A BUSINESS INTELLIGENCE SYSTEM FOR TRACING AND ANALYZING HEALTHCARE PERFORMANCE MEASUREMENT BASED ON THE KPIS FROM THE MINISTRY OF PUBLIC HEALTH OF THAILAND FROM 2013

PAIBOON UDOMKAEWKANCHANA

A THEMATIC PAPER SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (INFORMATION TECHNOLOGY MANAGEMENT) FACULTY OF GRADUATE STUDIES MAHIDOL UNIVERSITY 2015

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……..……..…..……
Mr. Paiboon Udomkaewkanchana
Candidate

……..……..…..……
Asst. Prof. Supaporn Kiattisin,
Ph.D. (Electrical and Computer Engineering)
Major advisor

……..……..…..……
Lect. Taweesak Samanchuen,
Ph.D. (Electrical Engineering)
Co-advisor

……..……..…..……
Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies
Mahidol University

……..……..…..……
Asst. Prof. Supaporn Kiattisin,
Ph.D. (Electrical and Computer Engineering)
Program Director
Master of Science Program in Information Technology Management
Faculty of Engineering
Mahidol University

Thematic Paper
entitled

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was submitted to the Faculty of Graduate Studies, Mahidol University
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(Information Technology Management)
on
May 7, 2015

……
Mr. Paiboon Udomkaewkanchana
Candidate

……
Asst. Prof. Adisorn Leelasantitham,
Ph.D. (Electrical Engineering)
Chair

……
Asst. Prof. Supaporn Kiattisin,
Ph.D. (Electrical and Computer Engineering)
Member

……
Prof. Somkiat Wattanasirichaikul,
M.D., FRCST (General Surgery)
Member

……
Lect. Taweesak Samanchuen,
Ph.D. (Electrical Engineering)
Member

……
Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies
Mahidol University

……
Lect. Worawit Israngkul,
M.S. (Technical Management)
Dean
Faculty of Engineering
Mahidol University

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Paiboon Udomkaewkanchana

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PAIBOON UDOMKAEWKANCHANA 5637422 EGIT/M

M.Sc. (INFORMATION TECHNOLOGY MANAGEMENT)

THEMATIC PAPER ADVISORY COMMITTEE: SUPAPORN KIATTISIN, Ph.D., TAWEESAK SAMANCHUEN, Ph.D.

ABSTRACT

This thematic paper presents a business intelligence system for tracking and analyzing healthcare performance measurement based on the KPIs (key performance indicators) of the Ministry of Public Health of Thailand from 2013. Forty-three data source files from Metta Pracharak Hospital (Wat Rai Khing) and details of the 66 KPIs from the fiscal year 2013 of the Ministry of Public Health were used to design and generate reports regarding the KPIs. Forty-three data source files were used in reference to only 24 KPIs. The other KPIs need data source files from other organizations such as the National Cancer Institute, Provincial Public Health Office, Department of Disease Control, etc. The forty-three data source files from Metta Pracharak Hospital (Wat Rai Khing) could not be used in reference to the other KPIs because it is a hospital that specializes in eye treatment, so they do not have any data for other illnesses. To create reports, it is necessary to have example data, but the available data imported into this system was incomplete and did not encompass all of the KPIs. The 43 files still lack accuracy of data, data integrity and traceability. In the future, the forty-three data source files need to be updated for data collection and data transmission from the health center to the Provincial Public Health continuing on to the Ministry of Public Health. This will help to provide even more accurate information and will be beneficial to the health system in the future.

KEY WORDS: BUSINESS INTELLIGENCE/ KPI/ HEALTHCARE

52 pages

ระบบธุรกิจอัจฉริยะ เพื่อติดตามและวิเคราะห์ผลการดำเนินงาน ของหน่วยงานสาธารณสุข อ้างอิงตามตัวชี้วัด ปี พ.ศ. 2556 ของกระทรวงสาธารณสุข

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ไพบูลย์ อุดมแก้วกาญจนา 5637422 EGIT/M

วท.ม. (การจัดการเทคโนโลยีสารสนเทศ)

คณะกรรมการที่ปรึกษาสารนิพนธ์: สุภาภรณ์ เกียรติสิน, Ph.D., ทวีศักดิ์ สมานชื่น, Ph.D.

บทคัดย่อ

สารนิพนธ์นี้นำเสนอ การนำระบบธุรกิจอัจฉริยะมาใช้กับข้อมูล 43 แฟ้ม เพื่อติดตามและวิเคราะห์ผลการดำเนินงานของหน่วยงานสาธารณสุข โดยอ้างอิงตัวชี้วัด ปี พ.ศ. 2556 ของกระทรวงสาธารณสุข โดยนำข้อมูลตัวอย่าง 43 แฟ้ม จากโรงพยาบาลเมตตาประชารักษ์ (วัดไร่ขิง) มา และข้อมูลตัวชี้วัด ปี พ.ศ. 2556 ของกระทรวงสาธารณสุข 66 ข้อ มาใช้ในการออกแบบและสร้างรายงานเพื่อตอบคำถามตามตัวชี้วัด พบว่า ข้อมูล 43 แฟ้ม นำมาเป็นข้อมูลเพื่อใช้ตอบคำถามตัวชี้วัดกระทรวงฯ ได้เพียง 24 ข้อ ส่วนที่เหลือต้องใช้ข้อมูลจากหน่วยงานอื่นๆเช่น สถาบันมะเร็งแห่งชาติ, สำนักงานสาธารณสุขจังหวัด, กรมควบคุมโรค และอื่นๆ เมื่อตรวจสอบข้อมูลตัวอย่าง 43 แฟ้ม ที่ได้รับมาพบว่า ไม่สามารถใช้ตอบคำถามตัวชี้วัดได้เนื่องจาก โรงพยาบาลเมตตาประชารักษ์(วัดไร่ขิง)เป็นโรงพยาบาลเฉพาะทางด้านโรคที่เกี่ยวกับตา จึงไม่มีข้อมูลของโรค หรือการเจ็บป่วยอื่นๆ มากนัก ทั้งนี้การทำรายงานในระบบธุรกิจอัจฉริยะ จำเป็นต้องสร้างข้อมูลตัวอย่าง เพื่อใช้เป็นข้อมูลต้นทางในการสร้างรายงาน และเมื่อนำข้อมูลจริงเข้ามาในระบบ จะทำให้รายงานสามารถตอบตัวชี้วัดของกระทรวงฯ ได้ ทั้งนี้ข้อมูล 43 แฟ้ม ยังคงมีจุดอ่อนในเรื่องความถูกต้องของข้อมูล, ความสมบูรณ์ของข้อมูล และการตรวจสอบย้อนกลับ ในอนาคตจำเป็นต้องมีการพิจารณาปรับปรุงการเก็บข้อมูล รวมไปถึงการส่งข้อมูลจากศูนย์บริการสุขภาพไปยังหน่วยงานระดับจังหวัดและต่อไปยังกระทรวงสาธาณสุข เพื่อให้ข้อมูลมีความถูกต้องมากยิ่งขึ้น,สามารถตรวจสอบได้และจะเป็นประโยชน์กับระบบสุขภาพของประเทศไทยในอนาคต

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INTRODUCTION

1.1 Background and Statement of Problem

Currently, the operating businesses of all types use the several information to help in the management and so those businesses run smoothly such as Financial, Manufacturing, Purchasing or even healthcare business. The health organizations need several information for patient, admission management, treatment planning, dispensation, drug inventory and etc. The Ministry of Public Health of Thailand call this information "Forty-three Data source files". It is used to supervise the policies and to implement the plan on the major health project. Further in the year 2013, the Ministry of Public Health of Thailand has set 66 key performance indicators to measure the performance and health system quality in various areas.

The forty-three data source files are used for the data sources from all hospitals, clinics, sanatoriums and health centers under the Ministry of Public Health of Thailand. This information is processed through data warehouse system and transmission from all of health centers to provincial health office for process and integrate information before send to Nation Health Security Office (NHSO) for preparation and publish health information to public health authorities and the general public.

1.2 Objectives

• To measure the indicators of the Ministry of Public Health, Thailand according to the forty-three data source files at the time for achievement.

• To improve the performance and planning to achieve the 66 KPIs according to the determination by the Ministry of Public Health.

1.3 Scope of work

This project uses the forty-three data source files from the kindness of Metta Pracharak Hospital (Wat Rai Khing) providing the forty-three data source files for analysis and development. Because of this hospital as eye specialist hospital, there are still the diagnosis and treatment of diseases by general physician's service. Therefore some information from the forty-three data source files are no record.

This project is developed by the use of "IBM Cognos BI" the Business Intelligence tool related to Ministry of Public Health's KPIs based on existing data. The scopes of work are as follows.

