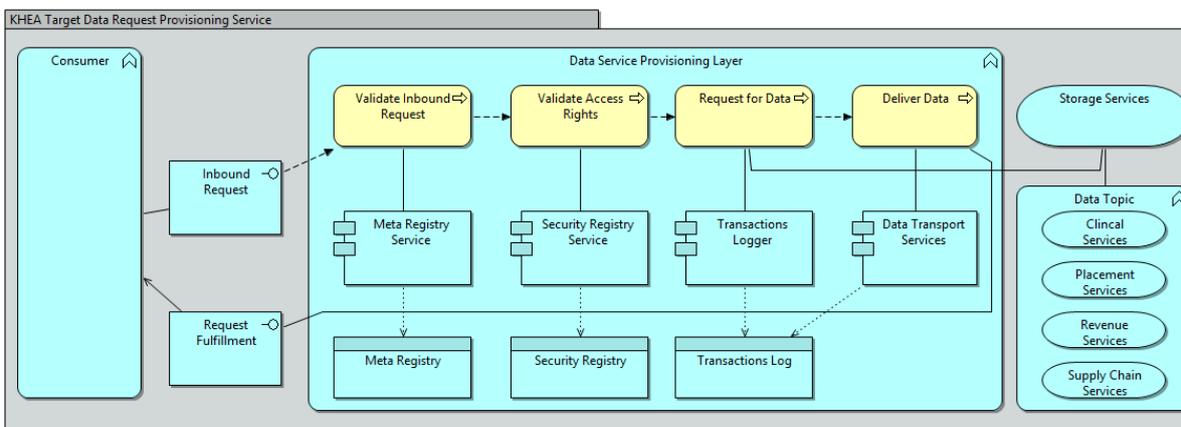
Figure 54. Data Provisioning Method Overview



#### 4.3.4.1 Consumer Provisioning Service

Figure 55 is a detailed illustration of the consumer *data provision method* flow.

Figure 55. Consumer Provision Service Model



1. A consumer shall make an inbound request for data through any of the channels described in section 6.2.1.
2. The provisioning layer shall **validate the inbound request** by making reference to the **Meta Registry** to confirm if the requested service exists.
3. If the service exists, the provisioning layer will **validate the rights of access** of the requestor / consumer to confirm that they have rights of access to the information registry / registries. Validation of such rights will be based on the security guidelines listed in section 6.3.3.
4. If the request passes steps 2 and 3, the provisioning layer will request the data from the relevant information registries.

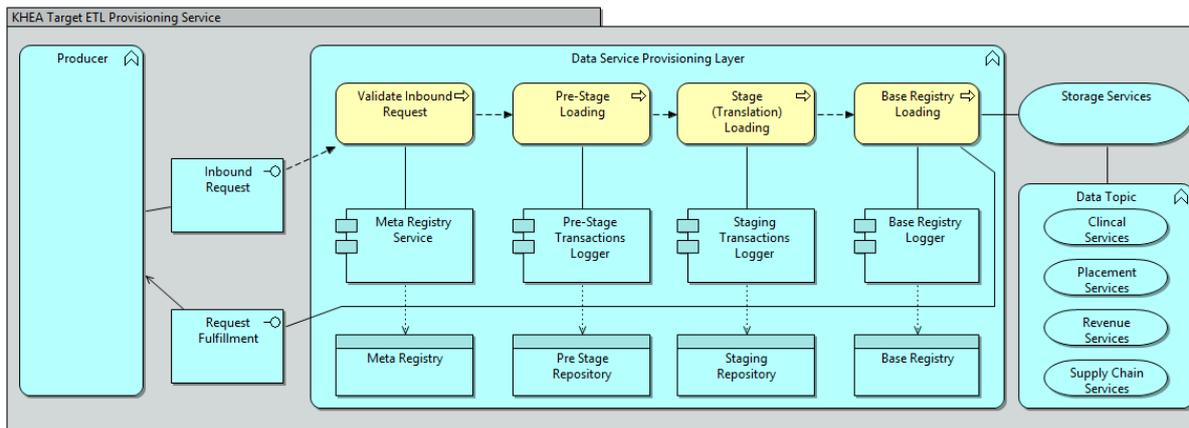
In fulfilling the data request, the provisioning layer will log the data showing who made the request, from which channel, the time the request was made, if access passed validation, if the data fetch was completed and so forth.

5. Data shall be delivered by the respective registry based on the topic area and transported back to the requestor in a secure manner as described in the security guidelines for data in transit.

#### 4.3.4.2 Producer Provisioning Service

There will be instances in which data are extracted from feeder systems, translated and loaded onto the information registry ready for consumption by the respective stakeholders. This process shall also involve a method, guidance and subject areas. The flow is shown in Figure 56:

**Figure 56. Producer Provisioning Service Model**



1. A **producer** shall make an inbound submission of data through any of the channels described in section 6.2.1. It is expected that most entry into the information registries shall be via automated processes of scheduled batch jobs. However, there might be instances of human initiated data import.
2. The provisioning layer shall **validate the inbound request** by making reference to the **Meta Registry** to confirm if such an import service process exists. All inbound / outbound data provisioning services will be registered in the Meta Registry.
3. If the service exists, the provisioning layer will load the data in the pre-staging repository for initial validation and confirmation that the data meet the interoperability standards described in the guidance section. In addition, DQA will be performed. Only data that pass the quality check will be eligible for moving to the staging registry.
4. The provisioning layer will transfer the data to the staging registry once the data pass step 3. Data in the staging registry shall be mapped to the column definitions in the base registry. The staging registry is a control area also to perform de-duplication and assure that only incremental data are transferred to the base registry.
5. Finally data shall be transferred to the base registry(ies) in accordance with the topics for the respective registry.
6. Transaction logs shall be maintained at each stage to track the lifecycle of the load process and provide a mechanism for tracking failures or requests that are in process of fulfilment.

Note that this process assumes the data provided by the producer are already in the format that shall be discussed and agreed as fit for loading in the base registry. The pre-stage and staging processes are additional layers of data quality. The bulk of data quality is expected to be performed by the producer before the data are transmitted for loading in the registries. High failure rate at pre-staging shall point to a poor pre-production data quality process.

### 4.3.5 Business Scenarios

#### 4.3.5.1 *Translating indicators into data sets and mapping to registries*

**Table 36. Mapping of Data Sets to Registries**

Category / Core Data Set	Indicator	Source	Mapped Registry
<b>IMPACT</b>			
Health outcomes data Set	Life expectancy at birth	KNBS	Research Registry
	Total annual number of deaths (per 100,000 population)		Research Registry
	Maternal deaths per 100,000 live births	KNBS	Research Registry

Category / Core Data Set	Indicator	Source	Mapped Registry
	Neonatal deaths per 1,000 live births	KNBS	Research Registry
	Under-five deaths per 1,000	KNBS	Research Registry
	Youth and adolescent deaths per 1,000	CRD	Research Registry
	Adult deaths per 1,000	CRD	Research Registry
	Elderly deaths per 1,000	CRD	Research Registry
	Years of life lived with illness/disability	WHO	Research Registry
Health Distribution Data Set	% range of Health Services Outcome Index	HIS	Research Registry
Service Quality Data Set	Client satisfaction index	Policy and planning	Research Registry
<b>HEALTH and RELATED SERVICE OUTCOME</b>			
Communicable conditions data set	% Fully immunised children	HIS	Service Registry
	% of target population receiving Multi-Drug Administration (MDA) for schistosomiasis	HIS	Research Registry
	% of TB patients completing treatment	HIS	Research Registry
	% HIV+ pregnant mothers receiving preventive ARVs	HIS	Research Registry
	% of eligible HIV clients on ARVs	HIS	Research Registry
	% of targeted children under one year old provided with long-lasting insecticide-treated nets	HIS	Research Registry
	% of targeted pregnant women provided with nets	HIS	Research Registry
	% of children under five treated for diarrhoea	HIS	Research Registry
	% school age children dewormed	HIS	Research Registry
Non-communicable conditions data set	% of adult population with Body Mass Index (BMI) over 25	KNBS/HIS	Research Registry
	% women of reproductive age screened for cervical cancer	HIS	Research Registry
	% of new outpatients with mental health conditions	HIS	Research Registry
	% of new outpatients cases with high blood pressure	KNBS/HIS	Research Registry
	% of patients admitted with cancer	HIS	Research Registry

Category / Core Data Set	Indicator	Source	Mapped Registry
Violence and injuries data set	% new outpatient cases attributed to gender based violence	HIS	Research Registry
	% new outpatient cases attributed to road traffic injuries	HIS	Research Registry
	% new outpatient cases attributed to other injuries	HIS	Research Registry
	% of deaths due to injuries	HIS	Research Registry
Essential health services data set	% deliveries conducted with skilled attendant	HIS/KNBS	Research Registry
	% of women of reproductive age receiving family planning	HIS	Research Registry
	% of facility based maternal deaths	HIS	Research Registry
	% of facility based under five deaths	HIS	Research Registry
	% of newborns with low birth weight	HIS	Research Registry
	% of facility based fresh stillbirths	HIS	Research Registry
	Surgical rate for cold cases	HIS	Research Registry
	% of pregnant women attending four antenatal care visits	HIS	Research Registry
Health risk factors data set	% population who smoke	KNBS	Research Registry
	% population consuming alcohol regularly	KNBS	Research Registry
	% infants under six months on exclusive breastfeeding	KNBS	Research Registry
	% of population aware of risk factors to health	KNBS	Research Registry
	% of salt brands adequately iodised	KEBS	Research Registry
Health-related sectors data set	% population with access to safe water	KNBS	Research Registry
	% children under five stunted	KNBS/HIS	Research Registry
	% children under five underweight	KNBS/HIS	Research Registry
	School enrolment rate	Ministry of Education	Research Registry
	% of households with latrines	KNBS	Research Registry
	% of houses with adequate ventilation	KNBS	Research Registry
	% of classified road network in good condition	Ministry of Transport	Research Registry
	% schools providing complete school health package	Ministry of Education/HIS	Research Registry

Category / Core Data Set	Indicator	Source	Mapped Registry
<b>HEALTH INVESTMENT OUTPUT</b>			
Service Access Data Set	Per capita outpatient utilisation rate	HIS	Service Registry
	% of population living within 5km of a facility	KNBS	Channel Registry
	% of facilities providing Basic Emergency Obstetric Care (BEOC)	HIS/NCPD	Channel Registry
	% of facilities providing Comprehensive Emergency Obstetric Care (CEOC)	HIS/NCPD	Channel Registry
	Bed Occupancy Rate	HIS	Service Registry
	% of facilities providing immunisation	HIS	Channel Registry
Quality of Care Data Set	TB cure rate	HIS	Service Registry
	% of fevers tested positive for malaria	HIS	Patient Registry
	% maternal audits/deaths audits	HIS	Leadership Registry
	Malaria inpatient case fatality	HIS	Patient Registry
	Average length of stay	HIS	Channel Registry
<b>HEALTH INPUT AND PROCESS INVESTMENT</b>			
Service Delivery Data Set	% of functional community units	HIS	Channel Registry
	% outbreaks investigated within 48 hours	IDSR	Research Registry
	% of hospitals offering emergency trauma services	HIS	Channel Registry
	% hospitals offering Caesarean services	HIS	Channel Registry
	% of referred clients reaching referral unit	HIS	Channel Registry
Health workforce data set	# of nurses per 10,000 population	HIS	HRH Registry
	% staff who have undergone CPD	HIS	HRH Registry
	Staff attrition rate	HIS	HRH Registry
	% public health expenditure (government and donor) on human resources	HIS	Finance Registry
	% of facilities equipped as per norms	HIS	Channel Registry
	# of hospital beds per 10,000 population	HIS	Health Infrastructure Registry
	% public health expenditures (government and donor) spent on infrastructure	HIS	Finance Registry

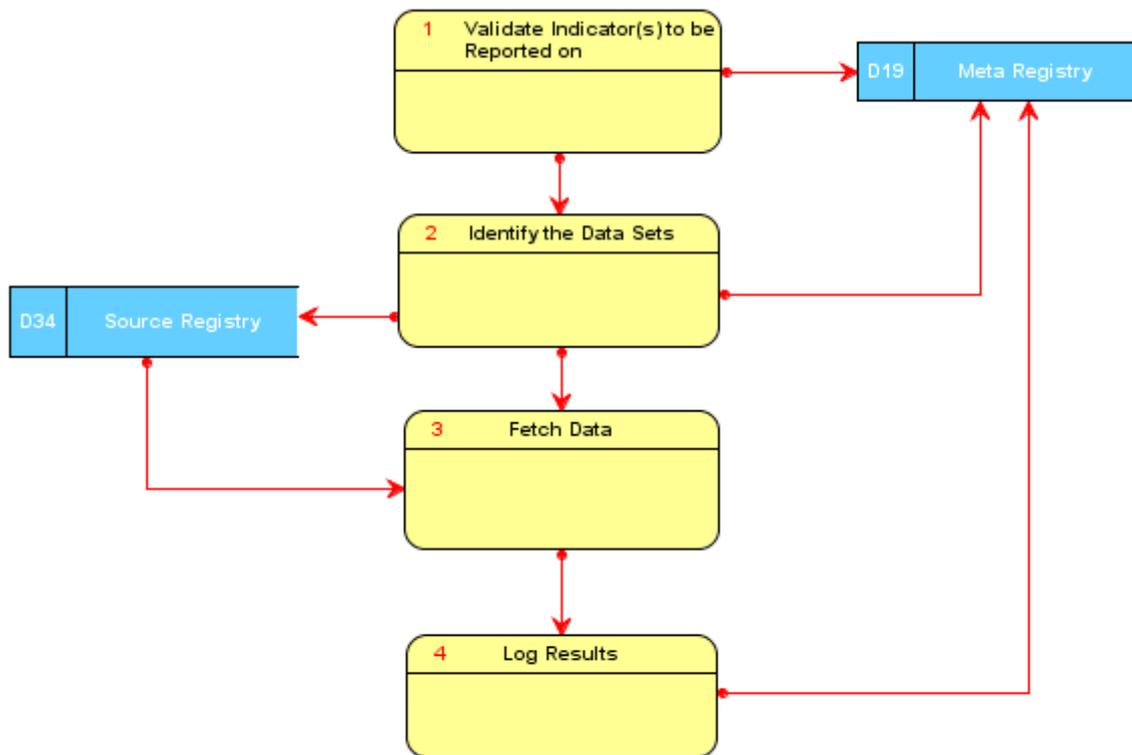
Category / Core Data Set	Indicator	Source	Mapped Registry
Health Products Data Set	% of time out of stock for Essential Medicines and Medical Supplies (days per month)	HIS	Health Products Registry
	% public health expenditures (government and donor) spent on health products	HIS/NHA	Finance Registry
Health Financing Data Set	General government expenditure on health as % of total government expenditure	NHA/PETS	Finance Registry
	Total health expenditure as a percentage of GDP	NHA/PETS	Finance Registry
	Off-budget resources for health as % of total public sector resources	NHA/PETS	Finance Registry
	% of health expenditure reaching the end users	NHA/PETS	Finance Registry / Service Registry / Patient Registry
	% of total health expenditure from out of pocket	NHA/PETS	Finance Registry
Health Leadership Data Set	% of health facilities inspected annually	All regulatory bodies and councils	Leadership Registry
	% of health facilities with functional committees	HIS	Leadership Registry
	% of counties with functional County Health Management Teams	HIS	Leadership Registry
	% of health sector steering committee meetings held at national level	HIS	Leadership Registry
	% of county interagency forum meetings held at county level	HIS	Leadership Registry
	% of facilities supervised	HIS	Leadership Registry
	% of facilities with functional anti-corruption committees		Leadership Registry
	% of policies/ documents using evidence as per guidelines	Unit R&D	Leadership Registry
	% of planning units submitting complete plans	Unit P&SP	Leadership Registry
	# of health research publications shared with decision-makers	Unit R&D	Leadership Registry
	% of planning units with performance contracts	HIS	Leadership Registry
	% of county planning units with performance contracts		Leadership Registry

Category / Core Data Set	Indicator	Source	Mapped Registry
Health Information Data Set	# of sector quarterly reports produced and disseminated.	HIS	Meta Registry
	% of planning units submitting timely, complete and accurate information	HIS	Meta Registry
	% of facilities submitting timely, complete and accurate information	HIS	Meta Registry
	% public health expenditures (gov't. and donor) spent on health information	HIS	Meta Registry
	% public health expenditures (gov't. and donor) spent on health information	HIS	Meta Registry

Note: NCPD=National Council for Population and Development, KEBS=Kenya Bureau of Standards, NHA=National Health Accounts, PETS=Public Expenditure Tracking Survey

#### 4.3.5.2 Registry Data Flow Diagram

Figure 57. Registry Data Flow Model



### 4.3.5.3 Reports and Reporting Responsibilities

**Table 37. Mapping of Reports to Registries**

No	Available Reporting Forms	County Responsible Person	Overall Responsibility at county	Sub-county Reporting Channel	Hospitals	Primary Health Facility/Community Unit	Overall Responsibility at Health Facility	Baseline Reporting Source	Target Reporting Source
1	CHEW Summary	Community Unit Focal person	County director of health	DHIS	CHEW	CHEW	Med Sup/ in-charge	Hardcopy / DHIS	
2	MoH 711 Integrated	Reproductive Coordinator/ District Public Health Nurse (DPHN)	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
3	MoH 731-1 HIV CT	CHMT Member responsible for HIV	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
	MoH 731-2 PMTCT	CHMT Member responsible for HIV	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
	MoH 731-3 C&T	CHMT Member responsible for HIV	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
	MoH 731-4 VMC	CHMT Member responsible for HIV	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
	MoH 731-5 PEP	CHMT Member responsible for HIV	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
	MoH 731-6 Blood Safety	CHMT Member responsible for HIV	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
4	HCBC	CHMT Member responsible for HIV	County director of health	DHIS	Sectional in-charge/HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
5	IDSr Weekly	District Disease Surveillance Coordinator(DDSC)	County director of health	DHIS	Facility surveillance focal person	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	

No	Available Reporting Forms	County Responsible Person	Overall Responsibility at county	Sub-county Reporting Channel	Hospitals	Primary Health Facility/Community Unit	Overall Responsibility at Health Facility	Baseline Reporting Source	Target Reporting Source
6	Hospital Administrative Statistics (HAA)	County HRIO	County director of health	DHIS	HRIO			Hardcopy / DHIS	
7	MoH 75 A OPD <5 years	County HRIO	County director of health	DHIS	HRIO	Facility in-charge	Med Sup/ v	Hardcopy / DHIS	
8	MoH 75 B OPD >5 years	County HRIO	County director of health	DHIS	HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
9	MoH 717 Service Workload	County HRIO	County director of health	DHIS	HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
10	MoH 718 Inpatient M and M	County HRIO	County director of health	DHIS	HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
11	MoH 710 Immunisation	CHMT member responsible for immunisation	County director of health	DHIS	HRIO	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
12	MoH 706 Laboratory Report	CHMT member responsible for lab services	County director of health	DHIS	Lab In-Charge	Facility Lab in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
13	Support Supervision	Chair CHMT	County director of health	DHIS	Sectional In-Charge/HRIO			Hardcopy / DHIS	
14	IMAM	CHMT member responsible for nutrition	County director of health	DHIS	Nutritionist	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
15	MoH 713 Nutrition Monthly Reporting	CHMT member responsible for nutrition	County director of health	DHIS	Nutritionist	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	

No	Available Reporting Forms	County Responsible Person	Overall Responsibility at county	Sub-county Reporting Channel	Hospitals	Primary Health Facility/Community Unit	Overall Responsibility at Health Facility	Baseline Reporting Source	Target Reporting Source
16	MoH 78 Environmental Health	CHMT member responsible for environmental health	County director of health	DHIS	PHT	Public Health Officer/Public Health Technician	Med Sup/in-charge	Hardcopy / DHIS	
17	Quarterly report on Tuberculosis and Multiple Drug Resistant TB case-finding	CHMT member responsible for TB	County director of health	DHIS	CO Tuberculosis and Lung	Facility in-charge	Med Sup/in-charge	Hardcopy / DHIS	
18	Cohort Report for TB	CHMT member responsible for TB	County director of health	DHIS	CO Tuberculosis and Lung	Facility in-charge	Med Sup/in-charge	Hardcopy / DHIS	
19	HSSF Monthly Expenditure	County Accountant	County director of health	DHIS	Facility accountant	Facility in-charge	Med Sup/in-charge	Hardcopy / DHIS	
20	HSSF summary	County Accountant	County director of health	DHIS	Facility accountant	Facility in-charge	Med Sup/in-charge	Hardcopy / DHIS	
21	Malaria Commodities Form	CHMT member responsible for malaria	County director of health	DHIS	Pharmacist	Facility in-charge	Med Sup/in-charge	Hardcopy / DHIS	
22	Non-Pharmaceutical	CHMT member responsible for Non-Pharmaceuticals	County director of health	DHIS	Matron	Facility in-charge	Med Sup/in-charge	Hardcopy / DHIS	
23	Division of Occupational	County Occupational Therapist	County director of health	DHIS	Occupational Therapist	Facility in-charge	Med Sup/in-charge	Hardcopy / DHIS	
24	Logistic Management Information	Reproductive Health Coordinator/Sub county PHN	County director of health	DHIS	Pharmacist	Facility In-Charge	Med Sup/in-charge	Hardcopy / DHIS	

No	Available Reporting Forms	County Responsible Person	Overall Responsibility at county	Sub-county Reporting Channel	Hospitals	Primary Health Facility/Community Unit	Overall Responsibility at Health Facility	Baseline Reporting Source	Target Reporting Source
25	FP Contraceptives	CHMT Member responsible for Reproductive Health	County director of health	DHIS	MCH In-Charge	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
26	Maternal Death Review Form	County HRIO	County director of health	DHIS	Maternity In-Charge - Maternal Death Review team	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
27	Ophthalmology Services	County Ophthalmologist	County director of health	DHIS	Ophthalmologist	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	
28	Orthopaedic Plaster	County Plaster technologist	County director of health	DHIS	Plaster technologies	Facility in-charge	Med Sup/ in-charge	Hardcopy / DHIS	

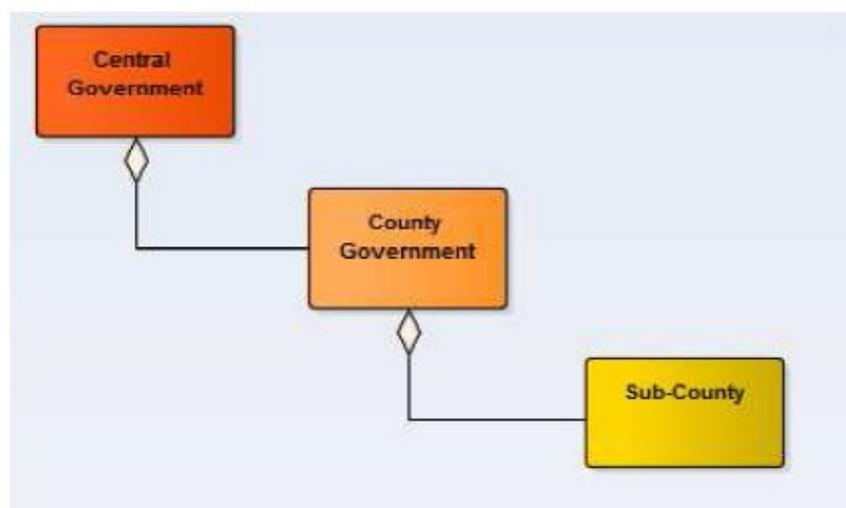
## 4.4 Application Reference Model

### 4.4.1 Introduction

The ARM is the framework for categorising KHEA IT applications and services to identify opportunities for sharing, reuse and consolidation.