1) Study the forty-three data source files from the Metta Pracharak Hospital (Wat Rai Khing)

2) Study the 66 key performance indicators of the Ministry of Public Health, Thailand.

3) Study the usage and setup of Business Intelligence system environment, based on IBM Cognos Business Intelligence tool.

4) To generate the data model which used to create business intelligence reports determine the KPIs.

1.4 Expected Results

• To determine the performance and public health quality of the Metta Pracharak Hospital (Wat Rai Khing) comparing with Ministry of Public Health's KPIs.

• To determine the solutions to improve the better public health service for the Metta Pracharak Hospital (Wat Rai Khing).

• To help the executive to plan and decision with health service problems in the future.

1.5 Outline Summary

The organization of thematic paper is as follows: Chapter 2 introduces the forty-three data source files and 66 KPIs from the Ministry of public Health. The next is business intelligence components and business intelligence tools in the market presence. The last is literature review of the usage of business intelligence system in health organization; Chapter 3 describes the development tools and how to map forty-three data source files with 66 KPIs from the Ministry of Public Health. The next, how to create data model and reports. The business intelligence reports and data model are given in Chapter 4; Finally, conclusion and recommendation are given in last chapter.

CHAPTER II
LITERATURE REVIEWS

2.1 Introduction

This chapter gives the overviews of forty-three data source files and structure. In addition, 66 KPIs of Ministry of Public Health are also included. Business Intelligence components and tools in today's market will also be described. Related researches on Business Intelligence usage by health organization and benefits will also be summarized.

2.2 Forty-three Data Source Files and Structure

The Office of Permanent Secretary, Ministry of Public Health of Thailand has developed a data delivery system and link data of hospitals and community health centers at level of provincial and central for 18 standard files structure. They use for both internal departments and health provincial organization within the Ministry of Public Health. Because of the situation of people with chronic illnesses tend to increase including lack of information for surveillance. So they re-structured standard data file to 21. By the National Health Security Office (NHSO) is the budget supporter for operations in both the central and provincial from fiscal year 2007 onwards [22].

The "forty-three Files" information is the database structure of medical and health in 43 standard files format. In the details of forty-three files information can see in the reference [10]. They are split to 11 categories information following as,

2.2.1. People and patients

This category includes the information overview of the people who use health service in the area, address, death records, history of health coverage of the people in responsible area and history of allergic reactions in patients who use health

services. Consist of 5 files are PERSON, ADDRESS, DEATH, CARD and DRUGALLERGY.

2.2.2 Households

The information of this category are location and sanitary of homes in area of responsibility. It has only 1 file which is HOME.

2.2.3 Service records

This information about people who use health service in hospital and outside hospital including next appointment records of them. These have 2 files are SERVICE and APPOINTMENT.

2.2.4 Outpatient service

The information of this category consist of trauma patients that attending to the emergency department of a hospital, the diagnosis of outpatients, the procedures and surgery of outpatients, the dispensation of outpatients and the cost of each service for outpatients. Consist of 5 files are ACCIDENT, DIAGNOSIS_OPD, PROCEDURE_OPD, DRUG_OPD and CHARGE_OPD.

2.2.5 Inpatient service

The information of this category looks like outpatient service category but it has different point is for inpatient only. So they does not have trauma patients but they have history of the patient is hospitalized. Consist of 5 files are ADMISSION, DIAGNOSIS_IPD, PROCEDURE_IPD, DRUG_IPD and CHARGE_IPD.

2.2.6 Health promotion service

This category has much information about health promotion such as information of patients with disease surveillance attending health service, information of reproductive age woman that living with her husband, information of family planning, information for vaccine to target people and attending, information for measure the nutrition and development of children aged 0-5 years, history of pregnant women in the area of responsibility, history of prenatal care of pregnant women in the

area of responsibility, birth records and postpartum care of women giving birth, history of babies born, postnatal care information, information on oral health of all teeth and promotion plan and treatment and history have been promoting medical services for particular target groups in the area of responsibility.

This information has 13 files contain this category as SURVEILLANCE, WOMAN, FP, EPI, NUTRITION, PRENATAL, ANC, LABOR, POSTNATAL, NEWBORN, NEWBORN_CARE, DENTAL and SPECIALPP.

2.2.7 Screening and monitoring patients with chronic diseases

This category includes the history has been screened for diabetes and hypertension for the target group 15 years and above, the chronic disease anyone who lives in the area of responsibility, the monitoring patients and laboratory data of patients with chronic diseases (diabetes, hypertension). Consist of 4 files are NCDSCREEN, CHRONIC, CHRONICFU and LABFU.

2.2.8 Community service

It is information services in the community for the target group in the area of responsibility. Only 1 file is COMMUNITY_SERVICE.

2.2.9 Mental health and rehabilitation services

This category includes the disabled people living in the area of responsibility, the ability to assess health conditions and other factors of disabled people, assessment of mental health and the information of rehabilitation services for disabled. Consist of 4 files are DISABILITY, ICF, FUNCTIONAL and REHABILITATION.

2.2.10 Community and events

This is general information and data related to the health of the communities and activities in the area of responsibility. This category contain 2 files are VILLAGE and COMMUNITY_ACTIVITY.

2.2.11 Service provider

Information providers of health care. Only 1 file is PROVIDER.

2.3 66 KPIs of Ministry of Public Health

In the year 2013, [11] the Ministry of Public Health in Thailand has setuped 66 standard indicators for tracking performance in many areas. The hospitals, clinics and any health centers whose are member and under Ministry of Public Health have responsible for data collection by using 43 template files and send all information to Ministry of Public Health. In the details of all KPIs can see in the reference [11].

So they can see the big picture of the health system and found some problems in the some areas. They can plan to solve and development in the poor performance areas are better. The Ministry of Public Health is split to 12 indicator groups for tracking health performance following as below,

1) Indicators of children and women (1-14)
2) Indicators of early childhood (15-20)
3) Indicators of school-age children and adolescents (21-25)
4) Indicators of working group (26-34)
5) Indicators of elderly and disabled (35-38)
6) Indicators of health and medical services system (39-49)
7) Indicators of drug (50-51)
8) Indicators of participation of civil society (52-53)
9) Indicators of participation of civil society (52-53)
10) Indicators of environmental systems are conducive to health (57-61)
11) Indicators of health literacy (62)
12) Indicators of performance management (63-66)

2.4 Forty-three Files Data Delivery

Provincial Health Office create database which links and send to outpatient services, health promotion and disease prevention information in the form of forty-three files to Office of Permanent Secretary, Ministry of Public Health

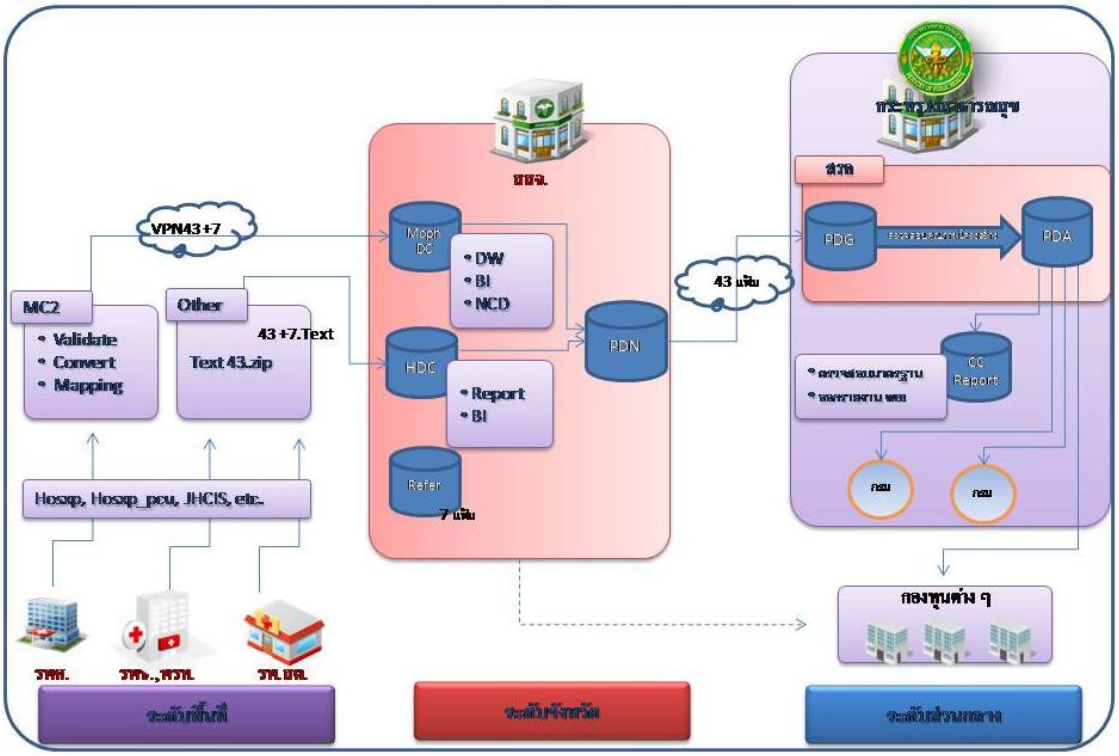


Figure 2.1 Data link systems based on standard structure “Forty-three Files”.

2.5 Business Intelligence Components

A technology or necessary tool for Business Intelligence is databases that collect and contribute data used to support decision making. This will include information system and many analysis application systems following as,

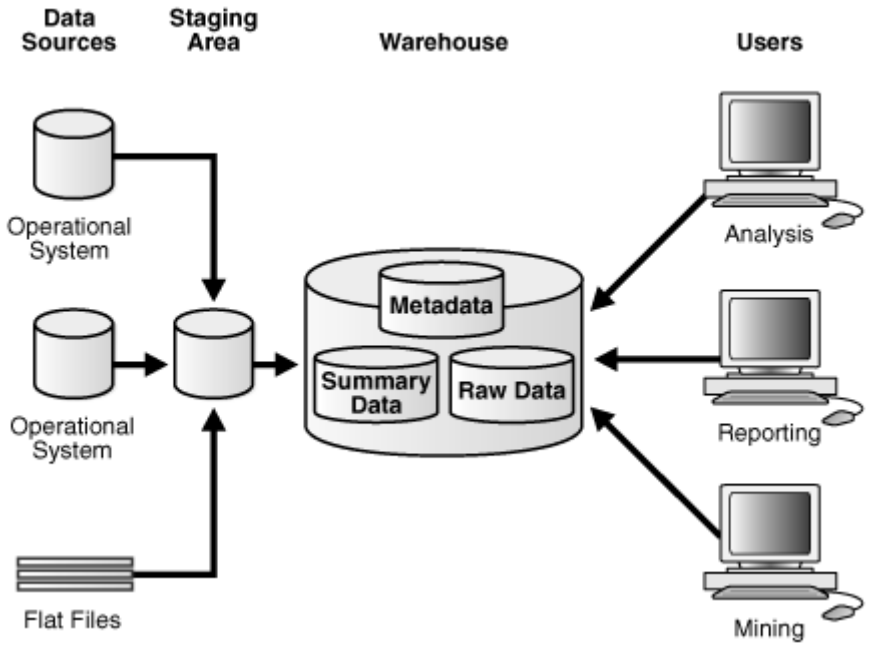


Figure 2.2 Data warehouse components [13].

2.5.1 Data Source

Data source is the information of interest being used as a starting point in the analysis. The most are operation data of the each business. Example ERP system has many modules such as Sales, Purchasing, Inventory etc. The Hospital Information System (HIS) is the program was developed to facilitate the provision of medical services in hospitals. Example including HIS module as Medical Record, Drug and Medical Supply Inventory, Appointment etc. These are operation system has to store data on the nature of the transaction. Beside the source data can take many formats based on each system including RDBMS, OLAP, XLS or flat files.

2.5.2 Data Warehouse

A large storage which contains information from database or group of information those are important to companies such as customers, products, financial information etc. The system is ETL process to transforms transaction data from other many systems to central theme of the organization. It make complicated things easier to understand for users [2].

In addition of data warehouse is a database that stores statistical information and important information in the past. It also can support Meta Data and working with them.

Meta Data is information is in data warehouse. They are designed to allow users to use data more easily and also allow IT staff to manage and maintain a data warehouse as well.

Data warehouse is database that stored aggregated and analyzed data [1]. This data uses for decision support system because of viewer can compare information in the history several years. Information is collected by major business of each organization such as customer information and sales and so on. The information is the same format and generates data consistent before it is presented to the user. Data stored in the data warehouse will not be modified but will add new information to the end without replacing the original data [14].

2.5.3 Data Mart

Set of specifications of each information type. They may be sent from the any data warehouse, depending on the architecture of the system that we use [2].

2.5.4 Data Mining

Information management system from large database to be used for decision making. There are several data mining models which each model is formulated Business involved. They have results in a different way, as a rule IF-then or a decision tree. Data Mining software-based such as SPSS Clementine, SAS Enterprise Miner, IBM Enterprise Miner, IBM DB2 Intelligent Miner and Oracle Data Mining, etc. [2].

2.5.5 OLAP

Online Analytical Processing (OLAP) is a technology that allows executives, analyst or related users can receive insight data through fast and correspond. They can access to a wide variety of possible view of information has been transformed from transactional data. These things reflect to real dimension of the business as understanding of users.

OLAP allow multi-users to access simultaneously and quickly response regardless of database size. In addition, OLAP help users through comparative, personal view, historical analysis and projected data model (what-if) in various scenarios.

OLAP focus on the retrieval of existing data from the database to be analyzed. The OLAP system users are groups of executive management, market researchers, statisticians or other related users whose work with data analysis. So the key success factor is the OLAP system must work quickly and easy to find the information from large databases to be fully calculated. Meanwhile, the system must be stable and not easy to make a mistake during usage [14].

2.6 Business Intelligence Tools in Today's Market

Currently, Business Intelligence tools are abundant. It is divided into 2 types those are available for free (Open Source) and commercial (Licensed). In this part, researcher needs to present BI features of each brand in today's market following as,

2.6.1 IBM Cognos Business Intelligence

The Cognos Business Intelligence from IBM is a complex business intelligence tool. They have many features and functions for data management and present reports.

From the figure 2.3 shows the components of IBM Cognos BI tools such as data source including relational, dimensional, flat files and other. The middle part is data management including metadata modeling tool as a Framework Manager. A model is a business presentation of the information in one or more data sources. Transformer used to create OLAP cubes structure and build the multidimensional analysis cubes called PowerCubes. Matric Designer is tool for creating scorecard structure. The upper part called Cognos Connection is tools for create business intelligence report [3].

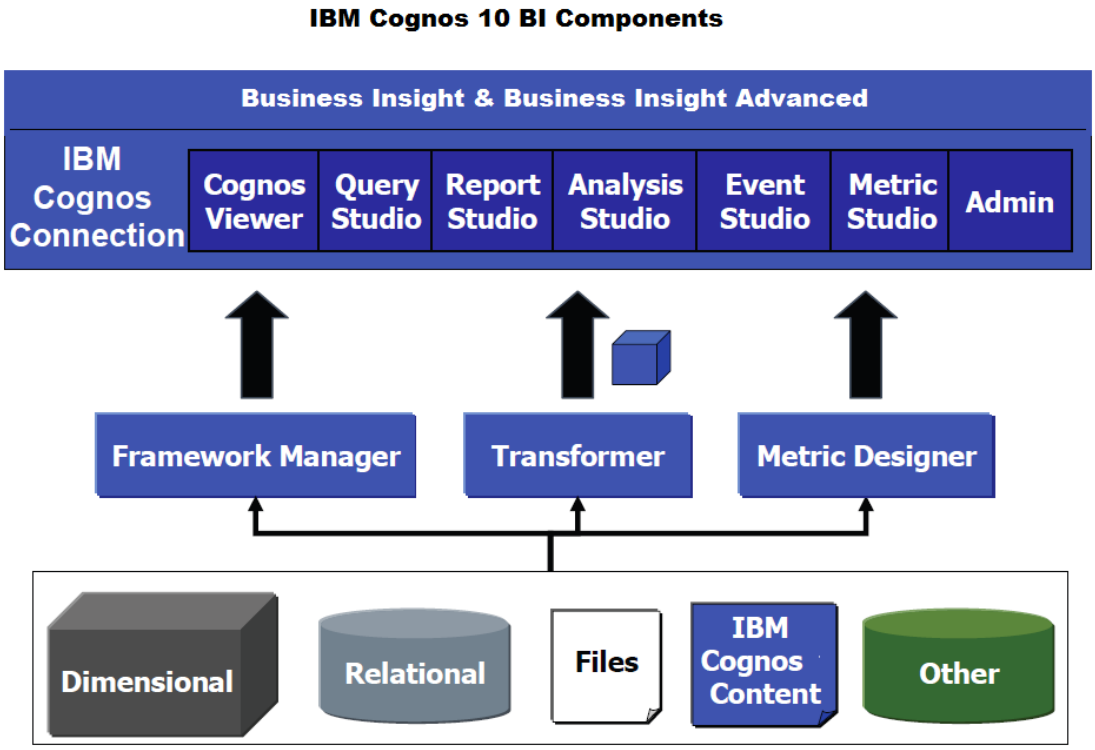


Figure 2.3 IBM Cognos 10 BI Components [3].