The ARM is a blueprint for deployment of individual application systems, their interactions and their relationships to the core business processes of the health enterprise. Its hierarchical modeling shows a relationship pattern between services for the purpose of establishing transactions and message exchange routes between consumers and services. The hierarchical pattern establishes parent-child associations between services.

Figure 58. ARM Levels of Aggregation



The ARM has three levels, namely:

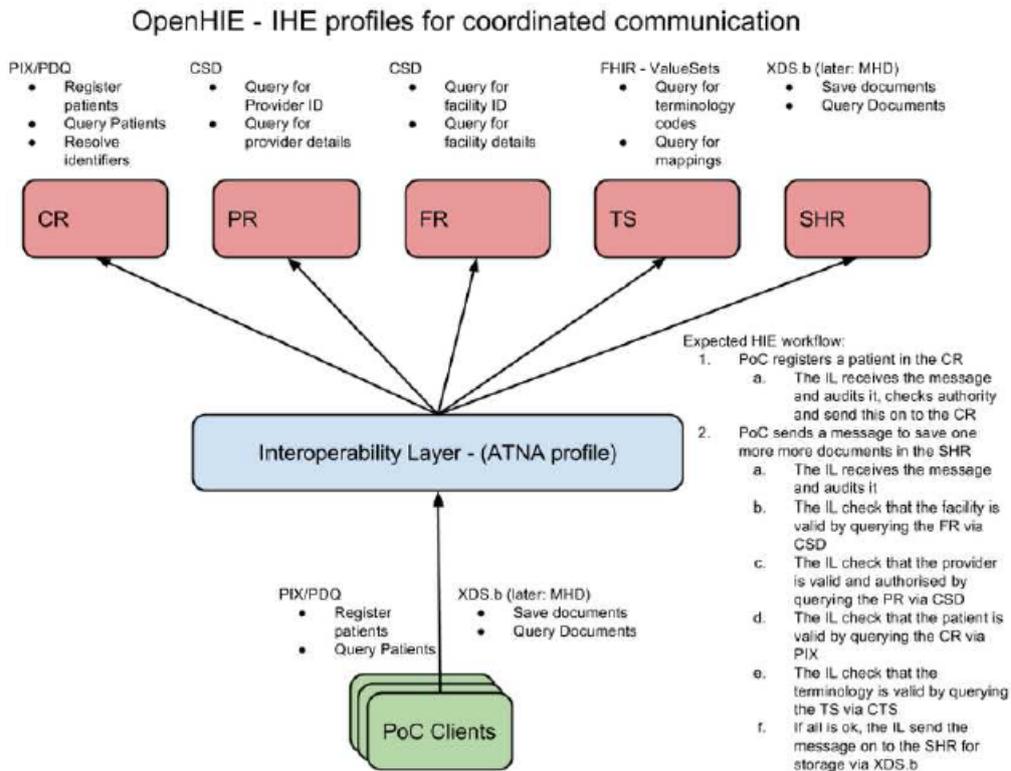
- 1) **Application Domains** – Sub-classification of applications in alignment with investment targets of the health sector.
- 2) **Investment Pillar Services** – Discrete sets of services clustered around particular topics that provide capabilities to collect, process, share and disseminate in support of specific business processes.
- 3) **Common Services** – Sets of shared services that are not specific to a topic within the sector but are used in conjunction with the line of business application services to support a specific business process.

**Figure 59. Target ARM**



This target ARM makes reference to the OpenHIE Mohawk architecture for a collaborative health platform as illustrated in Figure 60.

Figure 60. OpenHIE Collaborative Health Platform



#### 4.4.1.1 Application Principles

The Government of Kenya, through the ICT Authority, has set out a GEA. The architecture principles relevant to applications architecture that shall guide the KHEA shall be inherited from the GEA. The principles as set out within the GEA are:

- AAP 1: Common applications are shared across government
- AAP 2: Applications are independent of technology infrastructure
- AAP 3: Common applications are easy to use
- AAP 4: Traceability
- AAP 5: Flexibility
- AAP 6: Integrability
- AAP 7: Modularity
- AAP 8: Buy vs. Build
- AAP 9: Consolidation
- AAP 10: Interoperability
- AAP 11: Reusability
- AAP 12: Shareability
- AAP 13: Upgradability

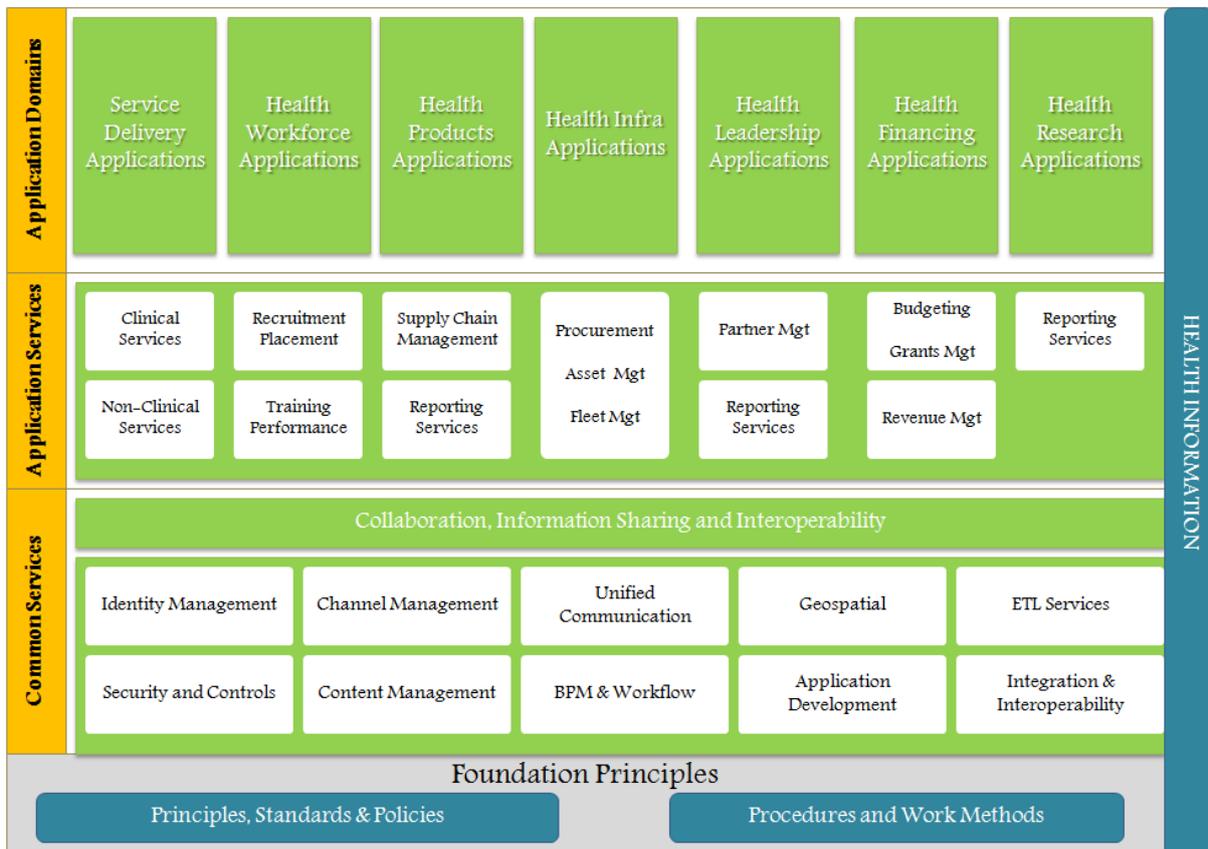
- AAP 14 Compliance
- AAP 15: Supportability

Proposed architecture principles guiding the application architecture are:

- Re-usability (inheritance)
- Traceability (agency based/encapsulated) each application shall have an owner
- Integrability (interoperability)

#### 4.4.2 Classification

Figure 61. Classification of Applications



Please refer to Appendix 3 for detailed ARM classifications.

#### 4.4.3 Integration / Interoperability / Interfaces

There are various types of interoperability, categorised as follows:

1. Presentation Integration/Interoperability:- Used to describe a common look-and-feel approach for applications guiding the user to the underlying functionality of the set of application services. This is primarily the user experience sub-domain focusing on rich Internet applications, fat / thin-client applications etc. This layer of interoperability covers the non-physical channels that deliver services.
2. Operational or Business Interoperability:- Used to describe how business processes are to be shared. This is primarily the sub-domain for Business Process Management (BPM) and workflow. Refer to section 6.3.3 which talks about guidance and standards of interoperability.
3. Information Interoperability:- Used to define how information is to be shared. This will primarily be the sub-domain of semantics and common data dictionary. Refer to section 6.3, on the IRM.
4. Technical Interoperability:- Used to define how technical services are to be shared or connect to one another. This will be primarily the sub-domain of message exchange protocols and mechanisms such as XML, web services and RMI through the Enterprise Service Bus (ESB).

#### 4.4.4 Application / Channel Mapping

**Table 38. Channel / Service / Application Matrix**

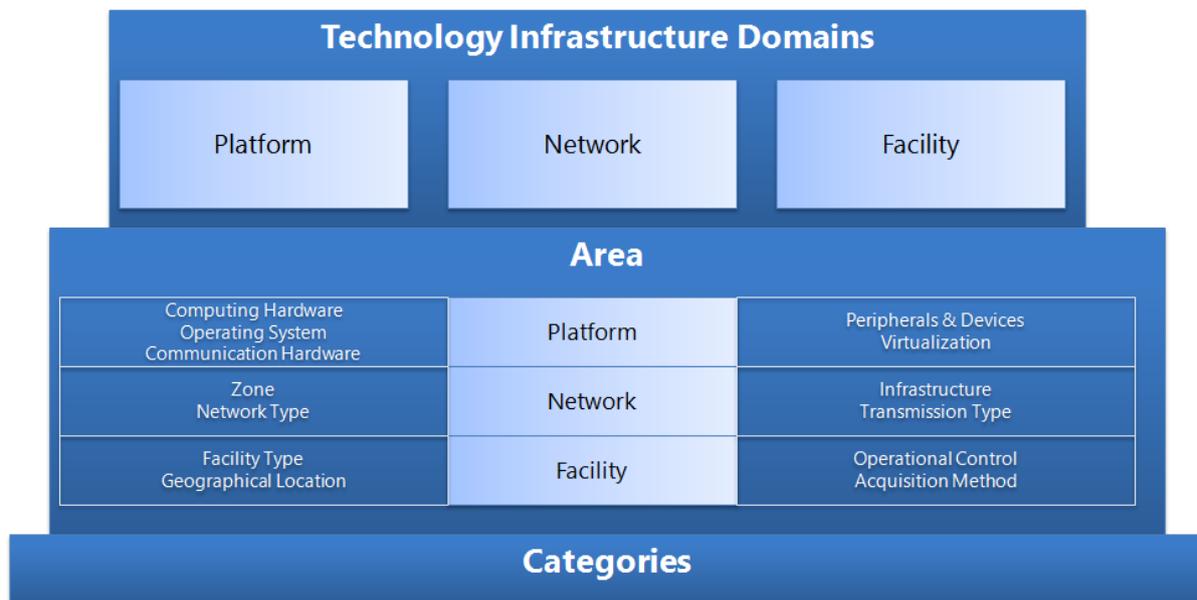
Interaction / Channel	Web	Portal	Mobile Apps	Facility	Phone	Other
Service Delivery Applications						
Health Products Applications						
Health Financing Applications						
Health Infrastructure Applications						
HRH Applications						
Health Leadership Applications						
Health Research Applications						
Health Information Applications						

## 4.5 Technology Reference Model

### 4.5.1 Introduction

The TRM is used to categorise IT infrastructure and the facilities and network that host the IT infrastructure in the KHEA. The TRM supports definition of infrastructure technology items and best practice guidance to promote sharing and re-use of infrastructure to reduce costs, increase interoperability across the sector and its partners, support efficient infrastructure procurement and deployment and enable greater access to information across the health enterprise.

Figure 62. Target TRM



The TRM is divided into three levels, namely:-

1. **Domain** - Consists of three entities, platform, network and facility. These are linked and related to each other to enable analysis of IT assets across the three dimensions.
2. **Area** - Consists of 13 areas which are linked to the three domains in level 1.
3. **Category** - Consists of granular level areas that are linked to level 2. For example Personal Computer - Laptop is linked to level 2 Area under Platform - > Peripheral & Devices classification.

#### 4.5.1.1 Technology architecture principles

The Government of Kenya, through the ICT Authority, has set out a GEA. The architecture principles relevant to technology architecture that shall guide the KHEA shall be inherited from the GEA. The principles as set out within the GEA are:

- TAP 1: Technology diversity is contained

- TAP 2: Technology components are able to interoperate and exchange information

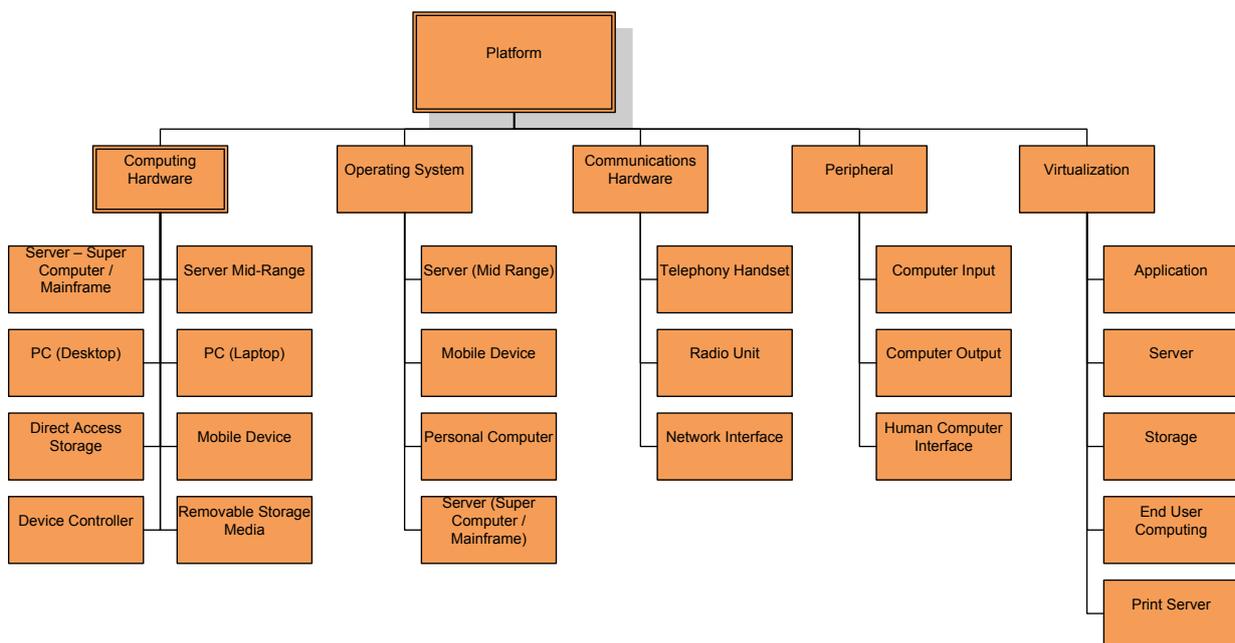
Therefore, the proposed architecture principles guiding KHEA Technology Reference Model are:

- Communicability
- Service orientation

## 4.5.2 Classification

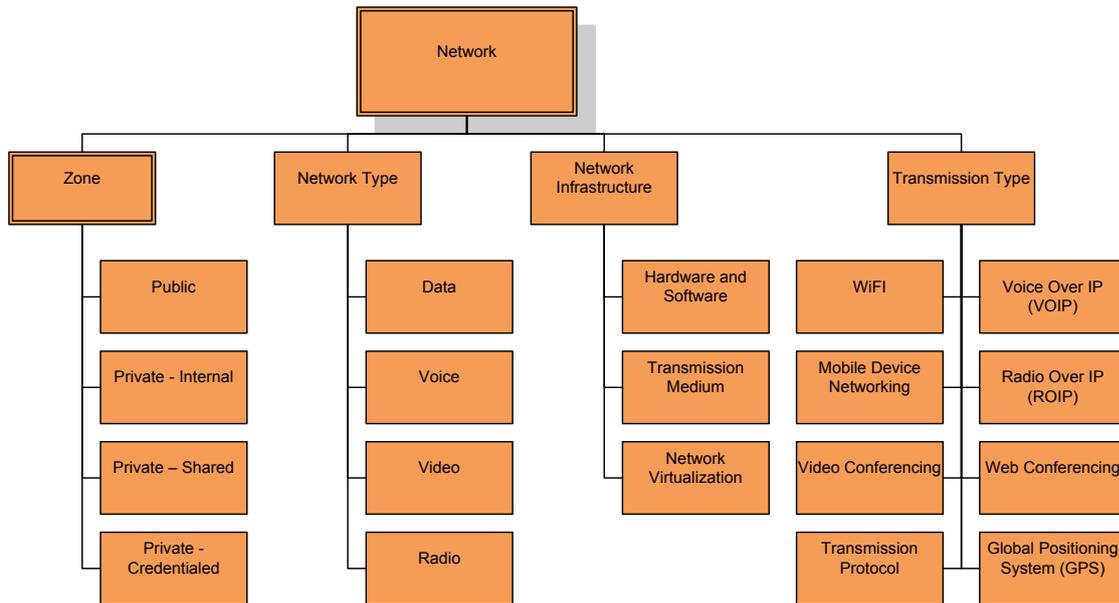
### 4.5.2.1 Platform

Figure 63. TRM Platform Classification



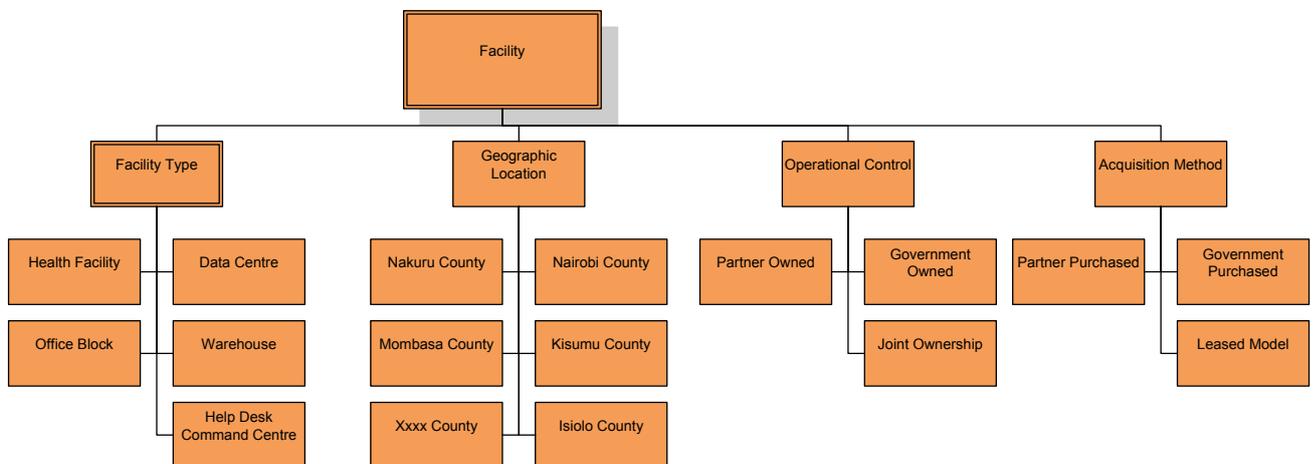
### 4.5.2.2 Network

Figure 64. TRM Network Classification



### 4.5.2.3 Facility

Figure 65. TRM Facility Classification



Refer to Appendix 4 for detailed classification of TRM

## 5 Recommendations

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### 5.1 Architecture Roadmap

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This section defines the gap between the current (as-is) and target (to-be) state business architectures.

#### 5.1.1 Gap Analysis

- Business domain gaps:
- People gaps
  - Absence of defined roles of domain architects within the sector
  - Little or no training in enterprise architecture
  - No office of health sector enterprise architecture
- Process gaps
  - Processes exist but they need to be documented, modelled and communicated for each domain
  - Visibility and traceability of implementation of recommendations from past studies on:-
    - Data domain, e.g. data quality protocol and data collection process.
    - Applications domain e.g. interoperability and approaches to software development.
    - Technology domain, e.g. the assessment of Afya House data centre.

#### 5.1.2 Architecture Roadmap and Implementation Plan

This section groups individual work packages in a timeline that will realise the target architecture. It also details the sequence of activities to be performed to achieve an architecture maturity level of 3.5 in a space of 24 months as illustrated by the road map diagram (Figure 66).