2.6.2 Oracle Business Intelligence Enterprise Edition

The BI tool from Oracle consist of several services such as Answers, Delivers, Interactive Dashboards and Applications [4].

From the figure 2.4 shows component of Oracle BI as bottom part are data source to support multiple systems. In the next pane is data management and data modeling tools. The next is reporting tools such as dashboard, ad-hoc information, and alert including Microsoft Office supported. The upper pane is Oracle BI applications. They are able to plug-in information from reporting tools and data modeling for display and analysis.

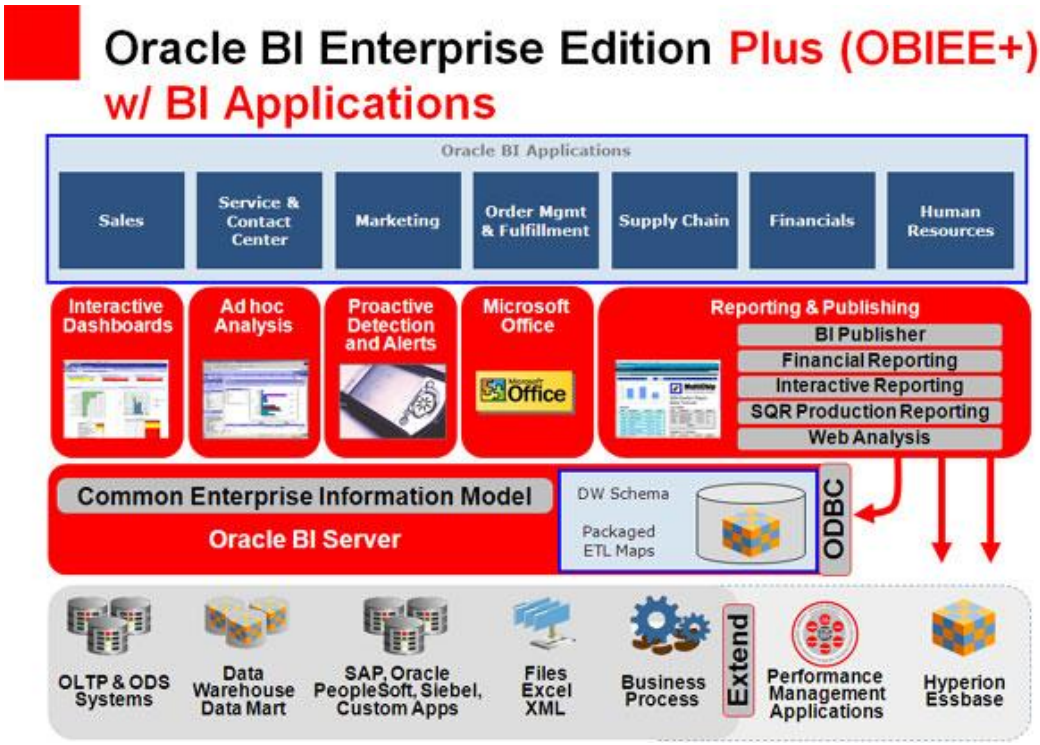


Figure 2.4 Oracle Business Intelligence Enterprise Edition Components [8].

2.6.3 Qlikview

QlikView Business Discovery is a tool to empower the data analysis (Business Intelligence tool) to be even more effective. The new concept to bridge the gap between the Traditional BI Standalone office applications, which gives users the freedom to access and analyze corporate information in an accurate and fast [5].

The component of Qlikview separate by 3 parts are Develop, Reload-Publish-Distribute and Dashboard analysis & reports. The develop part is a tool for data modeling design. The next part is tools for data modeling management by criteria for publish and distribute data to users and right format. The last part is client applications for viewing information and creating reports. In addition, it also supports Windows clients, AJAX-based WebAccess, JAVA clients, Internet Explorer plug-in or mobile access [9].

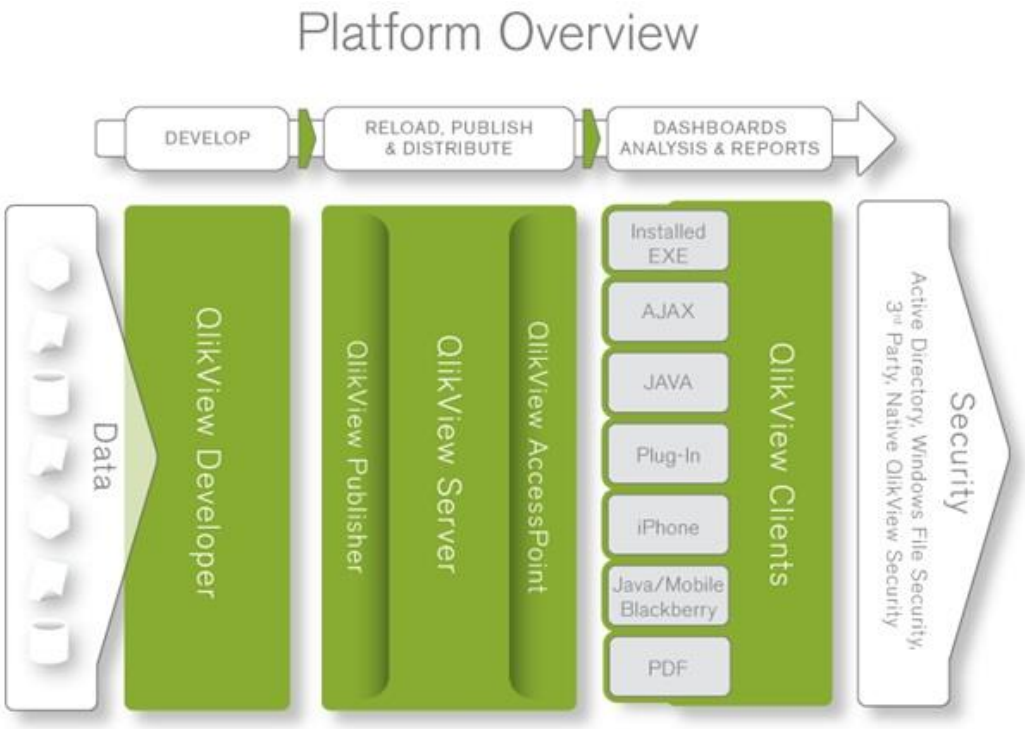


Figure 2.5 Qlikview Platform Overview [9].

2.7 Related Research

To have many research about healthcare Business Intelligence. This project would like to example related research with Business Intelligence system in health care aboard including the designing of health care measurement for decision making following as,

2.7.1 Business Intelligence in Healthcare Organizations

The purpose of this research [7] is study the factor that health organization to use the Business Intelligence system. They divided into four groups of health organizations whose collect health information in a manner different such as file drawer in a clinic, spreadsheets in a hospital, OLAP in an academic hospital and MIS at a general hospital. The most of factor to use the Business Intelligence based on size and level of ICT adoption and organizational learning. The spreadsheets are the most used in finance. OLAP and MIS can be seen in large hospital. Those can use benefit of the BI system to analysis and help related users decision-making in many areas.

Table 2.1 Summary of case results.

	CASE 1 – FILE DRAWER	CASE 2 – SPREADSHEET	CASE 3 – DATAWARE-HOUSE	CASE 4 - MIS
Size (#beds)	77	530	867	1100
ICT adoption	Low	Average	High	High
Scalability	Average	Average	High	Average
Shifting needs	Average	Average	High	Low
User acceptance	High	Average	High	Average
Perceived value	High	High	Low	Low
Data oriented	High	High	High	High
Decision oriented	Low	High	High	Average
Model oriented	Low	Average	Average	High
Ad hoc query	Low	Low	High	Average
Regular reports	High	High	High	High

2.7.2 The Use of Business Intelligence Systems in Healthcare Organizations in Poland

The purpose of this research [1] is study Business Intelligence system usage behavior in health organizations in Poland. Because of the health organizations have collect many raw data but still lack of transform those to information for analysis. This research recommended that the healthcare organization should emphasize with information system because it helps decision-making that will improve patient treatment and the quality of medical services. Beside those organizations should setup strategic approach to decision making based on historical information. At present, many organizations in Poland still believe that should reduce costs rather than improving efficiency in the treatment.

Figure 2.6 The schema of healthcare organization.

2.7.3 The Impact of Business Intelligence on Healthcare Delivery in the USA

This research [17] try to deploy the BI system in healthcare organization in the USA. Researcher use 4 capabilities of Business Intelligence are Organizational Memory, Information Integration, Insight Creation and Presentation/Communication to implement 4 public health organization and record benefit following as table 2.2.