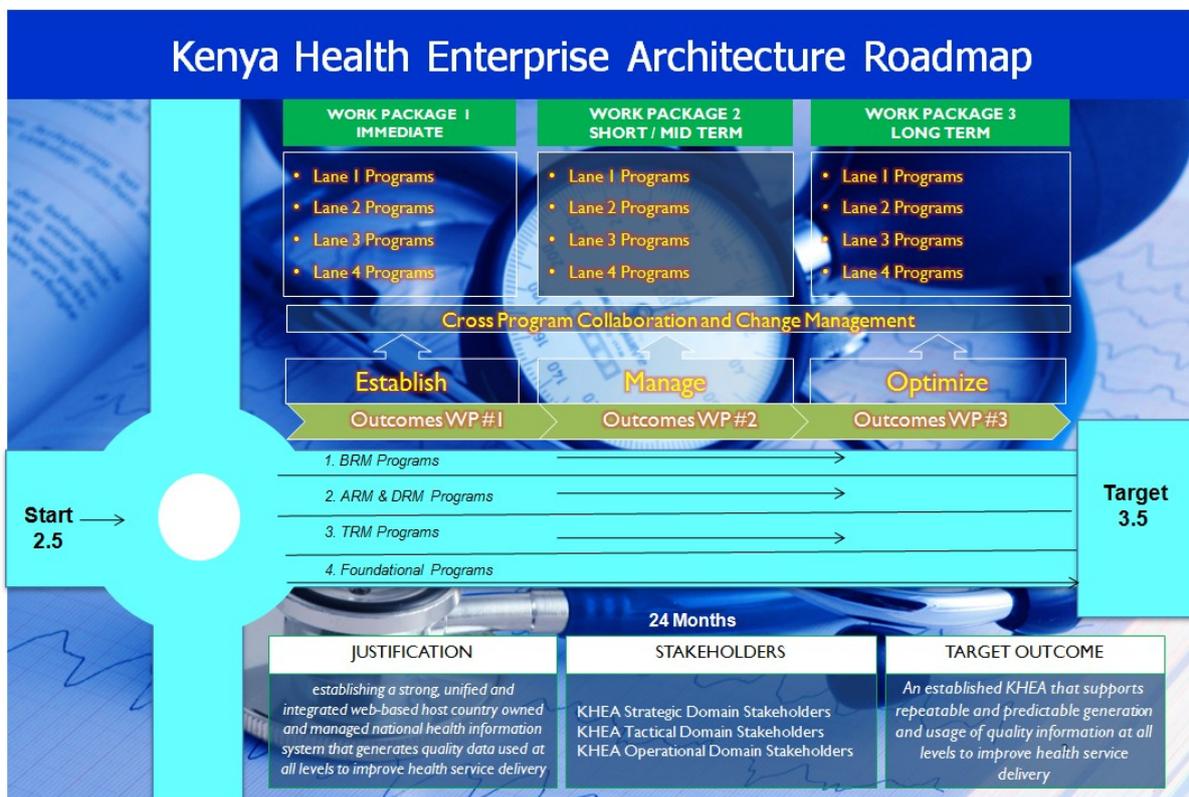
##### 5.1.2.1 Architecture Roadmap

Each work package identifies a logical group of activities that need to be carried out to realise the target architecture. Activities are grouped on the basis of the architectural domains identified as lanes in the roadmap. There will be three work packages, each feeding into the next to lead to the overall target. The work packages have been designed to deliver incremental benefits in the architecture landscape which shall be measured through collaborative cross-programme collaboration and change management. The intent of the work packages is to:-

- **Establish** the foundation for enterprise architecture. A weak foundation will compromise the stability of the resultant architecture; therefore activities at the establishment stage must be wholly owned and followed through to assure they are executed as intended.

- *Manage* the foundational enterprise architecture. Upon establishment of the foundation and the execution of work built on top of it, there will be need for consistent and effective management of the architecture to assure the aspirations of KHEA are not lost during the build process. At this point, there will be a lot of change management and capacity building to include discipline in the build process, transparency in deployment, accountability in delivery, and responsibility and fairness amongst the actors in the architecture landscape.
- *Optimise* the established architecture. Architecture is not static. Just as the capabilities that shall run on KHEA are dynamic, there will be need to repeatedly look at part or all of the landscape to make adjustments as and when needed. Programmes in this work package will address these needs in order to make the architecture responsive rather than inhibitive to business needs.

Figure 66. KHEA Roadmap



### 5.1.2.2 Implementation Plan

The Implementation Plan provides a schedule of the projects that will realise the target architecture. They are shown in the following three **work packages** (Tables 39-41): **Establish, Manage, Optimise**.

**Table 39. Work Package #1: Establish**

<b>Programme</b>	<b>Timelines (Months)</b>	<b>Benefits / Outcomes</b>	<b>Stakeholder</b>
<i>Lane 1 Programmes (BRM Programmes)</i>	<b>0-3</b>		
Complete the mapping of business services for all the investment pillars.		Completed BRM	
<i>Lane 2 Programmes (ARM and IRM Programmes)</i>	<b>0-3</b>		
Complete the mapping of data and application services for all the BRM services.		Completed ARM and IRM	
<i>Lane 3 Programmes (TRM Programmes)</i>	<b>0-3</b>		
Complete the mapping of technology services for all IRM and ARM services		Completed TRM	
<i>Lane 4 Programmes (Foundational Programmes)</i>	<b>0-3</b>		
<b>People</b>			
Identify, document enterprise architecture training needs and conduct training for: <ul style="list-style-type: none"> <li>• Strategic stakeholders</li> <li>• Tactical stakeholders</li> <li>• Operational stakeholders</li> </ul>		Informed stakeholders ready to champion change	
Define the organisation structure for KHEA <ul style="list-style-type: none"> <li>• Set up office / section / department to oversee KHEA governance</li> <li>• Define JDs for the roles of ; <ul style="list-style-type: none"> <li>• Business Architect(s)</li> <li>• Information Architect(s)</li> <li>• Technology Architect(s)</li> <li>• Application Architect(s)</li> </ul> </li> </ul>		Established architecture governance structures	
Establish linkages between county government and national government KHEA.		Established linkages within the sector and outside of it with regards to KHEA	
<b>Tools</b>			
Procure modelling tools, set up an architecture repository and deploy the artifacts already developed to the repository.		Available tools to manage the architecture changes.	
<b>Process</b>			
Industry validation of the KHEA and adoption		Fully understood and adopted KHEA.	

Table 40. Work Package #3: Optimise

Programme	Timelines (in Months)	Benefits / Outcomes	Stakeholder
<i>Lane 1 Programmes (BRM Programmes)</i>	19 -24		
Post implementation review of BRM in line of the changes in the ARM and IRM for each investment pillar		Alignment of changes to the ARM, IRM back to the BRM	
<i>Lane 2 Programmes (ARM and IRM Programmes)</i>	19 -24		
Changes to the IRM and ARM in response to findings and recommendations from the revised BRM		Alignment with changes to the BRM	
<i>Lane 3 Programmes (TRM Programmes)</i>	19 -24		
Changes to the TRM in support of the changes in the IRM, ARM domains.		Alignment with changes to the IRM & ARM	
<i>Lane 4 Programmes (Foundational Programmes)</i>	19 -24		
<b>People</b>			
Identify, document refresher enterprise architecture training needs and conduct training for; <ul style="list-style-type: none"> <li>• Strategic stakeholders</li> <li>• Tactical stakeholders</li> <li>• Operational stakeholders</li> </ul>		Informed and equipped team to support the ARM, IRM and TRM domains	
Review and refine the organisation structure for KHEA Office / section / department to oversee KHEA governance JDs for the roles of ; Business Architect(s) Information Architect(s) Technology Architect(s) Application Architect(s)		Adequate and fully resourced architecture governance structures	
Re-validate the effectiveness of linkages between county government and national government KHEA.		Strengthened linkages	
<b>Process</b>			
Conduct an overall appraisal of the architecture value realisation to make decisions about how to manage / optimise the KHEA going forward.		Visibility of value of KHEA over the period of execution	

## 5.2 Implementation Governance

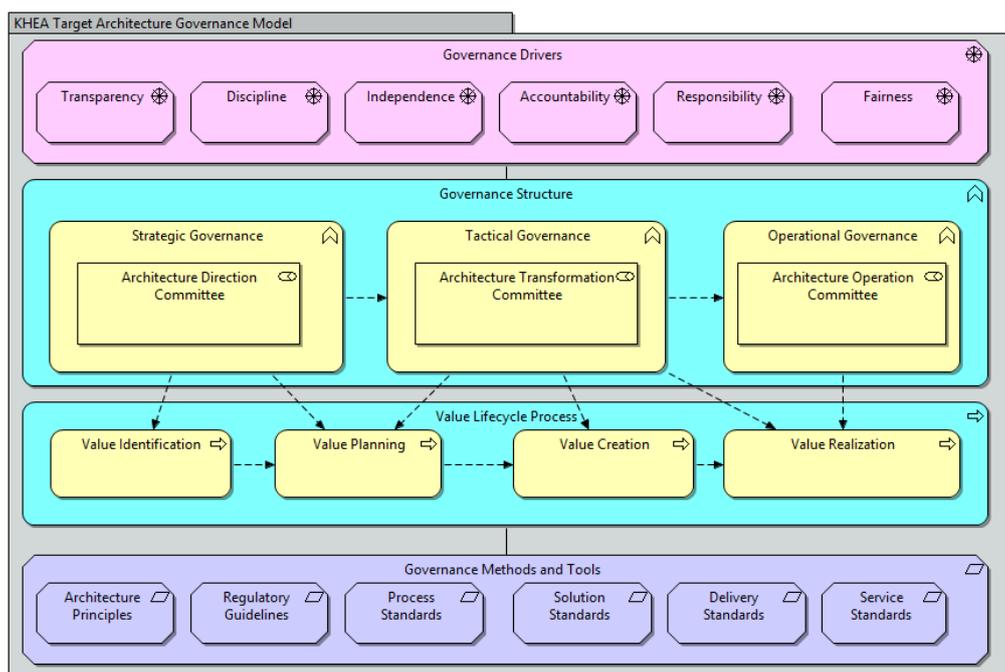
### 5.2.1 Introduction

This section assesses and documents internal capability required to provide oversight in transition from the current to the target state business architectures.

KHEA architecture governance has five layers described as drivers of governance, the structural design of authority structures, the process of value management and the tools and standards required as inputs or outputs in the governance cycle.

- **Drivers:** These are the foundational motivators for setting up the architecture governance as detailed in section 8.6.2. in section 8.6.2.
- **Structure:** Structure has three components that map the lifecycle of decision making and implementation: strategy, which sets architecture direction and then cascades to transformation, which implements direction, and finally operation, which safeguards direction after implementation.
- **Value Process:** The end-to-end process layer connects governance components. Without the process layer, governance structures are individual “silos”. Value origination to realisation cuts across the three governance domains and brings to life the governance drivers by ensuring accountability, transparency and discipline amongst the domains.
- **Governance Methods and Tools:** This is the layer responsible for providing tools, standards and methods to enable governance. The schedule of calendars for compliance checks, the standards that must be measured during architecture assessment and the decisions made by the various governance teams all will fall in this layer. It is the simply the governance repository.

Figure 67. KHEA Governance Model



## 5.2.2 Governance Motivators (Drivers)

The motivation for governance is based on the following tenets;

- **Discipline:** All parties will commit to adhering to procedures, processes and authority structures established by the health enterprise.
- **Transparency:** All actions implemented and their decision support will be available for inspection by authorised persons as per the architecture governance structure.
- **Independence:** All processes, decision making and mechanisms used will be established so as to minimise or avoid conflicts of interest.
- **Accountability:** The architecture board in the health enterprise will be authorised and accountable for the decisions /actions taken on the KHEA architecture.
- **Responsibility:** Each contracted party is required to act responsibly in providing service to the health enterprise and its stakeholders.
- **Fairness:** All decisions taken, processes used and their implementation will not be allowed to create unfair advantage to any particular party or interest group in the health enterprise.

## 5.2.3 Governance Structure

Table 41 lays out levels of architecture governance team involvement in three aspects of architecture governance. The levels of involvement are:

- **Low Level Involvement:** This means input by the team requires deep scrutiny of the artifacts associated with the domain to establish implications of changes to those artifacts, the risks involved and the mitigation required if changes must be made. The involvement here is *prescriptive* or *suggestive*, i.e. there is creation of a baseline for discussion and acceptance at medium and higher levels.
- **Medium Level Involvement:** This means input by the team involves review / adoption of work already done at lower levels for all the artifacts associated with the domain. The involvement is *consultative*, i.e. decision making requires mid level input before it is taken.
- **High Level Involvement:** This means input by the team involves review / adoption of work already done at lower levels and reviewed at medium level for all the artifacts associated with the domain. The involvement is two pronged:
  - *Escalative*, i.e. decision making cannot be made at the prior stages and requires involvement of governance team at the level.
  - *Informative*, i.e. governance team is kept in the loop as matter of informing without necessarily requirement for action.

**Table 41. KHEA Target Architecture Governance Matrix**

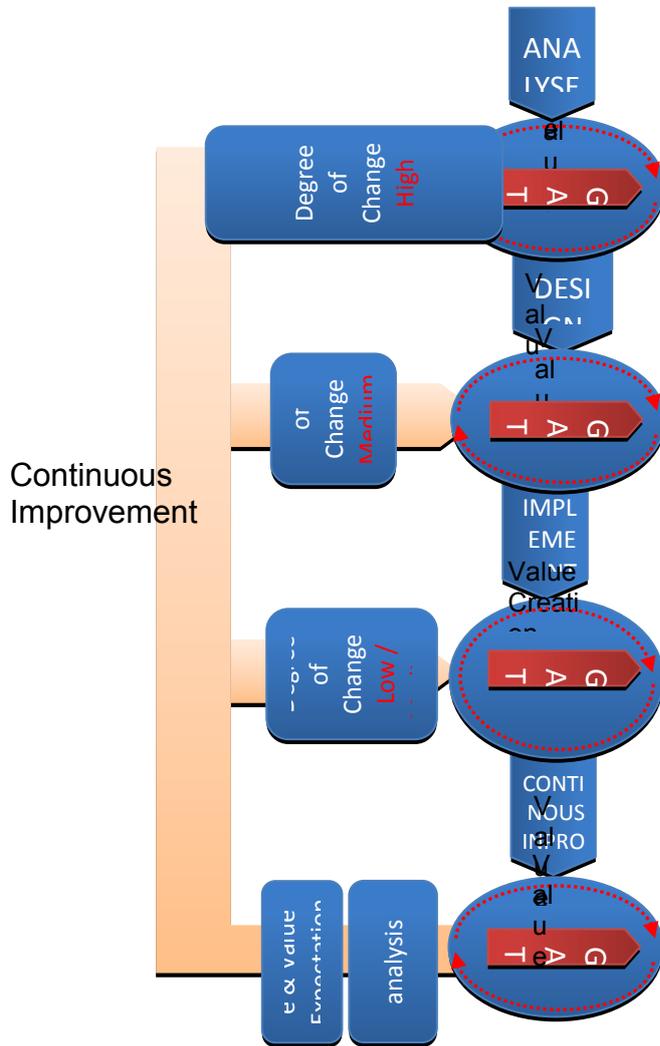
Governance Domain	Level of Involvement on Architecture Domains			
	Strategy Model	Business Model	Applications and Data Model	Technology Model
<b>Strategic governance (Committee responsible for direction)</b>	Low Level	Medium to High Level	High Level	High Level
<b>Tactical governance (Committee responsible for transformation)</b>	Medium Level	Medium to Low Level	Medium to Low Level	Medium Level
<b>Operational governance (Committee responsible for operation)</b>	High Level	Low Level	Low Level	Low Level

## 5.2.4 Governance Methods and Tools

### 5.2.4.1 Value Realisation Process

The architecture value realisation process is a four gate process as illustrated in Figure 68. Each gate has implications for governance.

Figure 1. Value Realisation Process



**Table 42. Value Realisation Process**

Gate Num.	Step	Description	Decision Actions	Governance Role
1	Value Investigation and Identification	The first step of identifying an initiative that would add value to the enterprise	Determine the business case	Strategic
			Determine adequacy of existing capabilities to meet requirement	Tactical and Operational
			Determine justification for extending architecture landscape	Strategic, Tactical and Operational
2	Value Planning	The second step of planning for an initiative after justification in gate 1.	Define the initiative and present high level aspirational view (showing concept design, roll out plan, dependencies and potential impact to the architecture)	Tactical and Operational
			Validate the high level aspirational view, identify risks and mitigations	Strategic, Tactical and Operational
3	Value Creation	The third step of value realisation gate process is the actual implementation of the value initiative.	Describe the initiative in detail	Tactical
			Source and evaluate the solutions	Operational and Tactical
			Do detailed planning of implementation	Tactical
			Implement (input in the design of the solution and testing phases)	Operational and Tactical
			Commission and accept the solution (using the architecture acceptance criteria)	Strategic, Tactical and Operational
4	Value Realisation	The fourth step of value realisation which is actual custody of the implementation after commission.	Manage changes to configurations	Operational
			Manage updates and upgrades	Operational

#### 5.2.4.2 Architectural changes

Architectural change will occur when a new initiative is implemented. To assure an appropriate level of decision making before change is made and a seamless transition, changes need to be considered and classified in accordance with the stakeholders they impact and the level of change in the architecture landscape. Table 43 shows categories of changes that KHEA might undergo as it matures.

**Table 43. KHEA Change Classifications**

<b>Change</b>	<b>Description</b>	<b>Risks</b>	<b>Time to Execute</b>	<b>Implications on Governance</b>
Simplification Change	A change introduced to optimise an existing process. This may be a change in configuration that does not involve creation / addition of new capabilities / artifacts in the landscape. It will tend to re-use existing artifacts in the landscape, e.g. configuring an end user device to personalise preferences in accessing report from the data services.	Low Risk	Short	Mostly handled at Operational level. It may not require consultation at Tactical or Strategic levels.
Incremental Change	A change introduced to enhance existing artifacts. This may be a mix of configuration and development which may require extending existing capabilities to meet the new requirement.	Medium to Low	Short to Medium Depending on Scope	Mostly handled at Tactical level. It might require consultation at Operational and Strategic levels.
Re-architecting Change	A change that requires to put the entire KHEA through an architecture re-development process focusing on a key domain like data and making significant changes to artifacts and the definitions therein.	High Risk	Medium to Long depending on scope	A deeply engaging exercise that requires engagement at all 3 levels. Business justifications and detailed designs and work plans must be reviewed to determine the impact and make informed decisions

Changes to the architecture will require a formal document that asks the architecture governance team to consider the change. The architecture change request form is shown in Table 44.

**Table 44. Sample Architecture Change Request Form**

<b>Change ID</b>	<<ID to uniquely identify this change request>>
<b>Change Title</b>	<<One line summary title for the change>>
<b>Change Requestor</b>	<<Name>> <<Position>> <<Organization>> <<Email>> <<Tel>>
<b>Change Sponsor(s)</b>	<<Details of business sponsors for this change>>
<b>Deadline</b>	<<Any deadline for implementing the change, including reason>>
<b>DESCRIPTION</b>	

<b>Business Drivers</b>	
<b>Business-as-usual developments</b>	
<b>Business exceptions</b>	
<b>Business innovations</b>	
<b>Business technology innovations</b>	
<b>Strategic change</b>	
<b>Technology Drivers</b>	
<b>New technology reports</b>	
<b>Asset management cost reductions</b>	
<b>Technology withdrawal</b>	
<b>Standards initiatives</b>	
<b>Operational Drivers</b>	
<b>Improvements based on operational experience</b>	
<b>Capacity planning</b>	
<b>RATIONAL FOR CHANGE</b>	
<b>IMPACT OF CHANGE</b>	

Once the architecture review board has reviewed the change request, they will make their notes and update the request with a go-no go decision.

Each “go” and “no go” decision will be logged in a decision log which will look like Table 45.

**Table 45. Architecture Decision Log**

Change Request ID	CR Date	Change Requestor	Change Title	Type of Change	Governance Assessment Notes	Governance Action	Governance Approver(s)
KHEA-CR-001	DATE	Requestor 1	Upgrade of the data services server	Incremental Change	Hardware only upgrade. Need for thorough testing of the data services layer for compatibility	Approved	Strategic Approver Tactical Approver Operational Approver
KHEA-CR-002	DATE	Requestor 2	HL7 standard upgrade to the new API	Re-architecting change	Data service impacting change. Likelihood of re-writing the service registry.	On hold pending detailed Point of Contact (PoC)	

### 5.2.4.3 Compliance Assessments

Once changes have been deployed, there will be need for periodic checks to confirm that the deployment is in compliance with the architecture standards. Compliance assessments will also be a mechanism for reviewing project progress to make sure the design and implementation is proceeding in line with the strategic and architectural objectives.

One of the tools to conduct compliance assessments is an assessment kit which has a set of checklists as follows:-

#### A. ARM (Investment Pillars Applications) Compliance Checklist

1. Are any of the capabilities required provided by standard products supporting one or more line-of-business applications? For example:-
  - Service Deliver Applications
  - Health Products Applications
  - Health Infrastructure Applications
  - Health Financing Applications
  - HRH Applications
2. Describe the process requirements for business application capabilities that are not met by the standard products.

#### B. ARM Interoperability Compliance Checklist

1. What integration points (business process/activity, application, data, computing environment) are targeted by this architecture?
2. What application integration techniques will be applied (common business objects, standard data definitions (XML, industry standards, etc.), common user interface presentation/desktop)?

### **C. ARM Application Components Compliance Checklist**

1. Describe how error conditions are defined, raised and propagated between application components.
2. Describe the general pattern of how methods are defined and arranged in various application modules.
3. Describe the approach that is used to minimise the number of round-trips between client and server calls, particularly for out-of-process calls, and when complex data structures are involved.
4. Describe the major data structures that are passed between major system components.
5. Describe the major communication protocols that are used between major system components.
6. Describe the extent to which objects are created, used and destroyed versus re-used through object pooling.
7. Describe the extent to which the system relies on threading or critical section coding.
8. Describe the approach and the internal documentation that is used internally in the system to document the methods, method arguments and method functionality.
9. Describe the code review process that was used to build the system.
10. Describe the unit testing that has been used to test the system components.

### **D. Method arguments and Data Values**

1. What are the processes that standardise the management and use of the data?
2. What business process supports the entry and validation of the data?
3. What business actions correspond to the creation and modification of the data?
4. What business actions correspond to the deletion of the data and are they considered part of a business record?
5. What are the data quality requirements required by the business user?
6. What processes are in place to support data referential integrity and/or normalisation?

### *Data Definition*

1. What are the data model, data definitions, structure and hosting options of purchased applications Commercial Off The Shelf Software (COTS)?
2. What are the rules for defining and maintaining the data requirements and designs for all components of the information system?
3. What shareable repository is used to capture the model content and the supporting information for data?
4. What is the physical data model definition (derived from logical data models) used to design the database?
5. What software development and data management tools have been selected?
6. What data owners have been identified to be responsible for common data definitions, eliminating unplanned redundancy, providing consistently reliable, timely and accurate information, and protecting data from misuse and destruction?

### *Security/Protection*

1. What are the data entity and attribute access rules which protect the data from unintentional and unauthorised alterations, disclosure and distribution?
2. What are the data protection mechanisms to protect data from unauthorised external access?
3. What are the data protection mechanisms to control access to data from external sources that temporarily have internal residence within the enterprise?

### *Hosting, Data Types and Sharing*

1. What is the discipline for managing sole-authority data as one logical source with defined updating rules for physical data residing on different platforms?
2. What is the discipline for managing replicated data, which is derived from operational sole-authority data?
3. What tier data server has been identified for the storage of high or medium-critical operational data?
4. What tier data server has been identified for the storage of type C operational data?
5. What tier data server has been identified for the storage of decision support data contained in a data warehouse?
6. What Database Management Systems (DBMSs) have been implemented?

### *Common Services*

What are the standardised distributed data management services (e.g. validation, consistency checks, data edits, encryption and transaction management) and where do they reside?

#### *Access Method*

1. What are the data access requirements for standard file, message and data management?
2. What are the access requirements for decision support data?
3. What are the data storage and the application logic locations?
4. What query language is being used?

### **E. TRM Compliance Checklist**

1. What system capabilities will involve high volume and/or high frequency data transfers?
2. How does the system design impact or involve end user devices?
3. What is the quantity and distribution (local and national) of usage, data storage and processing?
4. What existing applications and data services are impacted by the incoming project?
5. What hardware and operating system choices have been made before functional design of key elements of the system?
6. If hardware and operating system decisions were made outside of the project's control:
  - How can the project influence those decisions as system design takes shape?
7. If some non-standards have been chosen:
  - What are the essential business and technical requirements for not using established standards?
  - Is this supported by a business case?
  - Have the assumptions in the business case been subject to scrutiny?
  - What is the process for evaluating full lifecycle costs of hardware and operating systems?
8. How has financial management been engaged in evaluation of lifecycle costs?
9. Are there commitments to any supplier?
10. Are the requirements to be met by only one supplier or one supplier technology?

## F. Security Compliance Checklist

1. **Security Awareness:** Have you assured that the corporate security policies and guidelines to which you are designing are the latest versions? Have you read them? Are you aware of all relevant computing security compliance and risk acceptance processes? (Interviewer should list all relevant policies and guidelines.)
2. **Identification/Authentication:** Diagram the process flow of how a user is identified to the application and how the application authenticates that the user is who they claim to be. Provide supporting documentation to the diagram explaining the flow from the user interface to the application/database server(s) and back to the user. Are you compliant with corporate policies on accounts, passwords etc.?
3. **Authorisation:** Provide a process flow from beginning to end showing how a user requests access to the application, indicating the associated security controls and separation of duties. This should include how the request is approved by the appropriate data owner, how the user is placed into the appropriate access level classification profile and how the user ID, password and access are created and provided to the user. Also inform users of their responsibilities in using the application, give users information on how to change their password and whom to call for help as well as a copy of the access agreement and so forth.
4. **Access Controls:** Document how the user IDs, passwords and access profiles are added, changed, removed and documented. The documentation should include who is responsible for these processes.
5. **Sensitive Information Protection:** Provide documentation that identifies sensitive data requiring additional protection. Identify the data owners responsible for these data and the process to be used to protect storage, transmission, printing and distribution of the data. Include how the password file/field is protected. How will users be prevented from viewing someone else's sensitive information? Are there agreements with outside parties (partners, suppliers, contractors, etc.) concerning the safeguarding of information? If so, what are the obligations?
6. **Audit Trails and Audit Logs:** Identify and document group accounts required by the users or application support, including operating system group accounts. Identify and document individual accounts and/or roles that have super user type privileges, what these privileges are, who has access to these accounts, how access to these accounts is controlled, tracked and logged and how password change and distribution are handled, including operating system accounts. Also identify audit logs, who can read the audit logs, who can modify the audit logs, who can delete the audit logs and how the audit logs are protected and stored. Is the user ID obscured in the audit trails?

7. **External Access Considerations:** Will the application be used internally only? If not, are you compliant with corporate external access requirements?

#### **G. System Management Compliance Checklist**

1. What is the frequency of software changes that must be distributed?
2. What tools are used for software distribution?
3. Are multiple software and/or data versions allowed in production?
4. What is the user data backup frequency and expected restore time?
5. How are user accounts created and managed?
6. What is the system license management strategy?
7. What general system administration tools are required?
8. What specific application administration tools are required?
9. What specific service administration tools are required?
10. How are service calls received and dispatched?
11. Describe how the system is uninstalled.
12. Describe the process or tools available for checking that the system is properly installed.
13. Describe tools or instrumentation that are available that monitor the health and performance of the system.
14. Describe the tools or process in place that can be used to determine where the system has been installed.
15. Describe what form of audit logs are in place to capture system history, particularly after a mishap.
16. Describe the capabilities of the system to dispatch its own error messages to service personnel.

#### **H. System Engineering/Overall Architecture Checklists**

##### *General*

1. What other applications and/or systems require integration with yours?
2. Describe the integration level and strategy with each.
3. How geographically distributed is the user base?
4. What is the strategic importance of this system to other user communities inside or outside the enterprise?
5. What computing resources are needed to provide system service to users inside the enterprise? Outside the enterprise and using enterprise computing assets? Outside the enterprise and using their own assets?

6. How can users outside the native delivery environment access your applications and data?
7. What is the life expectancy of this application?
8. Describe the design that accommodates changes in the user base, stored data and delivery system technology.
9. What is the size of the user base and their expected performance level?
10. What performance and stress test techniques do you use?
11. What is the overall organisation of the software and data components?
12. What is the overall service and system configuration?
13. How are software and data configured and mapped to the service and system configuration?
14. What proprietary technology (hardware and software) is needed for this system?
15. Describe how each and every version of the software can be reproduced and re-deployed over time.
16. Describe the current user base and how that base is expected to change over the next three to five years.
17. Describe the current geographic distribution of the user base and how that base is expected to change over the next three to five years.
18. Describe how many current or future users need to use the application in a mobile capacity or who need to work off line.
19. Describe what the application generally does, the major components of the application and the major data flows.
20. Describe the instrumentation included in the application that allows for the health and performance of the application to be monitored.
21. Describe the business justification for the system.
22. Describe the rationale for picking the system development language over other options in terms of initial development cost versus long term maintenance cost.
23. Describe the systems analysis process that was used to develop the system architecture and product selection phase of the system architecture.
24. Who besides the original customer might have a use for or benefit from using this system?
25. What percentage of the users use the system in browse mode versus update mode?
26. What is the typical length of requests that are transactional?

27. Do you need guaranteed data delivery or update, or does the system tolerate failure?
28. What are the up-time requirements of the system?
29. Describe where the system architecture adheres or does not adhere to standards.
30. Describe the project planning and analysis approach used on the project.

#### *Processors/Servers/Clients*

1. Describe the client/server Application Architecture.
2. Annotate the pictorial to illustrate where application functionality is executed.

#### *Client*

1. Are functions other than presentation performed on the user device?
2. Describe the data and process help facility being provided.
3. Describe the screen-to-screen navigation technique.
4. Describe how the user navigates between this and other applications.
5. How is this and other applications launched from the user device?
6. Are there any inter-application data and process sharing capabilities? If so, describe what is being shared and by what technique/technology.
7. Describe data volumes being transferred to the client.
8. What are the additional requirements for local data storage to support the application?
9. What are the additional requirements for local software storage/memory to support the application?
10. Are there any known hardware/software conflicts or capacity limitations caused by other application requirements or situations which would affect the application users?
11. Describe how the look and feel of your presentation layer compares to the look and feel of the other existing applications.
12. Describe to what extent the client needs to support asynchronous and/or synchronous communication.
13. Describe how the presentation layer of the system is separated from other computational or data transfer layers of the system.

#### *Application Server*

1. Can/do the presentation layer and application layers run on separate processors?
2. Can/do the application layer and data access layer run on separate processors?

3. Can this application be placed on an application server independent of all other applications? If not, explain the dependencies.
4. Can additional parallel application servers be easily added? If so, what is the load balancing mechanism?
5. Has the resource demand generated by the application been measured and what is the value? If so, has the capacity of the planned server been confirmed at the application and aggregate levels?

*Data Server*

1. Are there other applications which must share the data server? If so, identify them and describe the data and data access requirements.
2. Has the resource demand generated by the application been measured and what is the value? If so, has the capacity of the planned server been confirmed at the application and aggregate levels?

*COTS (where applicable)*

1. Is the vendor substantial and stable?
2. Will the enterprise receive source code upon demise of the vendor?
3. Is this software configured for the enterprise's usage?
4. Is there any peculiar data or processes that would impede the use of this software?
  - Is this software currently available?
5. Has it been used/demonstrated for volume/availability/service-level requirements similar to those of the enterprise?
  - Describe the past financial and market share history of the vendor.

**I. System Engineering / Methods and Tools Checklists**

1. Do metrics exist for the current way of doing business?
2. Has the system owner created evaluation criteria that will be used to guide the project?
3. Describe how the evaluation criteria will be used.
4. Has research of existing architectures been done to leverage existing work? Describe the method used to discover and understand. Will the architectures be integrated? If so, explain the method that will be used.
5. Describe the methods that will be used on the project:
  - For defining business strategies
  - For defining areas in need of improvement
  - For defining baseline and target business processes
  - For defining transition processes

- For managing the project
  - For team communication
  - For knowledge management, change management and configuration management
  - For software development
  - For referencing standards and statements of direction
  - For quality assurance of deliverables
  - For design reviews and deliverable acceptance
  - For capturing metrics
6. Are the methods documented and distributed to each team member?
  7. To what extent are team members familiar with these methods?
  8. What processes are in place to assure compliance with the methods?
  9. Describe the infrastructure that is in place to support the use of the methods through the end of the project and anticipated releases.
    - How is consultation and trouble-shooting provided?
    - How is training coordinated?
    - How are changes and enhancements incorporated and cascaded?
    - How are lessons learned captured and communicated?
  10. What tools are being used on the project? (Specify versions and platforms.) To what extent are team members familiar with these tools?
  11. Describe the infrastructure that is in place to support the use of the tools through the end of the project and anticipated releases?
    - How is consultation and trouble-shooting provided?
    - How is training coordinated?
    - How are changes and enhancements incorporated and cascaded?
    - How are lessons learned captured and communicated?
  12. Describe how the project will promote the re-use of its deliverables and deliverable content.
  13. Will the architecture designs “live” after the project has been implemented? Describe the method that will be used to incorporate changes back into the architecture designs.
  14. Were the current processes defined?
  15. Were issues documented, rated and associated with current processes? If not, how do you know you are fixing something that is broken?

16. Were existing/planned process improvement activities identified and associated with current processes? If not, how do you know this activity is not in conflict with or redundant to other statements of work?
17. Do you have current metrics? Do you have forecasted metrics? If not, how do you know you are improving something?
18. What processes will you put in place to gather, evaluate, and report metrics?

### Levels of Compliance

- **Irrelevant:** The implementation has no features in common with the architecture specification (so the question of conformance does not arise).
- **Consistent:** The implementation has some features in common with the architecture specification, and those common features are implemented in accordance with the specification. However, some features in the architecture specification are not implemented, and the implementation has other features that are not covered by the specification.
- **Compliant:** Some features in the architecture specification are not implemented, but all features implemented are covered by the specification, and in accordance with it.
- **Conformant:** All the features in the architecture specification are implemented in accordance with the specification, but some more features are implemented that are not in accordance with it.
- **Fully Conformant:** There is full correspondence between architecture specification and implementation. All specified features are implemented in accordance with the specification, and there are no features implemented that are not covered by the specification.
- **Non-conformant:** Any of the above in which some features in the architecture specification are implemented not in accordance with the specification.

Compliance report output would contain the following;

**Table 46 Sample Compliance Assessment Report**

	<b>Issues</b>	<b>Risks</b>	<b>Total</b>
Total Capital Costs Required			
Total Revenue Costs Required			
Total People Required			
Total Timescales Change Required			
Total Scope Change Required			

## 5.3 Risks and Issues

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### 5.3.1 Tips to Assure Success of Enterprise Architecture Projects

The alignment of business and IT tops the list for an organisation to undertake an Enterprise Architecture (EA) project. Other reasons are to support change and strengthen organisational adaptability to change.

Despite great interest in EA, 66% of EA projects did not fulfil expectations. Why would the very initiative that is supposed to improve the connection between business and technology fail to do so and produce instead an unsatisfactory business / technology outcome?

In contrast to concrete, measurable achievements of a system implementation project – which might post a journal, recruit an employee, disburse funds or enrol a student – an EA project has no tangible outcome other than documents and models that mostly make sense only to the EA team. Therefore, justifying putting limited funds into an EA project is challenging.

What steps can an organisation take to make success of their EA project more likely?

1. **Appropriate Sponsorship:** To succeed, architects need three tools: access, leverage and funds. Lack of access to appropriate stakeholders, wrong placement in the value chain, lack of the right information and of funding are all ingredients for failure. The initiative must identify who is required for the project, what is expected of them, what is their level of engagement, what will the cost be and if there are funds to cover that cost and where the right information can be found.
2. **Appropriate Hire:** The inability to translate technology into simple business outcomes, or to listen, communicate, present and market enthusiasm for new technologies can lead to failure. An EA initiative must be led by a person with non-technical skills. Successful EA projects need a generalist (one who knows a little about a lot) rather than a specialist (one who knows a lot about a little).
3. **Don't Build an Ivory Tower:** Building complex models in isolation which make no sense to key stakeholders also risks failure. Don't just draw and push diagrams to stakeholders. The EA project is not for the architect but for the business. Every part of the EA work should interact with business staff in a language and style that clearly communicate how the project is achieving the business' expectations.
4. **Don't Police. Facilitate:** Forcing architecture down the throats of the operations side of the business in order to comply will meet resistance. EA outputs should be tools that facilitate operations. Process models, system models etc. must be building blocks of a better enterprise in line with the strategic drivers.
5. **Measure EA:** Producing diagrams and matrices while not producing frequent, meaningful and measureable business outcomes will rightly undermine support for EA. A prospective homeowner's core utility is not a diagram but a dwelling. Focus on measurable utilities in the eyes of the business.

6. EA is not about tools and frameworks: Over 80 frameworks and as many tools are available for use in an EA project. Spending time selecting the right tools takes time away from their use. A simplified methodology that is easily understood by the stakeholders will speed up progress.
7. EA is not IT: Most EA programmes are initiated by IT and never progress beyond the technology domain. They are limited to factors such as standardisation and roadmap solid engineering practice but won't align such with business goals to deliver business led technology innovation. Although EA uses IT, is not about IT and should not be led by an IT agenda.
8. **Think out of the box about "Enterprise"**: "Enterprise" does not necessarily mean the entire enterprise. It means stepping back and taking a look at the higher-level context before making a decision. Moving architecture to the real enterprise level requires a mature and committed organisation

### 5.3.2 Risks for KHEA

#### 5.3.2.1 Readiness factors

Understanding the readiness of the Kenyan health sector to accept change, identify issues and then deal with the issues in the Implementation and Migration Plans is key to successful KHEA implementation. Health sector readiness to execute the KHEA is anchored in the following 12 readiness factors<sup>10</sup>.

1. Vision is the ability to clearly define and communicate what is to be achieved.
2. Desire, Willingness, and Resolve is the presence of a desire to achieve the results, willingness to accept the impact of doing the work, and the resolve to follow through and complete the change.
3. Need, in that there is a compelling need to execute change.
4. Business Case exists that creates a strong focus for the project, identifying benefits that must be achieved and thereby creating an imperative to succeed.
5. Funding, in the form of a clear source of fiscal resources, exists that covers potential expenditures.
6. Sponsorship and Leadership exists and is broadly shared, but not so broad as to diffuse accountability.
7. Governance is the ability to engage the involvement and support of all parties with an interest in or responsibility to the change with the objective of ensuring that the corporate interests are served and the objectives achieved.
8. Accountability is the assignment of specific and appropriate responsibility, recognition of measurable expectations by all concerned parties and alignment of decision making with areas of responsibility and with where the impact of the decisions will be felt.

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<sup>10</sup> As guided by the TOGAF ADM, <http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap30.html>, accessed October 14<sup>th</sup>, 2015.

9. Workable Approach and Execution Model is an approach that makes sense relative to the task, with a supporting environment, modeled after a proven approach.
10. IT Capacity to Execute is the ability to perform all IT tasks required by the project, including the skills, tools, processes and management capability.
11. Enterprise Capacity to Execute is the ability of the enterprise to perform all the tasks required by the change in areas outside of IT, including the ability to make decisions within tight time constraints.
12. Enterprise Ability to Implement and Operate the transformation elements and their related business processes, absorb the changes arising from implementation, and continue to operate in the new environment.

#### 5.3.2.2 *Readiness Factor Rating*

The rating scheme is as follows:-

- **Urgency**, whereby if a readiness factor is urgent, it means that action is needed before a transformation initiative can begin.
- **Readiness Status**, which is rated as;
  - *Low* (needs substantial work before proceeding),
  - *Fair* (needs some work before proceeding),
  - *Acceptable* (some readiness issues exist; no showstoppers),
  - *Good* (relatively minor issues exist), or
  - *High* (no readiness issues).
- **Degree of Difficulty to Fix** rates the effort required to overcome any issues identified as:
  - *No Action Needed*,
  - *Easy*,
  - *Moderate*,
  - *Difficult*.

### 5.3.3 Current Readiness Ratings

#### 5.3.3.1 Summary assessment of readiness

**Table 47. Readiness Assessment Summary**

Business Factor Assessment Summary				
Ser	Factor	Urgency	Readiness Status	Degree of Difficulty to Fix
1	Vision	Low	Acceptable	Moderate
2	Desire, willingness, resolve	High	Fair	Moderate
3	Need	High	Acceptable	Difficult
4	Business case	High	Low	Easy
5	Funding	Low	Acceptable	No action needed
6	Sponsorship and leadership	High	Good	No action needed
7	Governance	High	Fair	Moderate
8	Accountability	High	Low	Moderate
9	Approach and execution model	Low	Fair	Moderate
10	IT capacity to execute	High	Acceptable	Moderate
11	Enterprise capacity to execute	High	Low	Moderate
12	Ability to implement and operate	High	Fair	Moderate

#### 5.3.3.2 Detailed assessment of readiness

**Table 48. Readiness Assessment Detail**

Business Factor Assessment Notes		
Ser	Factor	Detailed Status
1	Vision	Older versions of the e-health strategy, the health policy and the KHSSP clearly articulate what is to be achieved by the architecture initiative. However, the objectives are not clearly defined in either strategic or specific terms. The definition of the vision comes largely from a technical motivation rather than a business one. There are is a high level aspirational description of predictable processes to move from vision to execution. The primary drivers for the initiative are clear. The scope and approach of the transformation initiative have been defined throughout the organisation.
2	Desire, willingness, resolve	There is evidence of collective desire to achieve the results, and willingness to accept the impact of doing the work. However the resolve to follow through and complete the change requires strong governance. There is active discussion regarding the impact that executing the project may have on various stakeholders. Key resources (financial, human etc.) have been allocated for the change. However it is still unclear how top executives project the clear message that the ministry will follow through; a message that identifies the effort as well as the benefits.  There is evidence of completed initiatives in the past to address gaps in data collection and processing; however they lack the traceability of the effectiveness and efficiency of completion. There is agreement from select parts of the enterprise that the transformation initiative is the “right” thing to do.

<b>Business Factor Assessment Notes</b>		
<b>Ser</b>	<b>Factor</b>	<b>Detailed Status</b>
3	Need	There is a need to execute the change. This need is defined by a bigger need for data warehouse. However, there are no clear statements regarding what the enterprise will lose if the project does not proceed, and equally clear statements of what the project will enable the organisation to do. While there are visible and broadly understood consequences of change failure, but there are no clearly defined and communicated success criteria.
4	Business case	There is no documented business case that creates a strong focus for the project, identifying benefits that must be achieved and thereby creating an imperative to succeed.
5	Funding	A clear source of fiscal resources exists that meets the change's potential expenditures.
6	Sponsorship and leadership	Leadership is in the process of keeping every stakeholder "on board". There is emphasis on remaining focused to the strategic goals of the KSSHP. The change is sponsored by an executive. However it remains unclear as to how appropriately aligned leadership will guide the change to achieve the desired needs.
7	Governance	There are clearly identified stakeholders as aligned in the strategic investment pillars of KHSSP. However, there is a need instil a clear sense of their interest in and responsibility to the project; a culture that encourages participation towards health enterprise rather than silo objectives; a framework that successful enables execution of activities that cross interest areas; a culture that fosters meaningful, as opposed to symbolic, participation in management processes; and a commitment to ongoing project review and challenge and openness to outside advice.
8	Accountability	The framework of accountability is not fully aligned with the benefits of success or consequences of failure of the change across the stakeholder value chain. This potentially diminishes motivation for full engagement with an end in mind.
9	Approach and execution model	There is an approach that is appropriate to the task. As deduced from the draft e-health strategy, the approach identifies phases for deployment, objectives and milestones and performance metrics of the change initiative. However not all the stakeholders know their roles in the initiative. There is need for a communication plan covering all levels of the enterprise and meeting needs ranging from awareness to availability of technical detail. There is high level clarity of how implementation will occur and be monitored.
10	IT capacity to execute	Although there is IT capacity (insourced and outsourced) to perform the downstream tasks of change, the skills, tools, processes and management capability requires improvement. There is need for deeper understanding of EA by "doers", understanding of modeling techniques and adoption of a process for incremental changes of the target architecture.
11	Enterprise capacity to execute	Although there is non-IT capacity (insourced and outsourced) to perform the downstream tasks of the endeavour, the skills, tools, processes and management capability requires improvement. There is need for deeper understanding of non-IT parts of EA by "doers", understanding of modeling techniques and adoption of a process for incremental changes of the target architecture.

Business Factor Assessment Notes		
Ser	Factor	Detailed Status
12	Ability to implement and operate	There is some ability to absorb and operate the changes arising from implementation in the new environment. However, the enterprise requires a robust way to deal with change management issues arising from new processes and systems by putting in place a solid disciplined and process driven service management programme that provides operations, maintenance and support for the re-engineered enterprise.

### 5.3.4 Mitigation of Readiness Risks

Table 49. Risk Log

Risk ID	Risk	Preliminary Risk			Mitigation
		Effect	Frequency	Impact	
KHEA-RSK-001	Vision: Fragmented, incoherent vision documents which may lead to conflicting implementation efforts and duplication.	Critical	Likely	H	Harmonisation of the motivation for various enterprise visions which is driven by context, concepts, logics and physics as illustrated by the diagram in section 6.1. This would enable stakeholders to have various viewpoints depending on the level of view. The KHEA provides a framework to anchor any form of vision / strategy documents with cascading level of detail.
KHEA-RSK-002	Desire and willingness to change: Stakeholders are still loosely connected to the initiative. They don't see how they fit in within.	Critical	Likely	H	Educate stakeholders thorough on the concept of EA and how it applies to the KHEA. Map stakeholders according to the viewpoint levels in the diagram in section 6.1.
KHEA-RSK-003	Need for architecture: There are visible and broadly understood consequences of change failure, but there are no clearly defined and communicated success criteria.	Critical	Likely	H	KHEA attempts to create metrics with the data domain as illustrated in the detailed data architecture principles. In addition, the architecture governance process provides mechanisms to allocate monetary value to compliance or non-compliance to

Risk ID	Risk	Preliminary Risk			Mitigation
		Effect	Frequency	Impact	
					architecture thereby providing traceability to the implications.
KHEA-RSK-004	Business case: One of the investment pillars (Health Leadership) identifies one challenge of collaboration as the fragmented nature of partnership. The lack of a common framework to partner funding of initiatives may / has led to a proliferation of technology solutions creating complexity where re-usability would have sufficed.	Critical	Likely	H	The KHEA governance framework provides for a gate-process for onboarding of initiatives within the architecture landscape. This process begins with a business justification which is evaluated by the members of the architecture governance team at the strategic, tactical or operational level depending on the viewpoint. The framework gives a complete view of incoming / planned initiatives, their impact on the architecture and how to plan for potential disruption therein.
KHEA-RSK-005	Funding: Tied to business case and partnerships, funding for initiatives in a siloed manner becomes expensive for the health enterprise due to multiple terms for similar solutions.	Critical	Likely	H	The KHEA governance framework provides for consolidation of funding needs for similar initiatives thus optimising economies of scale in licensing, hosting services and using resources to deploy the solutions.
KHEA-RSK-006	Sponsorship and Leadership: There is no EA office.	Critical	Likely	H	As KHEA matures, there is need to set up an office of EA that is not domiciled in a technology department. This may require consultative and joint planning with the ICT Authority to have a common overall structure that cascades into sectors at various levels of government. This would minimise multiple efforts and assure re-usability of common standards to

Risk ID	Risk	Preliminary Risk			Mitigation
		Effect	Frequency	Impact	
					avoid significant effort being expended on re-writing already existing standards. For example if Ministry of Environment decides to have its own EA, what commonalities would it have with KHEA and how will those points be established using appropriate organisation structures?
KHEA-RSK-007	Capacity to execute: The level of awareness of EA is immature in the health sector. The KHEA is not a static blueprint but will change with the evolving needs of the sector. As of now, the sector doesn't have capacity to remodel / extend the defined target target architecture.				There is a need to train key resources from the sectors on how to do modelling at each of the architecture domains. But more than modelling, there is a need to create roles (positions) within the sector for solution architects / business architects / information architects / technology architects etc. so that these resources can start re-building their careers around those new roles.