Table 2.2 BI deployment in 4 Healthcare Organizations and Benefit.

ORGANIZATION NAME	INDUSTRY	BI TOOL	BENEFIT
Cardinal Health	Healthcare	Data Warehouse	Quality Data
Northshore University Health System	Healthcare	Integration	Ability To Identify At Risk Patients
Sahlgrenska University Hospital	Healthcare	Insight Creation	Discover Procedure Complications
Colorado Beacon Consortium	Healthcare	Presentation	Electronic Communica-tion Between Multiple Care Sites

CHAPTER III
RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes various developing steps for Business Intelligence system for analyzing health care performance measurement based on KPIs of the Ministry of Public Health of Thailand. Topics are presented as below,

3.2 Development Tools

The development tools consists of 2 types which are Hardware and Software. Summarized information is shown in below table,

Table 3.1 Development Tools.

Hardware	
CPU	Intel Pentium Core i7
RAM	8 GB
Hard Disk	100 GB
Peripherals	Monitor, Mouse, Keyboard, CD-ROM, Printer
Software	
Virtual Machine	VMware Workstation 6.5
Operating System	Windows Server 2008 R2 64Bit
Database	Microsoft SQL Express 2014 64Bit
Development Tools	IBM Cognos Business Intelligence 10.2.1 64Bit

3.3 Source of Data

With assistance of the Metta Pracharak Hospital (Wat Rai Khing) and Assistant Professor Supaporn Kiattisin, PhD. for an example of data source "forty-three Files" as of May 2013 (1 month) in this project.

In addition, I necessarily generate some data to create reports for reader to see that if we have data, we can crate anything.

3.4 Process Implementation Methods

3.4.1 Mapping Indicators with Forty-three Files

This stage need to map the forty-three files and 66 KPIs of the Ministry of Public Health. According to the forty-three files document [10] and 66 KPIs information [11], we found that not all forty-three files information can be used in reference to all KPIs. Some KPIs need other sources of data or use forty-three files information together with other sources.

Therefore, the forty-three files information can be used in reference to only 24 from 66 of the Ministry of Public Health's KPIs. The other 7 KPIs need forty-three files together with other data sources. The remaining 35 KPIs need other source of data alone from many organizations such as Provincial Health Office, Office of Permanent Secretary, Department of Mental Health, Bureau of Epidemiology, Department of Disease Control and Survey, etc.

Hence, the scope of this project will present the 24 Ministry of Public Health's KPIs that can use 43 files information as the only source of data for reference. The 24 KPIs are presented in business intelligence system as the following table 3.2 below,

Table 3.2 24 KPIs based on forty-three data source files.

No	KPI	Descriptions
1	1	Percentage of postpartum hemorrhage
2	2	Rate of postpartum hypoxemia
3	3	Percentage of pregnant women receiving prenatal care first before or equal to 12 weeks
4	7	Percentage of pregnant women receiving prenatal care 5 times completed
5	8	Percentage of pregnant women receiving iodine tablets
6	9	Percentage of postpartum women cared for 3 times completed
7	10	Percentage of children aged from newborn to 6 months for breastfed only
8	13	Percentage of children aged 0-2 years old with good height and good shape
9	15	Percentage of children with developmental age
10	16	Percentage of children who have tooth decay
11	18	Percentage of children aged 3-5 years old with good height and good shape
12	19	Percentage of children aged 3-5 years who received development check
13	20	Percentage of children under 3 years old who have been diagnosed with oral and they receive training to brush the teeth and get Fluorine vanish
14	21	Percentage of children aged 6-12 years old with good height and good shape
15	24	Percentage of primary school children who have been diagnosed with oral and sealants
16	27	Percentage of women aged 30-60 years old who have been accumulated to cervical cancer screening in 2014
17	28	The proportion of patients with breast cancer and cervical cancer stage 1 and 2
18	29	People aged 15 years old and above who have been screened for diabetes / hypertension not less than 90 percent
19	30	Percentage of patients with diabetes and control blood sugar levels as well
20	31	Percentage of patients with hypertension and control blood pressure as well
21	32	Percentage of patients with diabetes / hypertension with complications has been attendance or forward
22	37	Percentage of seniors who have been screened for diabetes / hypertension
23	39	Percentage of patients with diabetes and hypertension who were treated at health centers in the city and district
24	46	Percentage of patients receiving Thai medicine and standard alternative medicine

Although, all 24 KPIs are referred from 43 files data source as document [10], but when we check the information source carefully and found that 43 files for some tables does not have enough data source according to the terms of finding the KPIs answer, for example: KPIs no.13 “Percentage of children aged 0-2 years old for good height and good shape”. One of the conditions to find reference of this KPI is number of children aged 0-2 years have good shape. The 43 files do not have any tables or any fields indicating how the good shape is. So some KPIs from 24 topics cannot find the answer.

In addition, the data source are received to see that some files have data, some files do not have physical file. In the below table, we can import 13 data files into database. (As shown in green highlight in the table 3.3) Also, you can see items in orange highlight rows in the table which are files that are not received from them. In this part, we may discuss on the discussion topic. The rest that have no highlight only have header column name which are useless to be imported into the database.

Table 3.3 Checking forty-three files from the Metta Pracharak Hospital.

No.	43 Files name	Have data?	Have file?
1	ACCIDENT	Y	Y
2	ADDRESS	N	N
3	ADMISSION	Y	Y
4	ANC	N	Y
5	APPOINTMENT	Y	Y
6	CARD	N	N
7	CHARGE_IPD	Y	Y
8	CHARGE_OPD	Y	Y
9	CHRONIC	N	N
10	CHRONICFU	N	Y
11	COMMUNITY_ACTIVITY	N	Y
12	COMMUNITY_SERVICE	N	Y
13	DEATH	N	Y
14	DENTAL	N	Y
15	DIAGNOSIS_IPD	Y	Y
16	DIAGNOSIS_OPD	Y	Y
17	DISABILITY	N	Y

Table 3.3 Checking 43 Files from the Metta Pracharak Hospital. (Cont.)

No.	43 Files name	Have data?	Have file?
18	DRUGALLERGY	N	N
19	DRUG_IPD	Y	Y
20	DRUG_OPD	Y	Y
21	EPI	N	Y
22	FP	N	Y
23	FUNCTIONAL	N	Y
24	HOME	N	Y
25	ICF	N	Y
26	LABFU	Y	Y
27	LABOR	N	Y
28	NCDSCREEN	N	Y
29	NEWBORN	N	Y
30	NEWBORNCARE	N	Y
31	NUTRITION	N	Y
32	PRENATAL	N	N
33	POSTNATAL	N	Y
34	PRENATAL	N	Y
35	PROCEDURE_IPD	Y	Y
36	PROCEDURE_OPD	Y	Y
37	PROVIDER	Y	Y
38	REHABILITATION	N	Y
39	SERVICE	N	N
40	SPECIALPP	N	Y
41	SURVEILLANCE	N	Y
42	VILLAGE	N	Y
43	WOMEN	N	Y

After we found all data sources, we can summarize number of KPIs that use forty-three files source for reference. The below table is summary of some KPIs that cannot find the answer from 24 KPIs which are defined in the document [10] and they can use forty-three files as a data source for reference.

Table 3.4 Summary of KPIs that cannot determine the answer from forty-three data source files.

KPI	Sub KPI	KPI Description	Reasons to cannot finding KPI answer
1	-	Percentage of postpartum hemorrhage	No data source
2	-	Rate of postpartum hypoxemia	No data source
3	-	Percentage of pregnant women receiving prenatal care first before or equal to 12 weeks	No data source
7	-	Percentage of pregnant women receiving prenatal care 5 times completed	No data source
8	-	Percentage of pregnant women receiving iodine tablets	No data source
9	-	Percentage of postpartum women cared for 3 times completed	No data source
10	-	Percentage of children aged from newborn to 6 months for breastfed only	No data source
13	-	Percentage of children aged 0-2 years old with good height and good shape	The 43 files do not have any tables or any fields indicating how the good shape is
15	-	Percentage of children with developmental age	No data source
16	-	Percentage of children who have tooth decay	No data source
18	-	Percentage of children aged 3-5 years old with good height and good shape	The 43 files do not have any tables or any fields indicating that how the good shape is
19	-	Percentage of children aged 3-5 years old who received development check	No data source
20	20.1	Percentage of children under 3 years old, has passed the oral cavity checkup	No data source
20	20.2	Percentage of children under 3 years have passed brushing skills training	The 43 files do not have any tables or any fields indicating whose care for children under 3 years have passed brushing skills training

Table 3.4 Summary of KPIs that cannot determine the answer from forty-three data source files. (Cont.)