## APPENDIX 1. Detailed Data Architecture Principles

### Foundational Principles

#### *Primacy of Principles*

**Table A1-1. Primary of Principles**

Name	Primacy of Principles
<b>Reference</b>	KHEA-IRM-001
<b>Statement</b>	These principles of information management apply to all stakeholder organisations within the health sector.
<b>Rationale</b>	The only way we can provide a consistent and measurable level of quality information to decision-makers is if all stakeholder organisations abide by the principles.
<b>Implications</b>	Without this principle, exclusions, favouritism and inconsistency would rapidly undermine the management of information. Information management initiatives will not begin until they are examined for compliance with the principles. A conflict with a principle will be resolved by changing the framework of the initiative.
<b>Category</b>	Regulatory.
<b>Last Review Date</b>	
<b>Last Review Reason</b>	

**Table A1-2. Adherence to Regulation**

Name	Adherence to Regulation
<b>Reference</b>	KHEA-IRM-002
<b>Statement</b>	KHEA shall be aligned with the relevant legal framework.
<b>Rationale</b>	The policy and legal framework contemplated in the Constitution, Acts and Regulations of the Republic of Kenya is designed by legislatures to assure good governance, accountability, citizenship and an improved health service delivery in the country. Compliance with the legal framework reduces the risks of non-conformance and under-performance.
<b>Implications</b>	<ul style="list-style-type: none"> <li>• Laws, regulations and policies should be considered when developing Enterprise Architecture.</li> <li>• Changes in the law and regulations may drive changes in the Enterprise Architecture of departments and agencies, in particular services, functions, processes and applications.</li> <li>• Business process improvements may lead to changes in the legal framework.</li> </ul>
<b>Category</b>	Regulatory.
<b>Last Review Date</b>	
<b>Last Review Reason</b>	

## Availability Principles

**Table A1-3. Health Services are define**

Name	Health services are defined
Reference	KHEA-IRM-003
Statement	All health services provided shall be described in a service catalog.
Rationale	The only way the health sector can make service available to the citizens is by defining and describing it at all levels.
Implications	Existence of a health service catalog together with points of service will assure that citizens can easily trace a service and the service point.
Category	Advisory
Last Review Date	
Last Review Reason	

**Table A1-4. Health Services are discoverable**

Name	Health services are discoverable
Reference	KHEA-IRM-004
Statement	Described health services shall be easy to discover and interpret.
Rationale	The only way the health sector can improve service access by citizens is by making it easily discoverable and interpretable.
Implications	The service catalog shall be available to the public in a form and language they can understand.
Category	Advisory
Last Review Date	
Last Review Reason	

**Table A1-5. Health applications are fit for purpose**

Name	Health applications are fit for purpose
Reference	KHEA-IRM-005
Statement	Health applications shall be fit for their intended purpose as described in the service catalog.
Rationale	The only way the health sector can improve service availability is by appropriately mapping the software solutions to the service catalog thereby minimising workarounds and customisations / extensions.
Implications	The healthcare software applications used to provide service at front / middle or back office shall be fit for the service catalog. A fit-gap analysis shall be based on the service catalog to determine suitability. This will eliminate duplication of applications and overly customising applications that are not intended for the services they are applied to.
Category	Advisory
Last Review Date	
Last Review Reason	

## Completeness Principles

**Table A1-6. Health information is consistent**

Name	Health information is consistent
Reference	KHEA-IRM-006
Statement	Health information shall be consistent and meaningful across the information value chain.
Rationale	Data definitions that are consistent and meaningful assure the effective and efficient development, interoperability and use of data and applications in the health sector. The power of a common vocabulary and data definition also enable effective dialogue to empower user and citizens. Conversely, inconsistent data definitions lead to poor interoperability, misinterpretations and inconsistent reporting.
Implications	Data shall have a consistent and meaningful definition:- <ul style="list-style-type: none"> <li>• Health sector has a data dictionary that is freely shared and collectively owned by key stakeholders.</li> <li>• Health sector has a Information Reference Model (a schema that contains the data entities and their definitions), a meta-data model (a schema that defines relationship between the data entities) and a meta-data store (an electronic repository to store it).</li> <li>• Data definition scheme comply with a common data definition standard</li> <li>• Data definitions and dictionary of terms are available to all stakeholders to enable use, integration and common understanding.</li> <li>• Health sector meta-data management discipline is established, and data standardisation initiatives are coordinated throughout value chain.</li> </ul>
Category	Advisory
Last Review Date	
Last Review Reason	

## Quality Principles

**Table A1-7. Health information is trusted**

Name	Health information is trusted
Reference	KHEA-IRM-008
Statement	Each data element has a trustee accountable for data quality.
Rationale	As the degree of data sharing grows and stakeholders rely upon common information, it becomes essential that only the data trustee makes decisions about the content of data. Since data can lose their integrity when they are entered multiple times, the data trustee will have sole responsibility for data entry which eliminates redundant human effort and data storage resources.

Name	Health information is trusted
Implications	<ul style="list-style-type: none"> <li>• Real trusteeship shall dissolve the data “ownership” issues and allow the data to be available to meet all users’ needs. This implies that a cultural change from data “ownership” to data “trusteeship” will be required.</li> <li>• The data trustee will be responsible for meeting quality requirements levied upon the data for which the trustee is accountable.</li> <li>• It is essential that the trustee has the ability to provide user confidence in the data based upon attributes such as “data source”.</li> <li>• It is essential to identify the true source of the data in order that the data authority can be assigned this trustee responsibility. This does not mean that classified sources will be revealed nor does it mean the source will be the trustee.</li> <li>• Information should be captured electronically once and immediately validated as close to the source as possible. Quality control measures must be implemented to assure the integrity of the data.</li> <li>• As a result of sharing data across the enterprise, the trustee is accountable and responsible for the accuracy and currency of their designated data element(s) and subsequently must then recognise the importance of this trusteeship responsibility.</li> </ul>
Category	Advisory
Last Review Date	
Last Review Reason	

**Table A1-8. Health information is secure**

Name	Health information is secure
Reference	KHEA-IRM-009
Statement	Data are protected from unauthorised use and disclosure. This includes protection of pre-decisional, sensitive, source selection-sensitive and proprietary information.
Rationale	<p>Open sharing of information and the release of information via relevant legislation must be balanced against the need to restrict the availability of classified, proprietary and sensitive information.</p> <p>Existing laws (Data Protection Act) and regulations require the safeguarding privacy of data, while permitting free and open access. Pre-decisional (work-in-progress, not yet authorised for release) information must be protected to avoid unwarranted speculation, misinterpretation and inappropriate use.</p>
Implications	<ul style="list-style-type: none"> <li>• Aggregation of data both classified and un-classified will create a large target requiring review and de-classification procedures to maintain appropriate control. Data stewards and/or functional users must determine whether the aggregation results in an increased classification level. Appropriate policy and procedures shall be required to handle this review and declassification. Access to information based on a need-to-know policy will force regular reviews of the body of information.</li> <li>• In order to adequately provide access to open information while maintaining secure information, security needs must be identified and developed at the data level, not the application level.</li> <li>• Data security safeguards should be put in place to restrict access to “view only”, or “never see”. Sensitivity labeling for access to pre-decisional, decisional, classified, sensitive or proprietary information must be determined.</li> </ul>

Name	Health information is secure
	<ul style="list-style-type: none"> <li>• Security must be designed into data elements from the beginning. Systems, data, and technologies must be protected from unauthorised access and manipulation. Information at all levels, including generation, analysis and decision making, must be safeguarded against inadvertent or unauthorised alteration, sabotage, disaster or disclosure.</li> <li>• Policies on managing the duration of protection for pre-decisional, decisional and post-decisional cycles of information must be put in place or aligned accordingly.</li> </ul>
Category	Advisory
Last Review Date	
Last Review Reason	

**Table A1-9. Health systems and technologies are interoperable**

Name	Health systems and technologies are interoperable
Reference	KHEA-IRM-010
Statement	Software and hardware should conform to defined standards that promote interoperability of data, applications and technology.
Rationale	Standards help assure consistency, thus improving the ability to manage systems and improve user satisfaction, and protect existing IT investments, thus maximising return on investment and reducing costs. Standards for interoperability additionally help assure support from multiple vendors for their products, and facilitate supply chain integration.
Implications	Interoperability standards and industry standards will be followed unless there is a compelling business reason to implement a non-standard solution. A process for setting standards, reviewing and revising them periodically and granting exceptions must be established. Existing applications, data and technology platforms must be identified and documented and analyzed for conformance with set standards. Interoperability compliance roadmap must be developed and implemented.
Category	Advisory
Last Review Date	
Last Review Reason	



## APPENDIX 2. Detailed IRM Classification

### Patient Registry

**Table A2-1. Patient Registry**

Object	Description
<b>Person</b>	Every individual referred to in any patient's record in KHEA must exist as a Person. A Person is the foundational identifier of a patient and must exist in the national persons register using either a National Identifier, a passport, a birth certificate or other identifier.
<b>Person Identification</b>	A Person may have multiple types of identifications which must be valid. This object shall describe the person identification for each of the identifiers they present for identification.
<b>Patient</b>	A Patient is a business object that receives care in KHEA. A Patient must inherit personal details from a Person business object. A Patient can have multiple identifiers but they must all link up to one Person. For instance, a Patient may use a National Identifier, passport etc. for identification but all those identifications must be for the same Person.
<b>Relationship</b>	This business object provides definition of the nature of relationship between a person and a patient. A patient may be related to a person who is not a patient. E.g. a child patient may be related to a guardian / parent who is defined as a person.
<b>Contact Types</b>	A patient may have multiple contact types e.g. physical address, phone number, email address, mailing address: This object will describe the types of identifiers for each patient. This is a shared object with other entities that have contacts e.g. a Patient, a Facility.
<b>Contacts</b>	A Contact Type may have one or more contacts. This object will describe the contacts under each contact type for an entity e.g. telephone number may have mobile numbers, fixed lines, fax .
<b>Visit</b>	This model provides for the definition of an instance of access to health services by a patient. The appointment may be linked to a calendar or an ad hoc visit.

### Finance Registry

**Table A2-2. Finance Registry**

Object	Description
<b>Billing</b>	Billing is a business object that stores computed billable services in a Service Order which is used as a demand for the Patient to settle the bill as per their Billing Profile (i.e. if self-pay or scheme-pay)
<b>Billing Profile</b>	Billing Profile is the business object that stores the profile information of Patients in relation to bill settlement. This is useful in determining how payment for services rendered will be fulfilled.
<b>Revenues</b>	This is the business object that defines the funds received by the sector and the specific programmes for which they are allocated.
<b>Expenditure</b>	This is the business object that defines the usage of funds by the sector in the specific programmes for which revenues were allocated.

## HRH Registry

**Table A2-3. HRH Registry**

Object	Description
<b>Person</b>	Every individual who is referred to in any patient's record in KHEA must exist as a Person. A Person is the foundational identifier of a patient and must exist in the national persons register using either a National Identifier, a passport, a birth certificate or any other identifier.
<b>Person Identification</b>	A Person may have multiple types of identification; all must be valid. This object describes the person's identification for each type of identification they present.
<b>Qualification Types</b>	This business object defines qualification types by which a health worker is mapped. For example, a qualification type of BSc Nursing may be tied to a qualification for actor called Nancy Kamau describes as B.Sc in Nursing from University of Nairobi, Honors Degree in 1992.
<b>Qualifications</b>	This business object provides detailed definition of qualifications of a health worker.
<b>Contact Types</b>	A health worker may have multiple contact types e.g. physical address, phone number, email address, mailing address . This object will describe the types of identifiers for each worker. This is a shared object with other entities that have contacts e.g. a Patient, a Facility
<b>Contacts</b>	A Contact Type may have one or more contacts. This object will describe the contacts under each contact type for an entity e.g. telephone number may have mobile numbers, fixed lines, fax.

## Service Registry

**Table A2-4. Service Registry**

Object	Description
<b>Service Order</b>	A Service Order is the request issued for provisioning of services or delivery of products. For services, an Order is the request for certain action to be performed on a patient during the visit lifecycle.
<b>Service Catalog</b>	A Service Catalog is a listing of all possible services offered in the health enterprise irrespective of the provider i.e. a health worker or a channel (e.g. facility).
<b>Service Standards</b>	This model provides for the definition of Service Standards. Service standards are performance metrics linked to the Service Catalog. During assessments of services, these standards linked to key performance indicators (KPIs) will be measured against the facilities and health workers that provide them to determine the effectiveness. The standards provide the basis for assessment and intervention.
<b>Diagnosis</b>	A Diagnosis is the interpretation action performed when medical observation is conducted. It is the basis of the intervention required to be performed.
<b>Medical Intervention</b>	A Medical Intervention is a business object that describes intervention(s) required to be performed as a result of interpreted results from Diagnosis. Intervention may involve surgical procedures, drug administration, blood transfusion, prescriptions, referral etc.
<b>Medical Observation</b>	A Medical Observation is an iterative action on a Service Order. Medical observation can be the first action when a Patient seeks medical service in a health facility. It can also be the result of interpretation which asks for

Object	Description
	further observations (e.g. testing of samples). The collective observation record(s) of a given service order creates background information to enable Interpretation and Intervention.
<b>Recovery Programme</b>	Recovery Programme is a business object that describes post-medical interventions that may be further performed on the patient to boost the recovery process. For example, clinics, reviews and follow ups, admission for inpatient. Recovery Programme may give rise to a new Service Order for additional services (e.g. bed space).

## Channel Registry

**Table A2-5. Channel Registry**

Object	Description
<b>Channel</b>	This model provides for the definition of a service channel. Primarily the sector has identified a facility. However, a channel is a higher level definition of any type of channel that provides service. Services shall be categorised into physical and non-physical channels. A Facility is the physical infrastructure in which health services are provided e.g. a hospital, a health centre, a dispensary. A facility may have more than one location / contact attributes. Non-physical channels are electronic in nature e.g. mHealth or telehealth. They may not have a physical address but they would have an electronic address.
<b>Contact Types</b>	A channel (facility, electronic) may have multiple contact types e.g. physical address, phone number, email address, mailing address. This object will describe the types of identifiers for each channel. This is a shared object with other entities that have contacts e.g. a Patient, a Facility.
<b>Contacts</b>	A Contact Type may have one or more contacts. This object will describe the contacts under each contact type for an entity e.g. telephone number may have mobile numbers, fixed lines, fax.
<b>Facility</b>	This model is an instance of channel which provides for the definition of a Facility. A Facility is the physical infrastructure in which health services are provided e.g. a hospital, a health centre, a dispensary. A facility may have more than one location / contact attributes.

## Health Products Registry

**Table A2-6. Health Products Registry**

Object	Description
<b>Service Order</b>	A Service Order is the request issued for provisioning of services or delivery of products. For health products, an Order is the request for health commodities.
<b>Product Inventory</b>	This model provides for the definition of Product Inventory. Product Inventory information shall describe the stock holding level within each facility for health products.
<b>Product Catalog</b>	This model provides for the definition of Products. A Product is used during observation and intervention processes to deliver service. A Product Catalog contains the master definitions of all health products.

## Leadership Registry

**Table A2-7. Leadership Registry**

Object	Description
<b>Findings</b>	This model provides for the definition of intervention Findings. Findings will be resultant interpretations of observations during the execution of an Intervention Order. The findings will describe the causes and effects of the investigation carried out.
<b>Intervention Calendar</b>	This model provides for the definition of an Intervention Calendar. This calendar is a schedule of assessment cycle for services to enable planning by the governance team in execution of Service Intervention Orders.
<b>Indicators</b>	This model provides for the definition of Service KPIs. Service Metrics are the quantifiable parameters that will be assessed within a given assessment / Intervention Order to determine service effectiveness.
<b>Intervention Order</b>	This model provides for the definition of an Intervention Order. An Intervention Order will be the instruction required to carry out an intervention after it is observed that there is a need to perform that intervention. The Intervention Order will identify the scope, who should do what, where and when.

## Partner (Stakeholder) Registry

**Table A2-8. Partner (Stakeholder) Registry**

Object	Description
<b>Partner</b>	This object describes the partners or stakeholders involved in the generation or usage of enterprise information. They shall be classified according to the actor definition given in the KHSSP.
<b>Contact Types</b>	A partner may have multiple contact types e.g. physical address, phone number, email address, mailing address. This object will describe the types of identifiers for each partner. This is a shared object with other entities that have contacts e.g. a Patient, a Facility
<b>Contacts</b>	A Contact Type may have one or more contacts. This object will describe the contacts under each contact type for an entity e.g. telephone number may have mobile numbers, fixed lines, fax.

## Stakeholders

Table A2-9. Stakeholders

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**Table A2-10. Health Infrastructure Registry**

<b>Object</b>	<b>Description</b>
<b>Asset Register</b>	This object provides for the financial information of physical infrastructure that is used to provide medical care be it a health facility, a medical equipment, a vehicle or an ICT infrastructure.
<b>Asset Location</b>	An asset will be located in a physical location.
<b>Fleet Register</b>	This object provides for information about fleet of vehicles used directly to perform health service or to support health service.
<b>Service History</b>	An asset will have a log of interventions performed on it to keep in functional condition.

## Health Research Registry

**Table A2-11. Health Research Registry**

<b>Object</b>	<b>Description</b>
<b>Events Catalog</b>	This is a business object that describes vital events for which research is conducted. The events could be related to birth, death, disease outbreak etc.
<b>Conditions Catalog</b>	This is a business object that describes possible conditions (pre-existing) that a Patient reports / records during the first interaction when they are at a health facility. This information becomes useful during observation, interpretation and intervention.
<b>Disease Catalog</b>	A Disease Catalog is a business object that describes possible ailments that can be attached to diagnosis during interpretation of observations in order to give input to what can of intervention is to be performed.

## Meta Registry

**Table A2-12. Meta Registry**

<b>Object</b>	<b>Description</b>
<b>Registry Catalog</b>	This is a business object that describes the information registries in KHEA. The structure provides for the name and purchase of the registry and the business function it supports.
<b>Registry Service Catalog</b>	This object describes the services offered by each registry. The services include the data sets and the indicators supported by the data sets.
<b>Registry Security List</b>	This object describes which partner / stakeholder has access to what registry service offered by a combination of registries or a single registry.
<b>Transaction Log</b>	This object describes the logs that are generated for incoming data transactions and outgoing data transactions during data provisioning proves.



## APPENDIX 3. Detailed ARM Classification

### Investment Pillars Application Services

**Table A3-1. Investment Pillars Application Services**

INVESTMENT PILLARS APPLICATION SERVICES		
Discrete sets services clustered around particular topics that provide capabilities to collect, process, share, disseminate in support of specific business processes		
Area	Category	Description
Service Delivery Applications	Clinical Services	<p>Application software that is used to perform clinical services that a direct input into the curative or preventive health service</p> <ul style="list-style-type: none"> <li>• Patient Management                             <ul style="list-style-type: none"> <li>– Identification</li> <li>– Observation</li> <li>– Billing Profile</li> </ul> </li> <li>• Order Management                             <ul style="list-style-type: none"> <li>– Lab Orders</li> <li>– Radiology Orders</li> <li>– Prescription Order</li> </ul> </li> <li>• Results Management                             <ul style="list-style-type: none"> <li>– Lab Results</li> <li>– Radiology Results</li> <li>– Other Results</li> </ul> </li> <li>• Prescription Management</li> <li>• Referral Management                             <ul style="list-style-type: none"> <li>– Intra facility referral</li> <li>– Inter facility referral</li> </ul> </li> <li>• Rehabilitation Management                             <ul style="list-style-type: none"> <li>– Recovery programmes</li> </ul> </li> </ul>
	Non-Clinical Services	<p>Application software that is used to perform supportive roles to the clinical services</p> <ul style="list-style-type: none"> <li>• Schedule Management</li> <li>• Bed Space Management</li> <li>• Meal Plans Management</li> <li>• Cleaning Management</li> </ul>
Health Workforce Applications	Resource Planning and Allocation	<p>Software that supports the processes for identifying the workforce competencies required to meet the sectoral strategic goals and for developing the strategies to meet these requirements. The software also supports procedures for attracting and selecting high-quality, productive employees with the right skills and competencies, in accordance with merit system principles. This includes developing a staffing strategy and plan; establishing an applicant evaluation approach; announcing the vacancy, sourcing and evaluating candidates against the competency requirements for the position; initiating pre-employment activities; and hiring employees.</p>
	Skills Management	<p>Software that supports the proficiency of employees in the delivery of health services.</p>
	Team and	<p>Software that supports the hierarchy structure and identification of</p>

<b>INVESTMENT PILLARS APPLICATION SERVICES</b>		
Discrete sets services clustered around particular topics that provide capabilities to collect, process, share, disseminate in support of specific business processes		
<b>Area</b>	<b>Category</b>	<b>Description</b>
	Organisation Management	employees within the various sub-groups of the health enterprise.
	Awards	Software that supports the administration of employee bonus and monetary awards programmes. Also includes software used to design, develop, and implement pay for performance compensation programmes to recognise and reward high performance, with both base pay increases and performance bonus payments.
	Benefits	Software that supports the design, development, and implementation of benefits programmes for health workers. This includes establishing and communicating benefits programmes, processing benefits actions, and interacting as necessary with third party benefits providers.
	Education / Training	Software that supports the design, development, and implementation of a comprehensive employee development and training approach to assure that health workers have the right competencies.
	Employee Records	Software that manages employee personnel records and files.
	Staff Acquisition	Software that supports the procedures for attracting and selecting high-quality, productive employees with the right skills and competencies, in accordance with merit system principles. This includes developing a staffing strategy and plan, and establishing an applicant evaluation.
	Health Financing Applications	Accounts Payable
Accounts Receivable		Software that supports collections and receivables, including deposits, fund transfers, and receipts for sales or service.
Budget Planning and Execution		Software that supports all activities undertaken to determine priorities for future spending and to develop an itemised forecast of future funding and expenditures during a specified period of time. This includes the collection and use of performance information to assess the effectiveness of programmes and develop budget priorities and the legal (apportionment) and managerial (allotment and sub-allotment) distribution of budget authority to achieve results consistent with the formulated budget.
Financial Audit		Software used to track and manage financial audits.
General Ledger		Software that supports accounting for assets, liabilities, fund balances, revenues and expenses associated with the maintenance of federal funds and expenditure of federal appropriations (salaries and expenses, operations and maintenance, procurement, working capital, trust funds, etc.), in accordance with Public Finance Management Act.
Payroll		Software that supports the administration and determination of

## INVESTMENT PILLARS APPLICATION SERVICES

Discrete sets services clustered around particular topics that provide capabilities to collect, process, share, disseminate in support of specific business processes

Area	Category	Description
		employee compensation.
	Travel	Software that supports activities associated with planning, preparing, and monitoring of business-related travel expenses. This may include employees and others supporting the work of the government.
	Grant Administration	Software that supports the administration and monitoring of grants.
	Grant Announcement	Portal that posts and publishes announcements of grants to be funded.
	Grant Receipt of Proposals	Portal for the receipt of grant proposals.
	Grant Review	Software that supports the review process for grants.
Health Products Applications	Inventory Planning	Software that manages inflow and outflows of "products", as well as data about the level of health products on hand for each of the facilities.
	Inventory Master	Software that manages the definition of health products using established standards for coding of health products.
	Stock Management	Software that controls the movement, storage, shipping and receiving of health products.
Health Infrastructure Applications	Facilities and Equipment	Software that supports facilities management including the maintenance, administration, certification, and operation of health infrastructure be it vehicles, hospital buildings, medical equipment etc.
	Asset Register	Software that supports the tracking of information related to procured assets and resources with regard to quantity, quality, location, service history, depreciation, asset life etc.
	Infrastructure Logistics	Software that supports arrangements to allocate / book, track, optimally use both movable and immovable infrastructure e.g. fleet management of ambulances and cars to provide health services.
Health Leadership Applications	Governance, Risk and Compliance	Software that supports the structure of governance, identification and classification of risks and tracking of compliance with established norms for the health sector.
Health Research Applications	Analysis, Reporting and Statistics	Software that supports the practice of gathering, retaining, and analyzing computer-related data for investigative purposes in a manner that maintains the integrity of the data.

## Common Application Services

**Table A3-2. Common Application Services**

COMMON APPLICATION SERVICES		
Sets of shared services that are not specific to a topic within the sector but are used in conjunction with the line of business application services to support a specific business process		
Area	Category	Description
Identity Management	Persons Register	Software that uniquely identifies a person based on legally acceptable identification documents.
	System Register	Software that identifies individuals in a system and controls access to the resources in that system by placing restrictions on the established identities of the individuals as required by established information access policies.
Channel Management	Graphical Editor	Software that uses and combines data, presentation or functionality from two or more sources to create new services. It provides the ability to combine, aggregate and visualise information from multiple sources in one view. Ability to customise the channel to a look and feel that is desired by the end user without affecting the look and feel of other users.
	Charting	Software to develop graphical representation of data in which the data is represented by symbols such as bars, lines, slices, dots, size, etc.
	Data Mapping	Software that supports the process of creating data element mappings between two distinct data models. Data mapping is used as a first step for a wide variety of data integration tasks.
	Graphics	Software that enables a person to manipulate static, animated or video visual images on a computer.
	Idea Mapping	Software that is used to create diagrams of relationships between concepts, ideas or other pieces of information.
Security and Controls	Authentication and Authorisation	Software that supports obtaining information about parties attempting to log on to a system or application for security purposes and the validation of those users.
	Digital Signature	Software to use and manage electronic signatures to support.
	Encryption	Software to convert plaintext to ciphertext through the use of a cryptographic algorithm.
	Virus Protection	Software used to prevent, detect, and remove self-replicating programmes that run and spread by modifying other programmes or files.
Unified Communication	Calendaring	Software that provides users with an electronic version of a calendar, an appointment book, address book, and/or contact list.
	Email	Software that supports the transmission of memos and messages over a network.
	Event / News Management	Software that provides users with frequently updated content to which they subscribe.
	Instant Messaging	Software that supports text, voice and/or video communications between two or more users.
	Social Software	Software that supports the capturing, storing and presentation of

## COMMON APPLICATION SERVICES

Sets of shared services that are not specific to a topic within the sector but are used in conjunction with the line of business application services to support a specific business process

Area	Category	Description
		communication, usually written but may include audio and video as well. Interactive tools handle mediated interactions between a pair or group of users. They focus on establishing and maintaining a connection amongst users, facilitating the mechanics of conversation and talk.
	Syndication Management (RSS Feeds)	A family of web feed formats used to publish frequently updated works, such as blog entries, news headlines, audio, and video, in a standardised format.
<b>Geospatial</b>	Cartography	Software that supports the creation of maps.
	Geospatial Data Collection	Software that supports the collection or management of geospatial information.
<b>BPM &amp; Workflow</b>	Business Process Management	Software that allows organisations to abstract business process from technology infrastructure and support the managerial approach through enabling technology, bridging organisational and technology silos. Business Process Management applications and software include items such as: Process Engine, Business Analytics, Content Management, and Collaboration Tools.
	Business Rule Management	Software used to define, deploy, execute, monitor and maintain the variety and complexity of decision logic that is used by operational systems within an organisation or enterprise. This logic, also referred to as business rules, includes policies, requirements, and conditional statements that are used to determine the tactical actions that take place in applications and systems.
	Case Management	Software that manages the life cycle of a particular claim or investigation within an organisation to include creating, routing, tracing, assignment and closing of a case as well as collaboration amongst case handlers
	Change Management	Software that controls the process for updates or modifications to the existing documents, software or business processes of an organisation.
	Configuration Management	Software that controls the hardware and software environments, as well as documents of an organisation.
	Conflict Resolution	Software that supports the conclusion of contention or differences within the business cycle.
	Governance and Policy Management	Software the supports decisions, actions, business rules and other matters that govern an organisation.
	Business Process Management	Software that allows organisations to abstract business process from technology infrastructure and support the managerial approach through enabling technology, bridging organisational and technology silos. Business Process Management applications and software include items such as: Process Engine, Business Analytics, Content Management, and Collaboration Tools.

## COMMON APPLICATION SERVICES

Sets of shared services that are not specific to a topic within the sector but are used in conjunction with the line of business application services to support a specific business process

Area	Category	Description
<b>Data Management (ETL)</b>	Data Extraction, Transformation and Loading	Software that supports the extraction of data from a database, the manipulation and change of data to a different format and the population of another database with the data.
	Data Integration and Exchange	Software services that enable elements of distributed business applications to interoperate and the software development necessary to facilitate such integration. These elements can share function, content, and communications across heterogeneous computing environments.
	Data Lifecycle Management	Software that supports a policy-based approach to managing the flow of an information system's data throughout its life cycle: from creation and initial storage to the time when it becomes obsolete and is deleted.
	Data Quality Management	Software to assure that data are fit for their intended uses in operations, decision making and planning and to assure internal consistency of the data.
	Data Warehouse & Data Mart	Database used for reporting and analysis, where the data stored in the warehouse is uploaded from the transactional systems.
	Database Management System	Software that supports the storage, modification, extraction, and search for information within a database.
	Master Data Management	Software that supports a set of processes and tools that consistently define and manage the non-transactional data entities of an organisation, which may include reference data. It has the objective of providing processes for collecting, aggregating, matching, consolidating, quality-assuring and distributing such data throughout an organisation to assure consistency and control in the ongoing maintenance and application use of this information.
	Metadata Management	Software that supports the maintenance and administration of data that describe data.
<b>Integration and Interoperability</b>	Enterprise Service Bus	Software used for designing and implementing the interaction and communication between mutually interacting software applications in Service Oriented Architecture (SOA).
	Messaging Software	Software that enables passing of information message between different systems and IT assets using different communications technologies.
	Service Description or Interface	Software that enables various services available in SOA. It is designed to be interrogated by SOAP messages and to provide access to Web Services Description Language (WSDL) documents describing the protocol bindings and message formats required to interact with the web services listed in its directory.

## COMMON APPLICATION SERVICES

Sets of shared services that are not specific to a topic within the sector but are used in conjunction with the line of business application services to support a specific business process

Area	Category	Description
<b>Applications Development</b>	Integrated Development Environment	Software that provides comprehensive facilities to computer programmers for software development.
	Libraries	A collection of resources used to develop software which may include pre-written code and sub-routines, classes, values or type specifications.
	Software Configuration Management	Software to track and control changes in the software including the establishment of baselines and revision control.
	Software Development Kit	Software development tools that allow for the creation of applications for a certain software package, software framework, hardware platform, computer system, video game console, operating system, or similar platform.
	User Innovation Toolkit	Software toolkit based on the idea that manufacturers possess the knowledge of the solution possibilities, while the users possess the knowledge about needs.
	Validation Tools	Software tools that check web pages for accessibility and syntactical correctness of code.
<b>Content Management</b>	Document Imaging and OCR	Software that supports the document scanning and the interpretation of images into text.
	Document Library	On line repository of documents, letters, speeches, web sites, books, or articles to be shared.
	Document Management System	Software used to track, store and retrieve electronic documents and/or images of paper documents. It is usually capable of keeping track of the different versions created by different users (history tracking).
	Forms Management	Software that supports the creation, modification, and usage of physical or electronic documents used to capture information within the business cycle.
	Records Management	Software that supports the management and stewardship of a type of information by the federal government in order to facilitate communication and information archival.
	Web Content Management	Software that provides content authoring, content review and approval, tagging and aggregation, content publishing and delivery, and syndication management.
	Categorisation	Software that supports the creation and maintenance of relationships between data entities, naming standards and categorisation and allows classification of data and information into specific layers or types to support an organisation.



## APPENDIX 4. Detailed TRM Classification

### Platform Domain

Table A4-1. Platform Domain

PLATFORM DOMAIN		
<p>The Platform Domain includes a hardware architecture and a software framework, where the combination allows software, particularly application software, to run. For the purposes of the TRM, platforms include a computer's architecture, operating system, attached and internal devices, as well as software platforms that emulate entire hardware platforms (e.g., system virtualisation).</p>		
Category	Definition	
Hardware	<p>Hardware, in a computer context, refers to the physical components that make up a computer system, including the basic machine itself.</p> <p>There are many different kinds of machines and different kinds of hardware that can be installed inside, and connected to the outside, of a computer.</p>	
Server - Mainframe or Supercomputer	<p>A Server is a computer that provides data to other computers. It may serve data to systems on a Local Area Network (LAN) or a Wide Area Network (WAN) over the Internet.</p> <p>A Mainframe is a high-performance computer used for large-scale computing purposes that require greater availability and security. It often serves many connected terminals and is usually used by large complex organisations.</p> <p>A supercomputer is a high-performance computing machine designed to have extremely fast processing speeds. Supercomputers have various applications, such as performing complex scientific calculations, modeling simulations, and rendering large amounts of 3D graphics.</p> <p>The chief difference between a supercomputer and a mainframe is that a supercomputer channels all its power into executing a few programmes as fast as possible, whereas a mainframe uses its power to execute many programmes concurrently.</p>	
Server - Midrange	<p>A midrange computer is a medium-sized computer system or server. Midrange computers encompass a very broad range and reside in capacity between high-end personal computers (PCs) and mainframes. Formerly called "minicomputers", which were hosts to dumb terminals connected over dedicated cables, most midrange computers today function as servers in a network.</p>	
Hardware	Personal Computer - Desktop	<p>A desktop computer is a personal computer in a form intended for regular use at a single location, as opposed to a mobile laptop or portable computer. A PC is any general-purpose computer whose size, capabilities, and original sales price make it useful for individuals, and which is intended to be operated directly by an end-user with no intervening computer operator.</p>
Hardware	Personal Computer - Laptop	<p>A laptop computer is a personal computer for mobile use. A PC is any general-purpose computer whose size, capabilities, and original sales price make it useful for individuals, and which is intended to be operated directly by an end-user with no intervening computer operator. A laptop integrates most of the typical components of a desktop computer, including a display, a keyboard, a pointing device such as a touchpad and speakers into a single unit.</p>

## PLATFORM DOMAIN

The Platform Domain includes a hardware architecture and a software framework, where the combination allows software, particularly application software, to run. For the purposes of the TRM, platforms include a computer's architecture, operating system, attached and internal devices, as well as software platforms that emulate entire hardware platforms (e.g., system virtualisation).

Category	Definition	
Hardware	Mobile Computing Device	A mobile computing device is a small, hand-held computing device, typically having a display screen with touch input and/or a miniature keyboard and weighing less than 2 pounds (0.91 kg). Such devices have an Operating System (OS), and can run various types of application software, known as apps. Most devices can also be equipped with WI-FI, Bluetooth and GPS capabilities that can allow connections to the Internet and other Bluetooth capable devices such as an automobile or a microphone headset. A camera or media player feature for video or music files can also be typically found on these devices along with a stable battery power source such as a lithium battery.
Hardware	Direct Access Storage	Direct access storage device is a general term for magnetic disk storage devices and solid state storage devices. Within the TRM, the term refers to magnetic storage devices for mainframes, midranges, and PCs. "Direct access" means that all data can be accessed directly in about the same amount of time, rather than having to progress sequentially through the data.
Hardware	Removable Storage Media	Removable storage media is any type of storage device that can be removed from a computer while the system is running.
Hardware	Device Controller	A device controller is a part of a computer system that makes sense of the signals going to and coming from the CPU.
Operating System		An OS is a computer programme, implemented in either software or firmware, which acts as an intermediary between users of a computer and the computer hardware. The purpose of an operating system is to provide an environment in which a user can execute applications.
Operating System (Server – Mainframe or Supercomputer)		A mainframe or supercomputer operating system is, in simplest terms, a collection of programmes that manage a computer system's internal workings - its memory, processors, devices, and file system. Mainframe operating systems are tailored to meet the substantially different architectures and purposes of mainframes as high-volume transaction processing devices, or the purposes of supercomputers as high-volume algorithmic processors.
Operating System (Server – Midrange)		A midrange computer operating system is, in simplest terms, a collection of programmes that manage a computer system's internal workings - its memory, processors, devices, and file system. Midrange computers are almost universally known as servers to recognise that they often "serve" applications to end users at "client" computers, that they use a client/server computing model.
Operating System (Personal Computer)		For personal computers, operating systems are generally tailored to the needs of users on standalone machines that may or may not connect to a network, and are generally not servers of information to large numbers of other machines.

## PLATFORM DOMAIN

The Platform Domain includes a hardware architecture and a software framework, where the combination allows software, particularly application software, to run. For the purposes of the TRM, platforms include a computer's architecture, operating system, attached and internal devices, as well as software platforms that emulate entire hardware platforms (e.g., system virtualisation).

Category	Definition
Operating System (Mobile Computing Device)	As with other operating systems, a mobile computing device Operating System (OS) is a computer programme, implemented in either software or firmware, which acts as an intermediary between users of a computer and the computer hardware. The purpose of an OS is to provide an environment in which a user can execute applications.
Communications Hardware	Communications Hardware refers broadly to hardware intended primarily to create a link to the network from the user or another computational device.
Communications Hardware (Network Interface Device)	For the purposes of the TRM, a Network Interface Device is a broad term that includes devices that serve as a demarcation point between the carrier's local loop and the customer's on-premises wiring, where the data wires end and a customer's premise wiring starts, and network interface controllers (also known as a network interface card, network adapter, LAN adapter and by similar terms) which may be internal or external to a piece of computer hardware.
Communications Hardware (Telephony Handset)	A telephony handset is a device the user holds to the ear to hear the audio sound, usually containing the phone's microphone.
Communications Hardware (Radio Unit)	A radio unit is a device that transmits signals through free space by electromagnetic waves with frequencies significantly below visible light, in the radio frequency range, from about 3 kHz to 300 GHz. These devices may be analog or digital, and mobile or stationary.
Peripheral	<p>A peripheral is a device connected to a host computer, but not part of it. It expands the host's capabilities but does not form part of the core computer architecture. It is often, but not always, partially or completely dependent on the host.</p> <p>Usually, the word peripheral is used to refer to a device external to the computer case, but the devices located inside the computer case (particularly with laptops) are also technically peripherals. Devices that exist outside the computer case are called external peripherals, or auxiliary components. Devices that are inside the case such as internal hard drives or CD-ROM drives are also peripherals in technical terms and are called internal peripherals, but may not be recognised as peripherals by laypeople.</p> <p>For the purposes of the TRM, three different types of peripherals are recognised: Human-Computer Interface, Computer Input, and Computer Output.</p> <p>Storage devices, commonly a form of peripheral, are handled elsewhere.</p>

<b>PLATFORM DOMAIN</b>	
<p>The Platform Domain includes a hardware architecture and a software framework, where the combination allows software, particularly application software, to run. For the purposes of the TRM, platforms include a computer's architecture, operating system, attached and internal devices, as well as software platforms that emulate entire hardware platforms (e.g., system virtualisation).</p>	
<b>Category</b>	<b>Definition</b>
Peripheral (Human-Computer Interface)	The human-computer interface can be described as the point of communication between the human user and the computer, and, as such, all devices that primarily facilitate such ongoing interactions are grouped here.
Peripheral (Computer Input Device)	Inputs are the signals or data received by the system, and outputs are the signals or data sent from it. For the purposes of the TRM, computer input devices are those that provide data to the machine/application combination for further processing or for manipulation by users through the human-computer interface devices.
Peripheral (Computer Output Device)	Inputs are the signals or data received by the system, and outputs are the signals or data sent from it. For the purposes of the TRM, computer output devices are those that provide data from the machine/application combination to other machines or to the user for asynchronous consumption.
Virtualisation	In computing, virtualisation is the creation of a virtual (rather than actual) version of something, such as a hardware platform, Operating System (OS), storage device, or network resources. This section of the TRM categorises those mechanisms to create virtual platforms.
Virtualisation (Application)	For the purposes of the TRM, application virtualisation encapsulates application from the underlying operating system on which they are executed. A fully virtualised application is not installed in the traditional sense, although it is still executed as if it were. The application is fooled at runtime into believing that it is directly interfacing with the original operating system and all the resources managed by it, when in reality it is not. In this context, the term "virtualisation" refers to the artifact being encapsulated (application), which is quite different to its meaning in hardware virtualisation, where it refers to the artifact being abstracted (physical hardware).
Virtualisation (Server)	Virtual servers are virtual machines where each server, although running in software on the same physical computer as other customers' servers, is in many respects functionally equivalent to a separate physical computer. A virtual server is dedicated to the individual customer's needs, has the privacy of a separate physical computer, and is configured to run server software. The term cloud server is also used to describe the same concept, normally where such systems can be setup and re-configured on the fly.
Virtualisation (Storage)	Storage virtualisation applies virtualisation concepts to enable better functionality and more advanced features within the storage system. Storage systems use special hardware and software along with disk drives in order to provide very fast and reliable storage for computing and data processing.

PLATFORM DOMAIN	
The Platform Domain includes a hardware architecture and a software framework, where the combination allows software, particularly application software, to run. For the purposes of the TRM, platforms include a computer's architecture, operating system, attached and internal devices, as well as software platforms that emulate entire hardware platforms (e.g., system virtualisation).	
Category	Definition
Virtualisation (End-User Environment)	End-User Environment virtualisation is a broad term including desktop and client virtualisation. End-User virtualisation separates a personal computer desktop or mobile computing environment from a physical machine using the client-server model of computing.
Virtualisation (Print Server)	Print server virtualisation extends the virtualisation concept to the access to and management of print resources. For the purposes of the TRM, a print server can be a dedicated device, a standalone computer, specialised software, or some combination that handles receipt, queuing, delivery, and status of print jobs for printers on the network.

## Network Domain

**Table A4-2. Network Domain**

NETWORK DOMAIN		
The Network (Element Name) Domain (Level) describes the Network section of the TRM addresses how a particular IT asset accessed and used within the enterprise.		
Area	Category	Definitions
Zone		For the purposes of the TRM, a Zone is a conceptual division of the network into areas that are separated (usually by security measures) from one another.
Zone	Public	Assets in the public zone are accessible to anyone, without credentials, from outside the boundaries of the organisation.
Zone	Private - Internal	Assets in the private, internal zone are accessible only from within the boundaries of a single organisation
Zone	Private - Shared	Assets in the private, shared zone are accessible to more than one major organisation, but only within the boundaries of those participating organisations.
Zone	Private - Credentialed	Assets in the private, credentialed zone are accessible only with appropriate credentials from outside the boundaries of the organisation.
Network Type		For the purposes of the TRM, a Network Type categorises the major types of traffic on a given network. A single network may carry more than one type of traffic.
Network Type	Data	A data network type is an electronic communications process that allows for the orderly transmission and receptive of data, such as letters, spreadsheets, and other types of documents. What sets the data network apart from other forms of communication, such as an audio network, is that the data network is configured to transmit data only. This is in contrast to the audio or voice network, which is often employed for both voice communications and the transmission of data such as a facsimile transmission.

<b>NETWORK DOMAIN</b>		
The Network (Element Name) Domain (Level) describes the Network section of the TRM addresses how a particular IT asset accessed and used within the enterprise.		
<b>Area</b>	<b>Category</b>	<b>Definitions</b>
Network Type	Voice	Voice networks are sometimes dedicated, as in the original public switched telephone network (PSTN), but have changed to be a type of traffic carried on data networks using some form of packet-switching technology. Voice traffic is distinct from Data traffic in the delivery requirements (it needs to arrive nearly synchronously and be assembled in order without drop-outs) and bandwidth usage (which is high).
Network Type	Video	Video networks can be dedicated links devoted to video for large video conferencing installations. As with Voice traffic, Video is often a type of traffic carried on data networks using some form of packet-switching technology. Video traffic is distinct from Data traffic in the delivery requirements (it needs to arrive nearly synchronously and be assembled in order without drop-outs) and bandwidth usage (which is very high).
Network Type	Radio	Radio networks are transmitted through free space by radio waves. There are two types of radio networks currently in use around the world: the one-to-many broadcast network commonly used for public information and mass media entertainment; and the two-way type used more commonly for public safety and public services such as police, fire, taxicabs, and delivery services. Many of the same components and much of the same basic technology applies to both.
Infrastructure		For the purposes of the TRM, Infrastructure, as used here, is a broad term covering the various forms of basic hardware and software that comprise the foundation of a network.
Infrastructure	Hardware and Software	Specifically for Networks, Hardware and Software refers to many different kinds of devices and their firmware. These devices provide many things including routing, security, etc. The software included here is the firmware and/or Operating System (OS) associated with specific network devices.
Infrastructure	Transmission Medium	Transmission medium is the material and/or technology that carries signal from one location to another.
Infrastructure	Network Virtualisation	A virtual network is a computer network that consists, at least in part, of virtual network links. A virtual network link is a link that does not consist of a physical (wired or wireless) connection between two computing devices but is implemented using methods of network virtualisation. The two most common forms of network virtualisation are protocol-based virtual networks (such as Virtual Local Area Networks (VLAN), Virtual Private Networks (VPN), and Virtual Private LAN Services (VPLS)) and virtual networks that are based on virtual devices (such as the networks connecting virtual machines inside a hypervisor).
Transmission Type		The Transmission Type category allows for identification of the low-level infrastructure "applications" that form the core of the network, as well as the foundational protocols

## NETWORK DOMAIN

The Network (Element Name) Domain (Level) describes the Network section of the TRM addresses how a particular IT asset accessed and used within the enterprise.