KPI	Sub KPI	KPI Description	Reasons to cannot finding KPI answer
20	20.3	Percentage of children under 3 years old who are at risk of tooth decay and have fluoride varnishes applied	No data source
21	-	Percentage of children aged 6-12 years old with good height and good shape	The 43 files do not have any tables or any fields indicating how the good shape is
24	24.1	Percentage of children Grade 1 for the oral examination	The 43 files do not have any tables or any fields indicating which PID is studying Grade 1
24	24.2	Percentage of children grade 1 who have been sealant in the first molar permanent tooth	The 43 files do not have any tables or any fields indicating which PID is studying Grade 1
27	-	Percentage of women aged 30-60 years old who have been accumulated to cervical cancer screening in 2014	No data source
28	28.1	The proportion of patients with breast cancer stage 1 and 2	Need data source from National Cancer Institute and result of randomized survey
28	28.2	The proportion of patients with cervical cancer stage 1 and 2	The 43 files do not have any tables or any fields indicating which stage of the cervical cancer.
29	29.1	Percentages of people aged 15-34 years who have been screened for diabetes and hypertension.	No data source
29	29.2	Percentage of people aged 35-59 years who have been screened for diabetes	The 43 files do not have any tables or any fields indicating which PID is diabetes unconsciously

Table 3.4 Summary of KPIs that cannot determine the answer from forty-three data source files. (Cont.)

KPI	Sub KPI	KPI Description	Reasons to cannot finding KPI answer
29	29.3	People aged 35-59 years old who had been screened for hypertension	The 43 files do not have any tables or any fields indicating which PID is hypertension unconsciously
30	-	Percentage of patients with diabetes and control blood sugar levels as well	No data source
31	-	Percentage of patients with hypertension and control blood pressure as well	No data source
32	-	Percentage of patients with diabetes / hypertension with complications that has been attendance or forward	No data source
37	-	Percentage of seniors who has been screened for diabetes / hypertension	No data source
39	-	Percentage of patients with diabetes and hypertension who were treated at health centers in the city and district	Data source need only data from Tambon Health Promoting Hospital
46	-	Percentage of patients receiving Thai medicine and standard alternative medicine	No data source

Therefore, if we follow the KPIs document and examine the forty-three files description that are received from the Metta Pracharak Hospital, then we cannot answer any KPIs according to the reasons in the table 3.4.

3.4.2 System Environment Preparation

This project use IBM Cognos Business Intelligence as BI tools. Therefore, preparation needs to follow IBM instruction [12]. IBM has a guideline for user to prepare environment for installation.

The BI system can be installed on virtual machine that runs on Windows platform. This way it is easy to back up and restore when there is some error during setup.

Figure 3.1 shows the overall of this project system environment. The system will be setup in one server. This server has installed 3 main applications server which are database server, Business Intelligence server and web server, all of these run on virtual machine. The 43 files as data source will be imported to database server. Finally, when this system finish developing then we can use any equipment for connecting to the BI system to view any reports or view information. The equipment that can be used for connecting includes PC, notebook, smart phone and iPad.

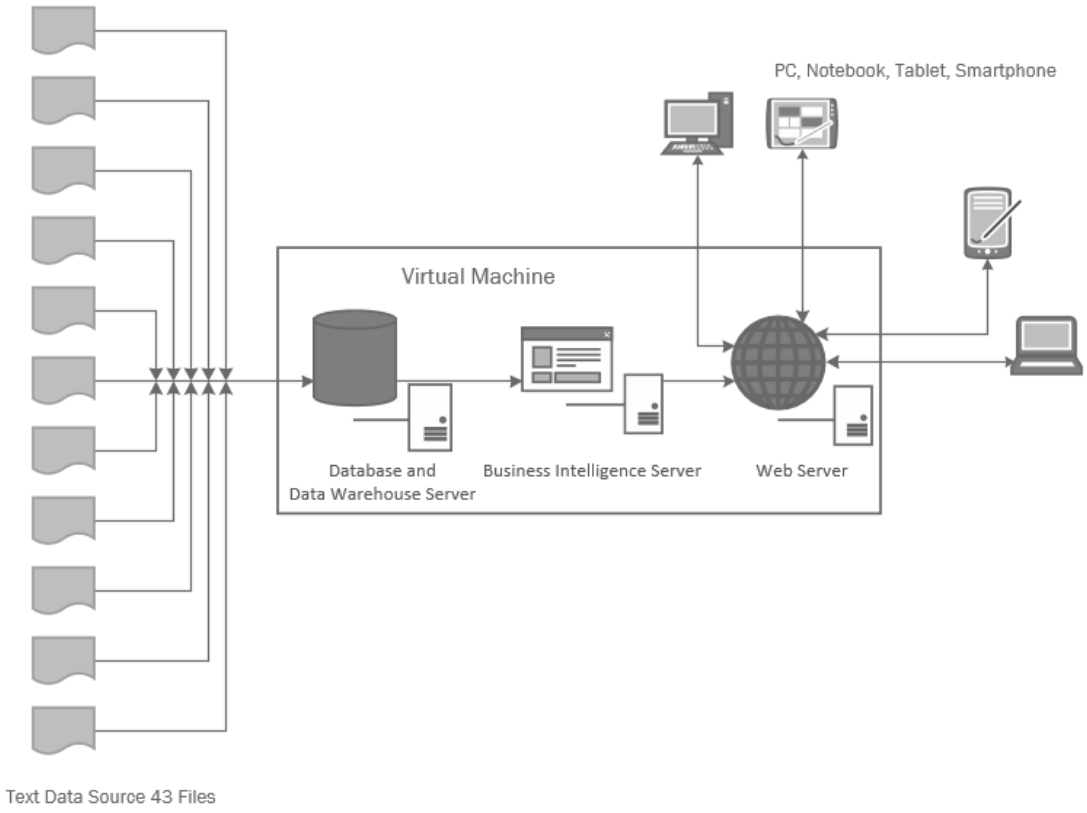


Figure 3.1 System environment overall.

3.4.3 Data Warehouse and Data Models design

The tool to be used for creating data warehouse is the 64 bit Microsoft SQL Express 2014. This database will store information of 2 major schemas which are BI software configure information and schema for store 43 files information. Since the forty-three files are structured and formatted, they are able to be imported into

database immediately as a data warehouse. This schema can use them as a data source in reference to the Ministry of Public Health's KPIs.

The tool to be used for creating data model is IBM Cognos Framework Manager. It is a part of BI software tool under IBM Cognos BI product. This tool is a metadata modeling tool for IBM Cognos Business Intelligence for reporting [19]. The forty-three files are able to setup in multi-dimensional formatted such as patient view, procedure or treatment view, service view and other view if needed. This part can use them as a data model for executive or are able to pivot or change dimension for finding some answers or some point for help in decision making.

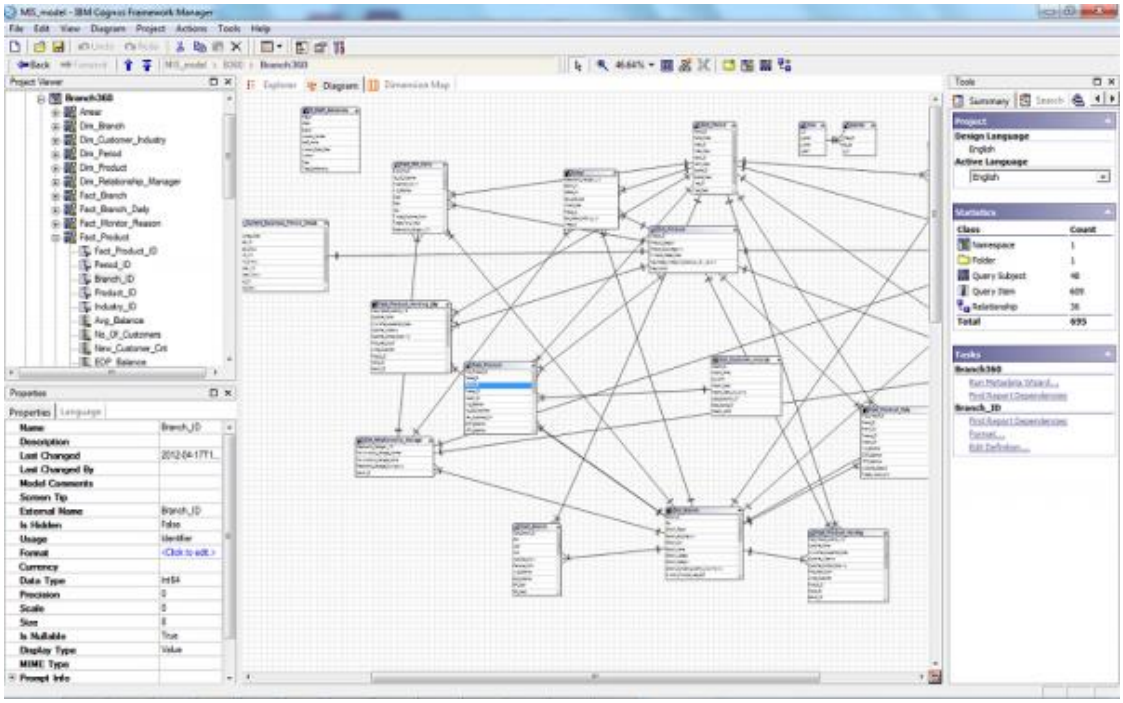


Figure 3.2 IBM Cognos Framework Manager example screenshot.