Area	Category	Definitions
Transmission Type	Voice over IP (VoIP)	<p>Voice over IP (VoIP, or Voice over Internet Protocol) commonly refers to the communication protocols, technologies, methodologies, and transmission techniques involved in the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks, such as the Internet. Other terms commonly associated with VoIP are IP telephony, Internet telephony, Voice over Broadband (VoBB), broadband telephony, IP communications, and broadband phone.</p> <p>Internet telephony refers to communications services – voice, fax, SMS, and/or voice-messaging applications – that are transported via the Internet, rather than the Public Switched Telephone Network (PSTN). The steps involved in originating a VoIP telephone call are signaling and media channel setup, digitisation of the analog voice signal, encoding, packetisation, and transmission as Internet Protocol (IP) packets over a packet-switched network. On the receiving side, similar steps (usually in the reverse order) such as reception of the IP packets, decoding of the packets and digital-to-analog conversion reproduce the original voice stream.</p> <p>Even though IP Telephony and VoIP are terms that are used interchangeably, they are actually different; IP telephony has to do with digital telephony systems that use IP protocols for voice communication, while VoIP is actually a subset of IP Telephony. VoIP is a technology used by IP telephony as a means of transporting phone calls.</p>
Transmission Type	Radio over IP (RoIP)	<p>Radio over Internet Protocol (RoIP) is similar to VoIP, but augments two-way radio communications rather than telephone calls. From the system point of view, it is essentially VoIP with PTT (Push To Talk). To the user it can be implemented like any other radio network. With RoIP, at least one node of a network is a radio (or a radio with an IP interface device) connected via IP to other nodes in the radio network. The other nodes can be two-way radios, but could also be dispatch consoles either traditional (hardware) or modern (software on a PC), POTS telephones, softphone applications running on a computer such as a Skype phone, PDA, smartphone, or some other communications device accessible over IP. RoIP can be deployed over private networks as well as the public Internet.</p>
Transmission Type	Radio Control over IP (RCoIP)	<p>Radio Control over Internet Protocol (RCoIP) builds on the concepts of RoIP, but can be used in combination with analog radio units. In RCoIP, handsets and other mobile units are remotely controlled using IP-delivered commands.</p>
Transmission Type	Web Conferencing	<p>Web conferencing refers to a service that allows conferencing events to be shared with remote locations. In general the service is made possible by Internet technologies, particularly on TCP/IP connections. The service allows real-time point-to-point communications as well as multicast communications from one sender to many receivers. It offers information of text-based messages, voice and video chat to be shared simultaneously, across geographically dispersed locations. Applications for web conferencing include meetings, training events, lectures, or short presentations from any computer.</p>

## NETWORK DOMAIN

The Network (Element Name) Domain (Level) describes the Network section of the TRM addresses how a particular IT asset accessed and used within the enterprise.

Area	Category	Definitions
Transmission Type	Video Conferencing	Vide Conferencing is the conduct of a videoconference (also known as a video conference or video teleconference) by a set of telecommunication technologies which allow two or more locations to communicate by simultaneous two-way video and audio transmissions. It has also been called 'visual collaboration' and is a type of groupware.
Transmission Type	Wi-Fi	Wi-Fi ( / ɪˈwaɪfaɪ /, also spelled Wifi or WiFi) is a popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network, including high-speed Internet connections. The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards". However, since most modern WLANs are based on these standards, the term "Wi-Fi" is used in general English as a synonym for "WLAN".
Transmission Type	Global Positioning System (GPS)	The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.
Transmission Type	Mobile Device Networking	Mobile Device Networking covers the sets of standards commonly used for mobile devices and mobile telecommunication services and networks that comply with specifications by the International Telecommunication Union. Such standards find applications in wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV, amongst others.
Transmission Type	Transmission Protocol	Transmission Protocol is a category that allows grouping and identification of various transmission standards, at a basic level in the OSI stack.

## Facility Domain

**Table A4-3. Facility Domain**

<b>FACILITY DOMAIN</b>		
The Facility (Element Name) Domain (Level) of the TRM addresses how and/or where a particular asset acquired, deployed, and operated.		
<b>Area</b>	<b>Category</b>	<b>Definition</b>
Facility Type		The particular kind of location in which the assets are deployed.
Facility Type	Data Centre	A data centre is a facility used to house computer systems and associated components, such as telecommunications and storage systems. It generally includes redundant or backup power supplies, redundant data communications connections, environmental controls (e.g., air conditioning, fire suppression) and security devices.
Facility Type	Helpdesk Comand Centre	An operations centre is designed to monitor IT assets deployed elsewhere on an enterprise network. There are many different kinds of operations centres, including "Network Operations Centre" (NOC) and "Security Operations Centre" (SOC).
Operational Control		Operational Control describes the three key aspects of IT asset operations: ownership, operations, and scope of use / re-use.
Operational Control	GoK Owned	Owned by the government, or a specific department or agency of government
Operational Control	Partner Owned	Operated by the government by owned and maintained by a development partner.
Acquisition Method		The method by which IT assets are acquired.
Acquisition Method	GoK Purchased	Built by the government or purchased Off The Shelf (GOTS).
Acquisition Method	Partner Purchased	Purchased by the development partner.
Acquisition Method	Leased Model	Partner provides the service on a leased model to the government for a specified period of time.
Geographic Location		Geographic location is the actual region in which the IT asset is deployed, regardless of facility type. These divisions are derived from the constitution of Kenya 2010 in the form of 47 counties and sub-counties therein.



## APPENDIX 5. Case Studies

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### **Mozambique: Mozambican Open Architecture Standards and Information Systems**

Moasis, or the Mozambican Open Architecture Standards and Information Systems (<http://www.moasis.org.mz/>), established in September 2008, is a *Living Lab* and research non-profit organisation affiliated with Eduardo Mondlane University and supported directly by Jembi Health Systems based in Cape Town, South Africa.

Moasis specialises in the area of Information Systems for Health (SIS), and norms and standards of e-Health. Its main objectives are to support and strengthen SIS and e-Health in the private, public and academic sectors and be an independent and impartial mediator to support the actions of donors to SIS and e-Health.

Moasis is funded by the U.S. Centers for Disease Control and Prevention (CDC), World Health Organisation (WHO), Twinning Center, Rockefeller Foundation, International Development Research Centre (IDRC), Health Informatics Public Private Partnership (HI-PPP) and Jembi Health Systems.

Key Moasis activities:

**Institutional Development at Ministry of Health (MOH):** Moasis works with the MOH to train Ministry staff and provide technical support to other similar initiatives on issues related to e-health

**IIESS:** IIESS refers to the maintenance and promotion of infrastructure equipment Registration and Health Services (formerly known as SAM)

**IT in Provinces:** Moasis provides support and maintenance to IT infrastructure and SIS in the provinces of Mozambique

**mICD-10:** In this innovative project, Moasis directed staff to develop a simple application for low-cost mobile phones for a quick reference ICD-10 database.

**MOH Data warehouse and Connectivity:** Moasis created a data warehouse for the MOH, improved the internal network for general information sharing and improved connectivity of DIS-MOH.

**Institutional Development at Ministry of Women and Social Action (MMAS):** Moasis strengthened the information system for monitoring and evaluation of the MMAS.

**Basico module-SIS:** The main objective is to perform any maintenance and emergency fixes, including automated integration of some chips resulting from the revision of the SIS course for Offshore installation.

**SAND:** The Maputo Central Hospital works with the Moasis team in developing a software for the management of the power system for the hospital.

**SESP:** SESP is the definition of national policy, rules and procedures for the individual patient record systems in Mozambique.

**SI-MAM:** The SI-MAM operates with the support of the Supply Chain Management Systems project (SCMS), an implementing partner of PEPFAR that supports the MOH in managing the supply chain of medicines and medical products in Mozambique.

**SIBI:** The overall objective of the SIBI is to get the requirements for a future electronic health information system based on the individual.

**SIS-Compact Station (CS-SIS):** CS-SIS is an Moasis innovation that consists of a touch screen microcomputer powered by open-source allowing the functioning of a predetermined list of applications allowed by the administrator software.

**SIS-Hospitals (SIS-H):** SIS-H is implementing a Hospital Information System that aggregates data on hospital admissions.

**SIS-Monitoring and Evaluation (SIS-MA):** SIS-MA supports the collection, analysis, interpretation and continuous dissemination of systematic health data that are used to set and monitor public health policies in all districts of Mozambique.

**SIS-ROH** the national mortality register: Improves the coverage and quality of the national system of hospital mortality in Mozambique.

**uDCD:** The uData capture device is a low cost device designed for insertion of micro data.

## **Rwanda: Ministry of Health eHealth Coordination Unit**

### **Summary**

The Rwanda Health Enterprise Architecture (RHEA) initiative seeks to define, develop and implement a health enterprise architecture for Rwanda. The initiative supports Rwanda's eHealth programme.

### **Programme goals**

The first phase is focused on the maternal healthcare domain, and the main objectives are to:

- Complete an Implementation Science/Research Project to present the impact of a Health Information Exchange (HIE) on the maternal healthcare delivery system in Rwanda.
- Develop a pilot implementation of the HIE on the maternal healthcare delivery system.
- Expand the understanding of HIE in Rwanda within the healthcare delivery system and the technical community.

The project includes identifying and defining high level architecture for the health domain in Rwanda, identification of appropriate standards, functional requirements and interoperability profiles across multiple business and foundational domains.

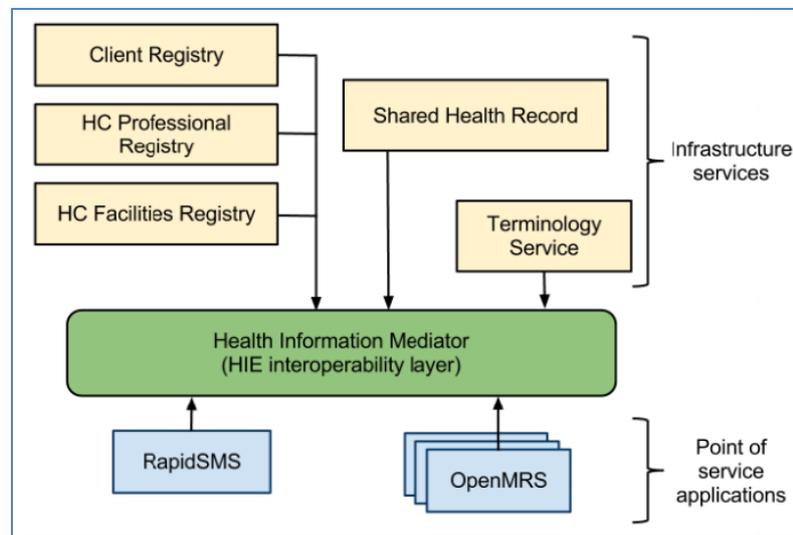
### **Key programme components**

This programme will define and configure the foundational components of the proposed enterprise architecture of the HIE, including client and provider registries,

terminologies and a shared health record. This phase also aims to accurately scope, define and plan for the implementation pilot. This includes surveys of end users, eliciting information, knowledge extraction, definition of specifications, definition of cases and storyboards, definition of usability and security issues, and definition of vocabularies and information standards. It will also develop capacity in Rwanda by creating an advisory committee to define a phased approach for training coverage for the pilot and then expanding to a train the trainer approach. The user groups to be trained include IT professionals, end users such as community health workers, clinicians, administrative staff and managers. It will also open a country office to coordinate work and build local capacity on a sustainable basis, develop an implementation science and evaluation framework to assess the potential impact of providing access to foundational registries and services and improving interoperability between applications. The Implementation Pilot sub-project will implement a limited scope pilot reference HIE using technology selected and approved by the Rwanda MoH and reviewed by a technical assessment team. The main deliverables are the foundational building blocks to support the specific domain. These are: the configuration of the development framework; customisation and content of the provider; client and facility registries; customisation of terminology services; development of the interoperability layer; and integration of two different points of care applications, OpenMRS and RapidSMS.

### RHIE Reference Model

Figure 69. RHIE Reference Model



(Source: [www.jembi.org](http://www.jembi.org))

### Canada: Ontario Ministry of Health and Long-term Care, eHealth Architecture Blueprint

The central themes of Ontario's eHealth Blueprint are connectivity, innovation and a commitment to improve patient care and care outcomes. Through these themes and through collaboration will deliver Ontario's Electronic Health Record (EHR).

The blueprint sets the architectural scope and context for eHealth and provides a framework for the implementation of Ontario's EHR.

This blueprint addresses the challenge of multiple health information systems that are unable to communicate or share patient information with each other.

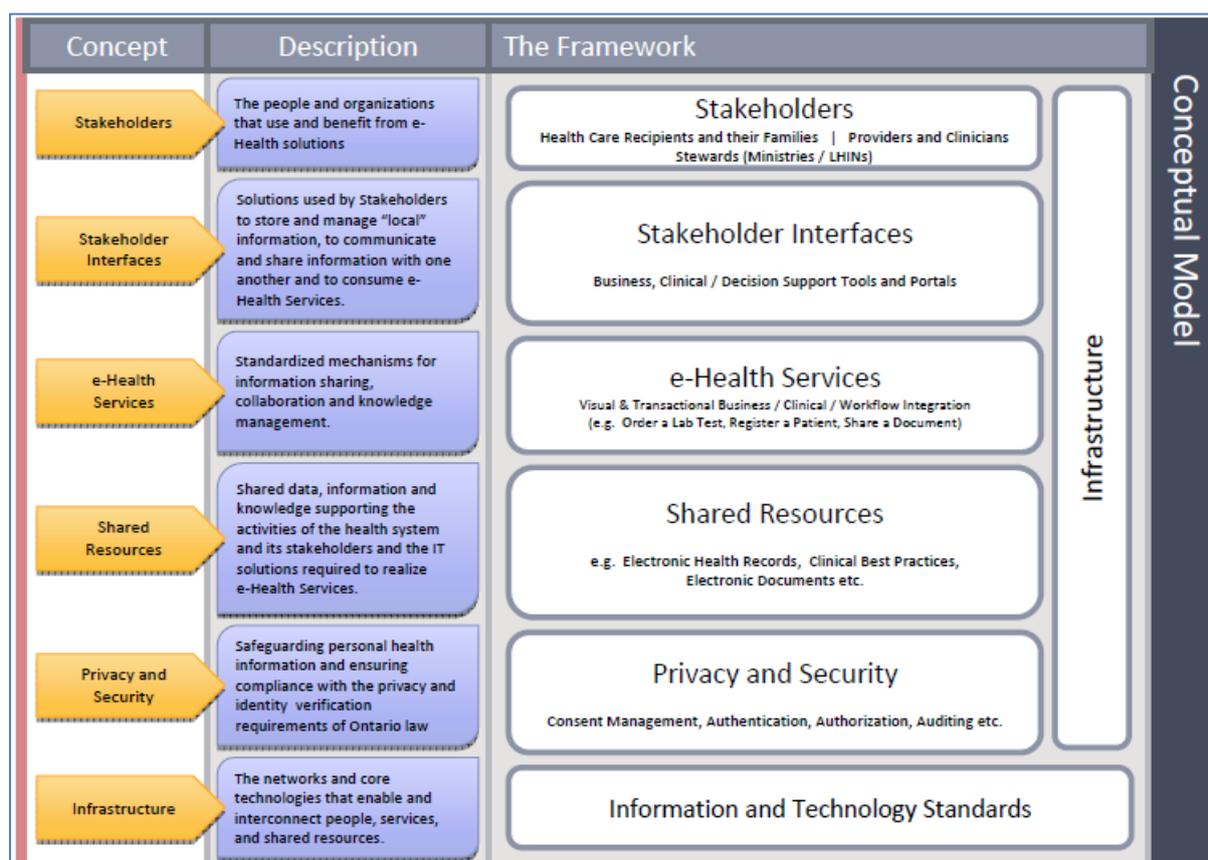
The EHR's goal is to have a well-managed, sustainable, and cost-effective eHealth network. It must also allow patient information to be safely and securely shared with the highest level of privacy. Ultimately it must improve health care delivery and patient outcomes.

In support of that goal, the Blueprint helps Ontario's healthcare community in the following ways:

- It provides an overarching framework for collaboration and communication amongst stakeholders participating in the evolution of the EHR;
- It acts as a "map" to assist in planning and delivery of the EHR;
- It supports a governance framework that will assure high quality, successful delivery of the EHR to the province;
- It establishes a set of standard target architectures to be used by all participants;
- It identifies the foundational components necessary to allow longitudinal patient information to be shared across the continuum of care throughout the province; and
- It illustrates the progress made thus far on each component.

The blueprint is a provincial asset that was created based on extensive consultation with healthcare providers and delivery partners across the province. Additionally, eHealth Ontario has worked closely with the Ministry of Health and Long Term Care, Canada Health Infoway and healthcare thought leaders to assure alignment with the national Blueprint.

Figure 70. Ontario e-health conceptual model



(Source: [www.ehealthontario.on.ca](http://www.ehealthontario.on.ca))

### United States: Office of the National Coordinator for Health IT, Federal Health Architecture

The Federal Health Architecture (FHA) is an e-government initiative managed by the Office of the National Coordinator for Health IT (ONC) within the U.S. Department of Health and Human Services (HHS). FHA was formed to coordinate health IT activities amongst the more than 20 federal agencies that provide health and healthcare services to citizens.

FHA and its federal partners are helping build a federal health information technology environment that is interoperable with private sector systems and supports the President's plan to enable better point-of-service care, increased efficiency and improved overall health in the U.S. population.

FHA is responsible for:

- Supporting federal efforts to deploy standardised health IT systems and measure health IT standard adoption
- Ensuring that federal agencies can seamlessly exchange health data amongst themselves, with state, local and tribal governments, and with private sector partners

- Providing guidance to federal agencies on how to best manage and maintain health IT investments

FHA contributes to the national health IT agenda through:

- **Input:** FHA provides a coordinated federal voice and collaboration on national health IT solutions
- **Implementation:** FHA gives guidance to federal agencies on standards-compliant health IT investments that support interoperability
- **Accountability:** FHA assures accountability for health IT programmes in the federal government in an effort to advance interoperability.

At their core, all FHA activities focus on improving citizen access to care, improving quality of care and reducing costs.

Amongst its many accomplishments, FHA and the federal partners are responsible for developing CONNECT, an open source software that allows health organisations to securely exchange health-related information through health information exchanges. CONNECT is based on the standards and governance outlined by the Nationwide Health Information Network.

([www.healthit.gov](http://www.healthit.gov))

## **United States: Federal Health Information Model**

FHA is working with federal agencies to build the Federal Health Information Model (FHIM).

### **Goal**

The goal is to produce a logical, health information model that supports semantic interoperability and that is built by harmonising information from the individual federal partners and standards organisations.

### **Scope**

The scope of the FHIM information model is all health information (including, healthcare, research, regulatory, public health, payor, etc.)

### **Description**

A logical health information model will be developed and expressed in the Unified Modeling Language (UML) notation. The model will be made available in other formats as requested by the Federal partners and as time allows. At a minimum the model will also be made available in an HTML format. The model will be in the public domain, freely available and easy to access.

The FHIM is not dependent on, but leverages the HL7 Reference Information Model (RIM) as a reference model. (The FHIM can also leverage other reference models.) The FHIM will be designed to meet all Federal partner semantic interoperability needs for the exchange of information with other organisations and will support existing national health standards.

The FHIM also includes a sub-project to accomplish terminology modeling and value set definition work in support of the FHIM.

### **Modeling Process**

The broad set of health information that falls within the scope of the FHIM is subdivided into information domains. Information domains are prioritised and modeled essentially in order of their priority. A temporary work effort is established to model an information domain and federal partners who participate in the work effort bring their use cases and information requirements to the effort. Additionally, the information requirements of standards organisations are addressed. The modeling process that produces the FHIM harmonises the information requirements across the federal partners and standards organisations to produce a single, harmonised information model.

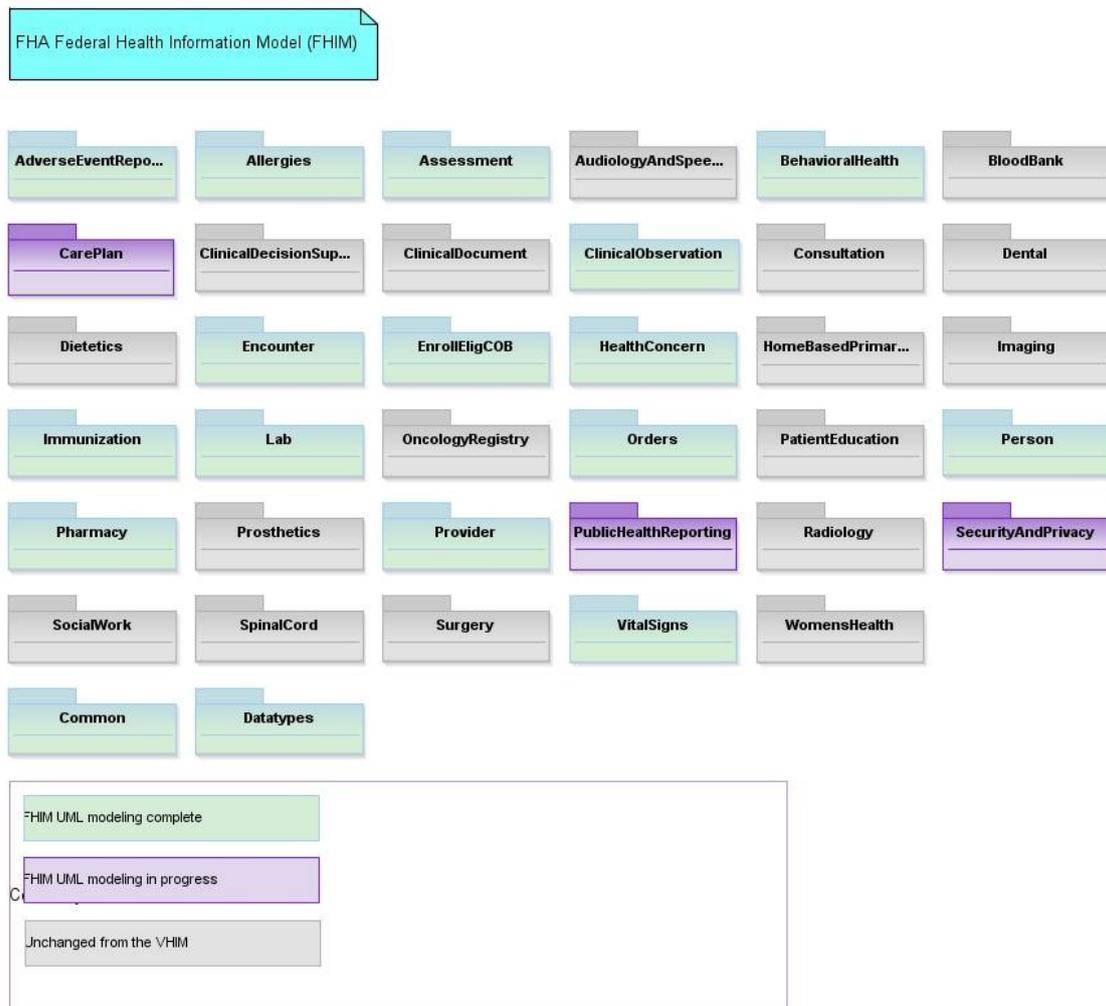
Terminology and value set requirements are discussed concurrent with the information modeling effort and are formally modeled/defined once the information model for a domain is essentially complete.

### **FHIM Reference Model**

The FHIM is organised into information “domains”, which are simply logical groupings of related concepts. These domains are represented in the model by using UML Packages.

This diagram is the main diagram of the FHIM, and it simply shows the UML packages which make up the FHIM. The packages are color-coded to indicate the current state of completion. Packages which are unchanged from the federal partner-supplied models are red, packages which are in-progress are yellow, and completed packages are green.

Figure 71. Federal Health Information Model



(Source: [www.fhims.org](http://www.fhims.org))

### Singapore: National Electronic Healthcare Record

Healthcare IT represents an important means of driving effectiveness and efficiency in Singapore’s healthcare system. So it’s no surprise that the country is in the midst of its modern healthcare journey, and a strategy in place to put Singapore on par with world leaders in connected health.

Singapore’s National Electronic Healthcare Record (NEHR) is the cornerstone of its connected health strategy, and with the first phase completed in 2011, the Singaporean government is on track to deliver on the vision of “one Singaporean, one health record”.

The NEHR, which was developed in collaboration with more than 200 clinicians and suppliers, is a summary of healthcare profiles and a consolidated view of a patient’s current problems, medications and investigations. The NEHR initiative includes enterprise architecture and standards for interoperability and health information exchange, unique patient identifiers and robust information governance

arrangements. The plan is to incorporate learning in phases and exploit rapidly developing technologies.

There are two important trends driving further progress towards connected health in Singapore. First, there is significant growth in portable computing through mobile phones and tablets. Second, Singaporeans are becoming more proactive in managing their own health. Experts predict that citizens themselves will soon become powerful advocates of connected health and increasingly expect their healthcare providers to make use of healthcare IT.

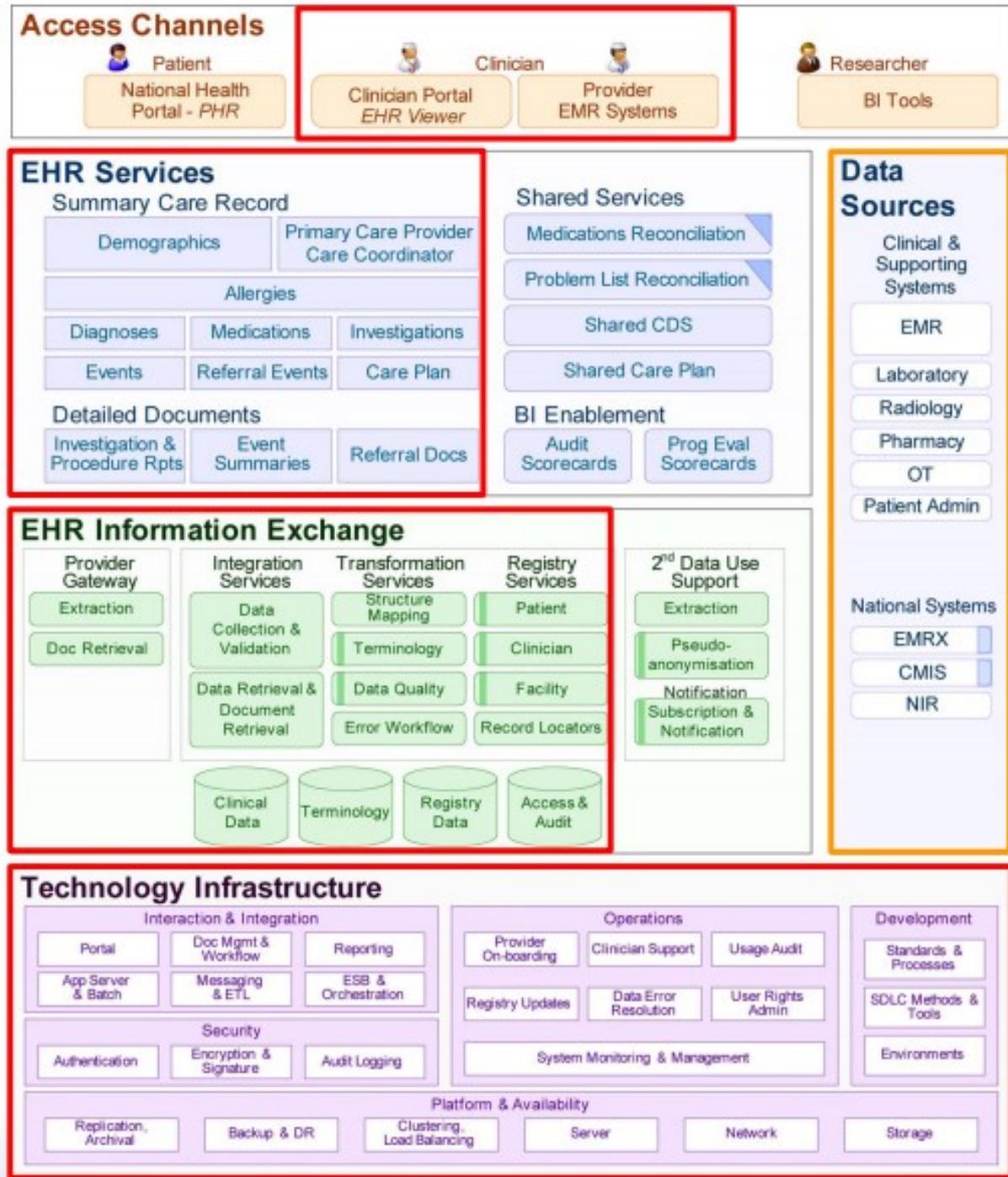
Certainly, the journey ahead is not without its obstacles. Realising the vision of “one Singaporean, one health record” will require greater physician engagement—especially doctors in primary care operating in private practices—to increase healthcare IT adoption and use. Experts note the importance of the government continuing to support local innovation and experimentations with new ideas. Learning from leading practice locally, monitoring progress and showcasing early benefits will be important factors to drive progress.

### **The NEHR Reference Architecture**

The NEHR Architecture consists of:

1. **Access Channels** that enable viewing of NEHR data in an appropriate format for patients, clinicians and researchers
2. **NEHR Services** that provide the NEHR functions to clinicians and researchers
3. **Data Sources**, including clinical and supporting systems, that provide the patient and clinical data.
4. **NEHR EHR Information Exchange** is a set of services that facilitates the sharing of information
5. **Technology** infrastructure that provides the supporting platforms, integration, security and operations capabilities

Figure 72. Singapore NEHR Reference Architecture



(Source: [www.indiamedicaltimes.com](http://www.indiamedicaltimes.com))

### Australia: Connected Health

Australia has embarked on an ambitious strategy to transform its healthcare. This strategy revolves around the concept of “Connected Health” and its key characteristics are:

1. A nationwide personally controlled electronic health record (PCEHR) system under development for initial deployment in July 2012
2. Investments in point-to-point technologies such as electronic referrals, electronic discharges and event summaries and electronic transmission of prescriptions
3. Significant investment in interoperable infrastructure including health identifiers (with support by national privacy legislation) interoperability standards and a national compliance body to review, test and certify solutions
4. Various programmes for delivery of clinical information systems to primary and secondary care settings
5. A national vendor accreditation scheme

The three key cornerstones under which this strategy will be carried out are:

**Healthcare IT adoption:** The AUD\$467 million investment in the national PCEHR programme is a cornerstone of Australia’s e-health strategy. The country’s National e-Health Transition Authority and the Commonwealth Government are seeking to deliver a national PCEHR system by 1 July 2012.

**Health Information Exchange:** While Australia is relatively well advanced in healthcare IT adoption, particularly in primary care, compared to some countries in the study it lags somewhat in sharing health information across the system.

**Insight Driven Healthcare:** Historically, individual organisations have shared healthcare data amongst themselves, but this is expected to change as the PCEHR system is deployed and enhanced.

**Figure 73. Connected Health Ecosystem**



(Source: [www.indiamedicaltimes.com](http://www.indiamedicaltimes.com))

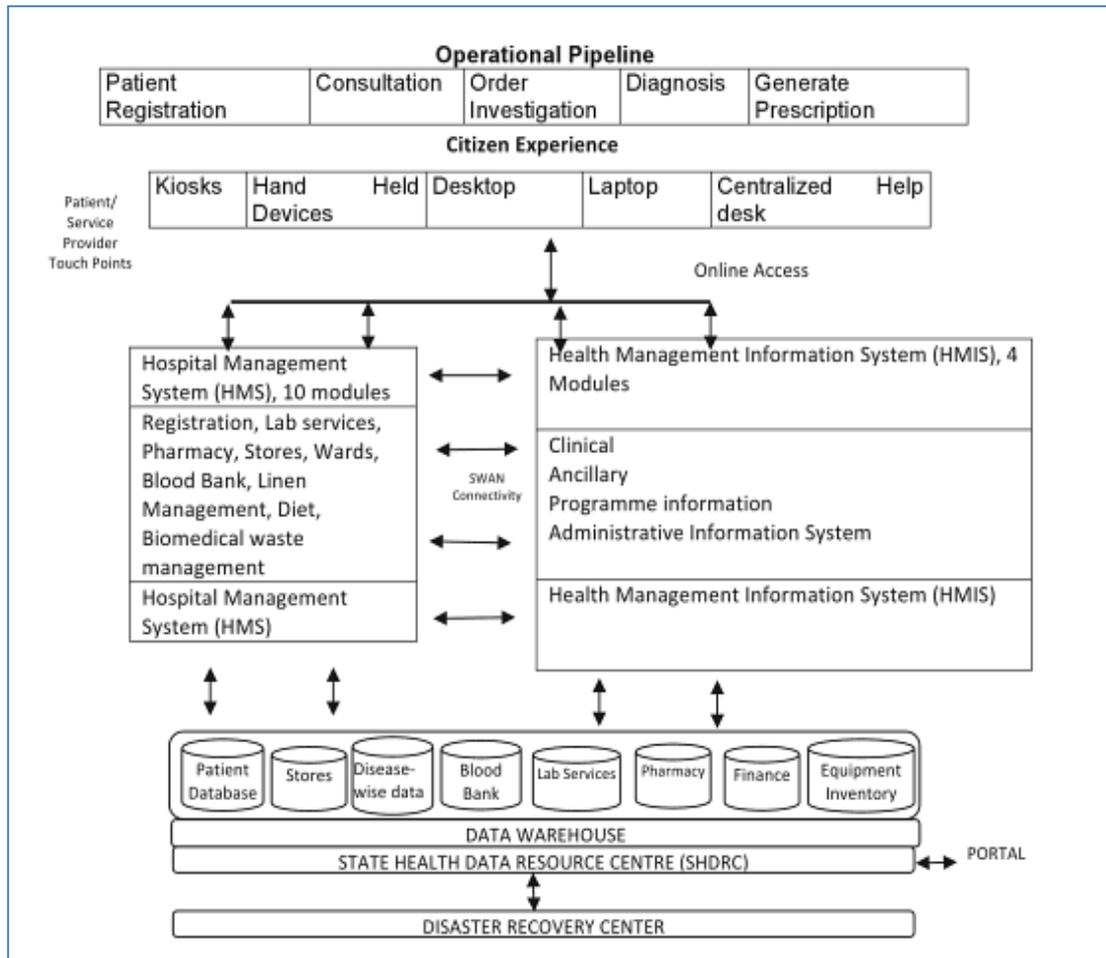
## **India: Tamil Nadu Health Management Information System**

Prior to the Tamil Nadu Health Management Information System (TNHMIS), manual systems for health care management were in place which had lots of challenges. For instance, the system of data collection and use was fragmented, disease specific, inconsistent and often of poor quality. Additionally, the expanding public health systems made the administration of healthcare more complex. The state introduced a new system driven by the objective of improving the effectiveness of healthcare by using technology and rationalising key business processes.

The Tamil Nadu Health and Family Welfare Department envisioned a comprehensive health management system as a part of better healthcare governance. The health management information system (HMIS) is a comprehensive digital health initiative covering the entire state which has an estimated population of 74 million. The web-based solution covers 276 secondary-care hospitals, 1,539 primary care centres, 46 tertiary care institutions and 19 medical colleges. Each hospital in the state has an independent hospital management system which is linked to the state level HMIS. This makes real-time data available across all hospitals in 32 districts centrally.

The operating model was designed on the basis of business process integration and standardisation. It used enterprise architecture to develop a digitally structured process of service delivery originating from channels or service touch points to access business services that were delivered via information systems sitting on infrastructure, as illustrated below.

Figure 74. Tamil Nadu Health Management Information System



(Source: [www.hmis-mis.tn.gov.in/mis/](http://www.hmis-mis.tn.gov.in/mis/))



## APPENDIX 6. Modelling Language

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### Introduction

To provide a uniform representation for target architecture description, the ArchiMate<sup>11</sup> enterprise architecture modelling language has been used. ArchiMate offers an integrated architectural approach that describes and visualizes the different architecture domains and their underlying relations and dependencies. It is a fairly well known in the international enterprise architecture community, and fully supports TOGAF.

According to the ArchiMate 2.1 Specification (2012-2013), ArchiMate is a lightweight and scalable language in several respects:

- Its architecture framework is simple but comprehensive enough to provide a good structuring mechanism for architecture domains, layers, and aspects.
- The language incorporates modern ideas of the “service orientation” paradigm that promotes a new organizing principle in terms of (business, application, and infrastructure) services for organizations, with far-reaching consequences for their enterprise architecture.
- Although it intentionally resembles the Unified Modeling Language (UML), the ArchiMate modeling notation is intuitive and much lighter than currently proposed by UML 2.0. Nevertheless, the language is expressive enough to allow for the modeling of all layers (business, application, and technology infrastructure) and all aspects (structure, behavior, and information) of an organization in an integrated way.
- The two enterprise architecture standards of The Open Group – TOGAF and ArchiMate – complement each other and can be used well in combination.

### Core Concepts

The language consists of *active structure* elements, *behavioural* elements and *passive structure* elements. The active structure elements are the business actors, application components and devices that display actual behaviour, i.e. the ‘subjects’ of activity (right side of the figure below). Then there is the behavioural or dynamic aspect (center of the figure below). The active structure concepts are assigned to behavioural concepts, to show who or what performs the behaviour.

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<sup>11</sup> ArchiMate® Technical Standard 1.0 Specification

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S/Nr	Organization	S/Nr	Organization
1	CDC Emory	12	IntraHealth
2	ITECH	13	Afyainfo
3	Palladium Group	14	WHO
4	mHealth Kenya	15	Dimension Data
5	KEMSA	16	Kenya Healthcare Federation
6	Jacaranda Health	16	World bank
7	Savannah Informatics	17	CHAI

8	BRHC	18	Pathfinder International
9	AMREF Health Africa	19	Measure Evaluation
10	University of Nairobi SCI	20	Welcome Trust
11	ICT Authority	21	

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Figure 75. Generic Metamodel: The Core Concepts of ArchiMate

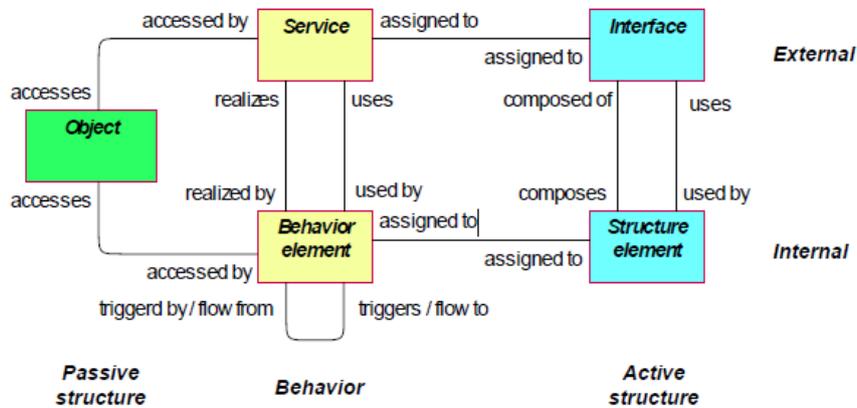
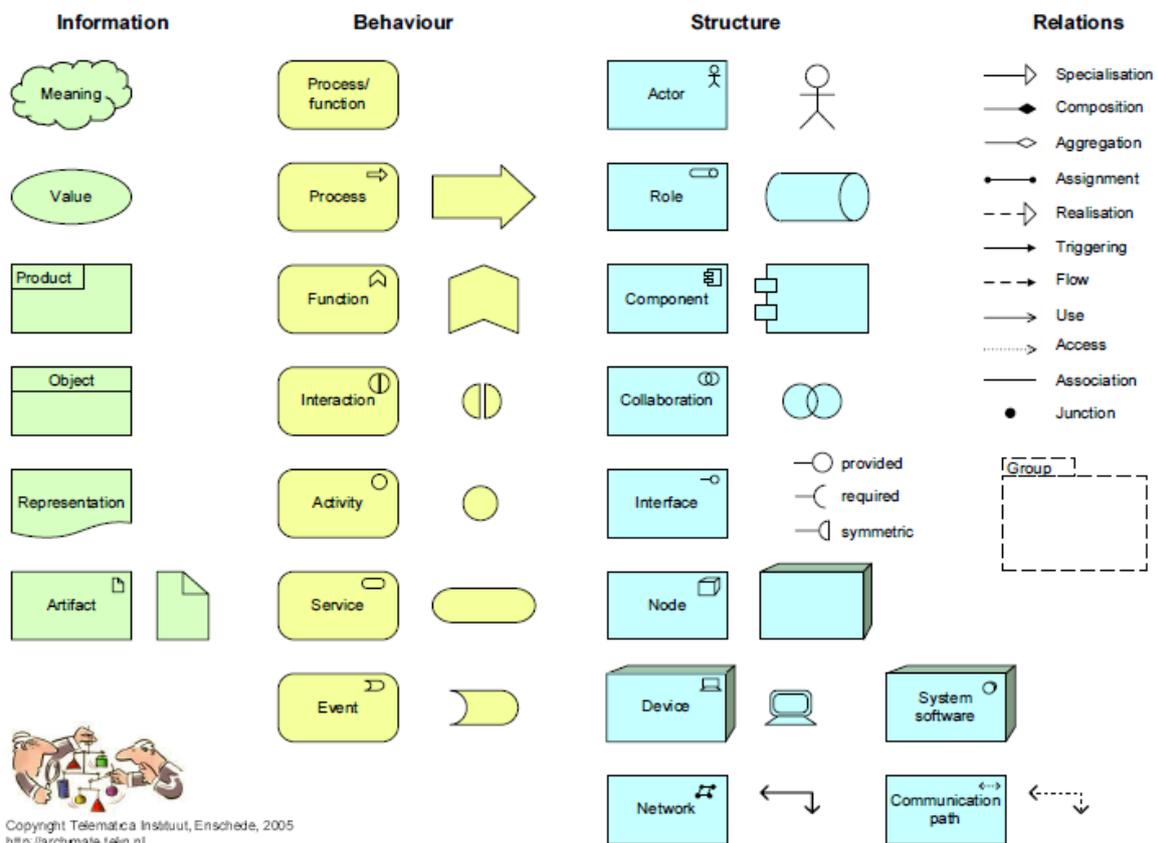


Figure 76 Archimate Quick Reference Guide



## **APPENDIX 7. Core Data Set and Other Service Delivery Indicator Definitions**

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Following are the minimum data sets that will be used by the health sector for the next implementing and reporting period for the medium term plans for the Kenya Health Policy Framework 2012–2030 and KHSSPs. The data sets are organised in topics as tabulated in the attachment.

## Bibliography

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ArchiMate 2.1 Specification (2013), <http://pubs.opengroup.org/architecture/archimate2-doc/chap01.html>, accessed 10 October, 2015

Blowers, M. (2012). Hybrid enterprise architecture frameworks are in the majority. <http://www.ovum.com/hybrid-enterprise-architecture-frameworks-are-in-the-majority/>

eHealth Ontario. (2015). Ontario's Ehealth Blueprint: [www.ehealthblueprint.com/en](http://www.ehealthblueprint.com/en)

Executive Office of the President of the United States, Office of Management and Budget. (2012). The Common Approach to Federal Enterprise Architecture.

India Medical Times. (2014). <http://www.indiamedicaltimes.com/>

Jembi Health Systems. (2015). Rwanda Health Information Exchange (RHIE). [www.jembi.org/project/rwanda-health-enterprise-architecture-rhea/](http://www.jembi.org/project/rwanda-health-enterprise-architecture-rhea/)

Mitchell, R.K. (2009). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts.

Mozambican Open Architecture Standards and Information Systems. (2014). Current Projects. [www.moasis.org.mz/en/project-category/current-projects/](http://www.moasis.org.mz/en/project-category/current-projects/)

Office of the National Coordinator for Health IT. (2014). Federal Health Architecture. [www.healthit.gov/sites/default/files/pdf/fact-sheets/federal-health-architecture.pdf](http://www.healthit.gov/sites/default/files/pdf/fact-sheets/federal-health-architecture.pdf)

The Open Group. (2009). Technical Standard: The ArchiMate® 1.0 Specification.

The Open Group. (2011). TOGAF® Version 9.1. <http://pubs.opengroup.org/architecture/togaf9-doc/arch/>

Sussman (2009). The “CLIOS Process”.

[https://esd.mit.edu/Faculty\\_Pages/sussman/CLIOS-PROCESS.pdf](https://esd.mit.edu/Faculty_Pages/sussman/CLIOS-PROCESS.pdf)

Ulrich, W. (2010). Business Architecture: The Art and Practice of Business Transformation.

United States Department of Health and Human Services, Office of the Chief Information Officer Enterprise Architecture. (2010). HHS Enterprise Architecture-Framework Version 16.0.