3.4.4 Business Intelligence Reports

The IBM Cognos BI reporting tool is generating chart in various formats. This part will use "Report Studio" to calculate and generate report to make it easier to answer the questions of the Ministry of Public Health's KPIs. This project will use gauge chart to compare with goal of KPIs.

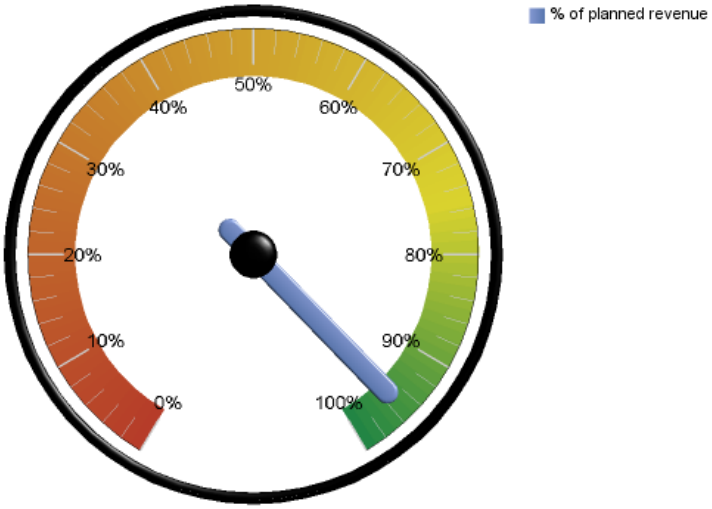


Figure 3.3 Example gauge chart generated by IBM Cognos BI tools [20].

The other part is analysis reporting. It is the component of IBM Cognos Business Intelligence and this part can be used for multidimensional analysis and exploration of large data sources. It uses the interactive drag-and-drop environment in "Analysis Studio" to explore and analyze data to find answers to business questions [21].

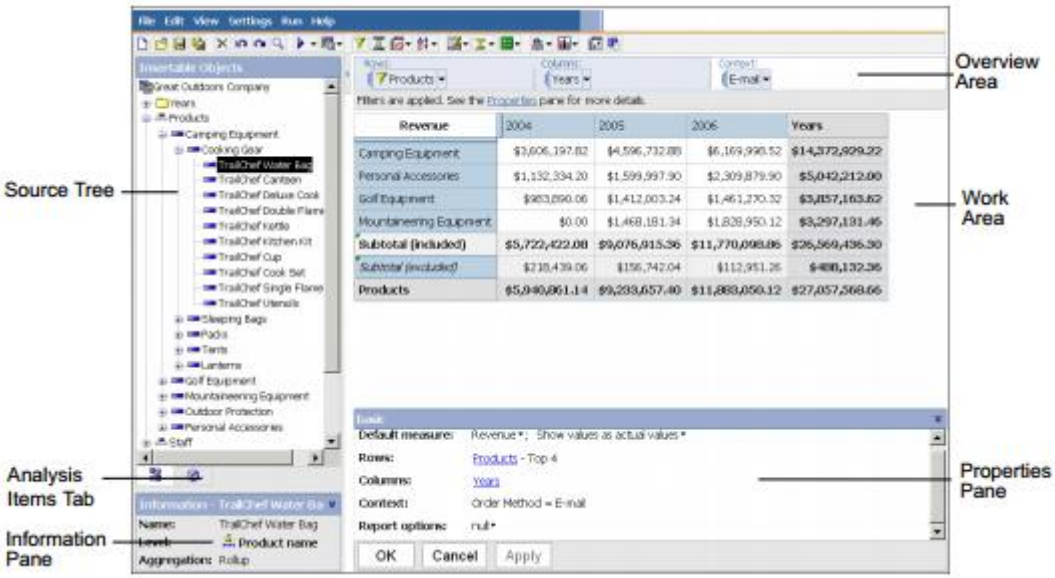


Figure 3.4 IBM Cognos Analysis Studio example screen

3.5 Research Time

The plan for implement this project is shown as below timeline,

Table 3.5 Research time.

No	Activities	Time (August 2014 - May 2015)																																					
		Aug				Sep				Oct				Nov				Dec				Jan				Feb				Mar				Apr				May			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Study 43 Files Definition																																								
2	Study 66 KPIs from the Ministry of Public Health																																								
3	Study and collect information and related theory																																								
4	Introduce to advisor and revise																																								
5	To do Thematic Paper Proposal for Examination (Chapter 1-3)																																								
6	Setup Business Intelligence Environment																																								
7	Data Warehouse and Data Modeling Design																																								
8	Data Model and Business Intelligence reports																																								
9	To do Thematic Paper Proposal for Examination (Chapter 4-5)																																								
10	Check and review the Thematic paper accuracy																																								
11	Introduce to Faculty of Graduate Studies and revise																																								

3.6 Conclusions

This chapter summarized the development tools, source of data, process implementation methods, and research time. These processes described above have been done thought out the thematic paper.

CHAPTER IV
RESULTS AND DISCUSSION

4.1 Introduction

This chapter shows the results and discussion in details according to the described procedure list of the project in Chapter III.

4.2 Importing Data Source

The data source received from the Metta Pracharak Hospital (Wat Rai Khing) has 37 of the 43 files. All are flat files of each table. We can bring them to import into the database immediately without having to create a structure of a table in database.

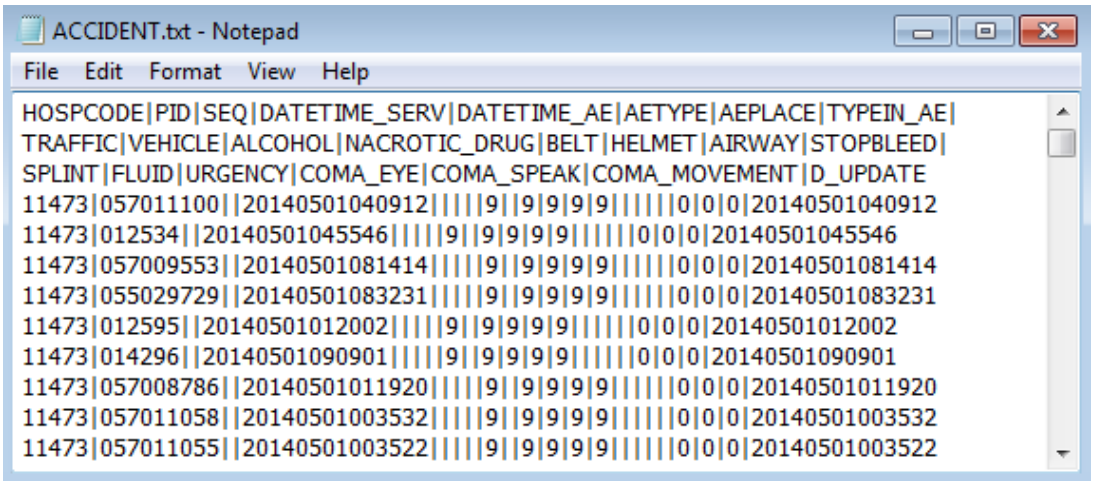


Figure 4.1 Example data source flat file "ACCIDENT.txt".

The SQL Server is the database tool that allows data of each file to be imported. First, we create database and/or schema for supporting files that we will

import. After that we can immediately import them to database. There are other database tools that have this similar feature but this tool can manage column, delimiter, data type and table name which suit our requirement. In order to maintain simplicity, we will use the same name for the table as the name in the document [10].

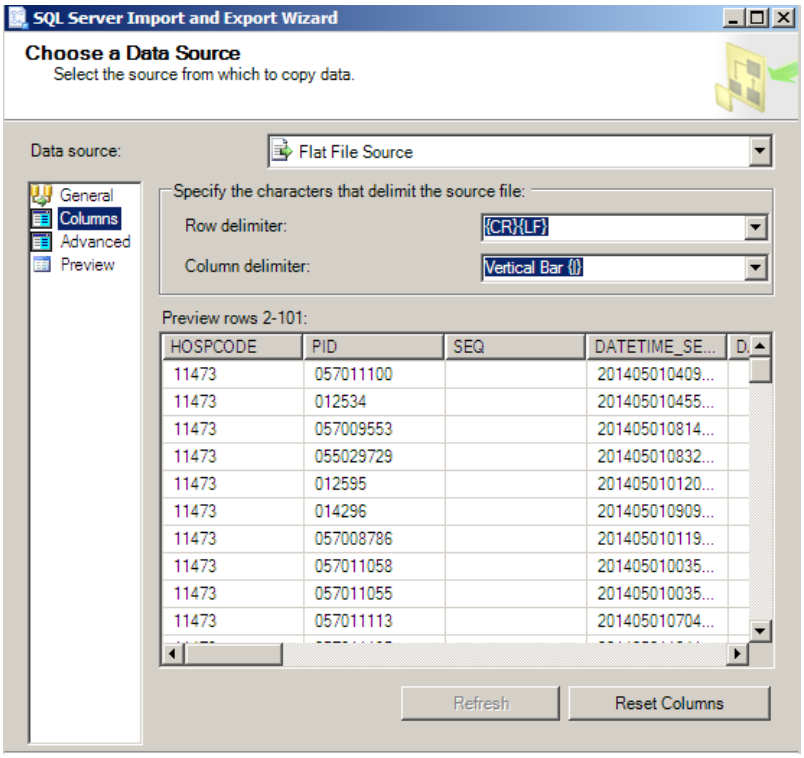
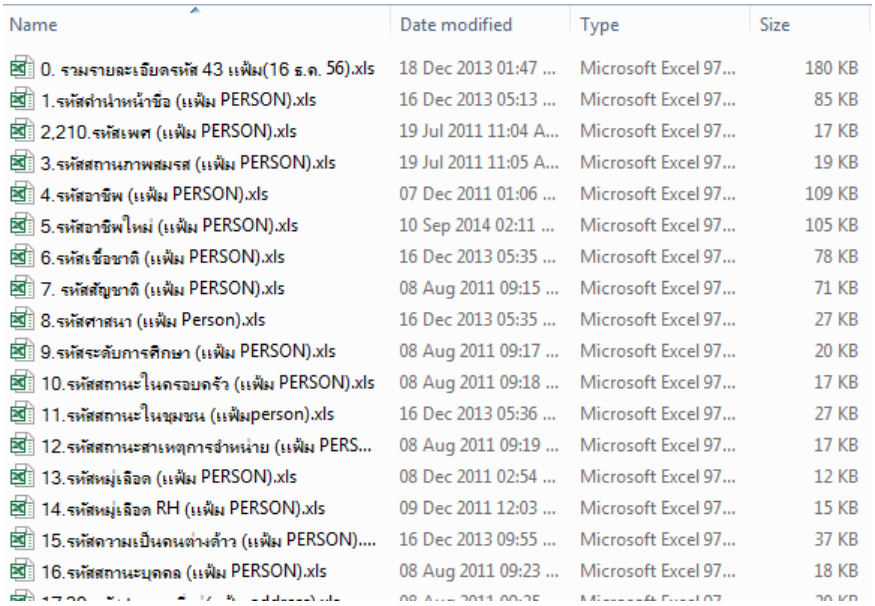


Figure 4.2 Importing flat file data source.

When the forty-three data source files imported already, we also need to import master data to find the description of each field on forty-three files. These master data file can be downloaded from Thai Health Coding Center website. (http://thcc.or.th/) We will name the table to be the same as column name of each forty-three files and put prefix “M_” in front of each name.



Name	Date modified	Type	Size
0. รวมรายละเอียดรหัส 43 แฟ้ม(16 ธ.ค. 56).xls	18 Dec 2013 01:47 ...	Microsoft Excel 97...	180 KB
1.รหัสคำนำหน้าชื่อ (แฟ้ม PERSON).xls	16 Dec 2013 05:13 ...	Microsoft Excel 97...	85 KB
2.210.รหัสเพศ (แฟ้ม PERSON).xls	19 Jul 2011 11:04 A...	Microsoft Excel 97...	17 KB
3.รหัสสถานภาพสมรส (แฟ้ม PERSON).xls	19 Jul 2011 11:05 A...	Microsoft Excel 97...	19 KB
4.รหัสอาชีพ (แฟ้ม PERSON).xls	07 Dec 2011 01:06 ...	Microsoft Excel 97...	109 KB
5.รหัสอาชีพใหม่ (แฟ้ม PERSON).xls	10 Sep 2014 02:11 ...	Microsoft Excel 97...	105 KB
6.รหัสเชื้อชาติ (แฟ้ม PERSON).xls	16 Dec 2013 05:35 ...	Microsoft Excel 97...	78 KB
7. รหัสสัญชาติ (แฟ้ม PERSON).xls	08 Aug 2011 09:15 ...	Microsoft Excel 97...	71 KB
8.รหัสศาสนา (แฟ้ม Person).xls	16 Dec 2013 05:35 ...	Microsoft Excel 97...	27 KB
9.รหัสระดับการศึกษา (แฟ้ม PERSON).xls	08 Aug 2011 09:17 ...	Microsoft Excel 97...	20 KB
10.รหัสสถานะในครอบครัว (แฟ้ม PERSON).xls	08 Aug 2011 09:18 ...	Microsoft Excel 97...	17 KB
11.รหัสสถานะในชุมชน (แฟ้มperson).xls	16 Dec 2013 05:36 ...	Microsoft Excel 97...	27 KB
12.รหัสสถานะสาเหตุการจำหน่าย (แฟ้ม PERS...	08 Aug 2011 09:19 ...	Microsoft Excel 97...	17 KB
13.รหัสหมู่เลือด (แฟ้ม PERSON).xls	08 Dec 2011 02:54 ...	Microsoft Excel 97...	12 KB
14.รหัสหมู่เลือด RH (แฟ้ม PERSON).xls	09 Dec 2011 12:03 ...	Microsoft Excel 97...	15 KB
15.รหัสความเป็นคนต่างด้าว (แฟ้ม PERSON)....	16 Dec 2013 09:55 ...	Microsoft Excel 97...	37 KB
16.รหัสสถานะบุคคล (แฟ้ม PERSON).xls	08 Aug 2011 09:23 ...	Microsoft Excel 97...	18 KB

Figure 4.3 Master data files when you are download and extract them.

After finish importing data, we have found the result as shown in below picture,

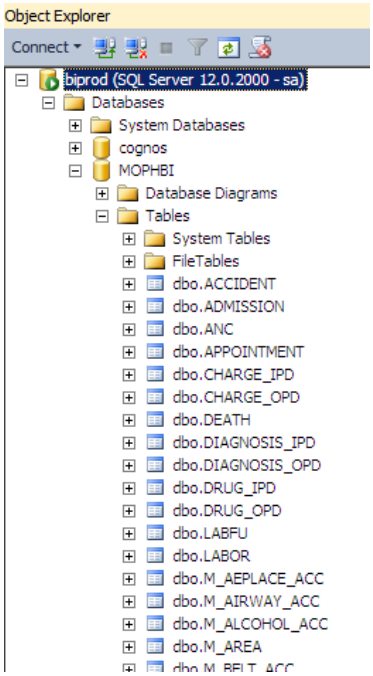


Figure 4.4 Import data result.

4.3 Data modeling and package

In previous section, we have data source imported like data warehouse. We can use them to create data modeling and package to be used with BI tools. According to the mapping data source received section in the chapter 3, we found that there is only one KPI that can be used as a reference. For this reason, we will generate more example of some data as data source in reference to the KPIs. We generate example data for LABOR and ANC file in reference to the KPI number 1, 2 and 3. The table 4.1 is the summarized mapping of 43 files in reference to the KPIs.

Table 4.1 Summarized mapping of forty-three files in reference to the KPIs.

KPI	Sub KPI	KPI Description	Mapping with Forty-three files
1	-	Percentage of postpartum hemorrhage	LABOR
2	-	Rate of postpartum hypoxemia	LABOR
3	-	Percentage of pregnant women who received prenatal care first before or equal to 12 weeks	ANC
7	-	Percentage of pregnant women who received prenatal care 5 times completed	ANC LABOR
8	-	Percentage of pregnant women who received iodine tablets	DRUG_OPD ANC
9	-	Percentage of postpartum women who have been cared for 3 times completed	LABOR POSTNATAL
10	-	Percentage of children aged from newborn to 6 months for breastfed only	NEWBORN NEWBORN_CARE
13	-	Percentage of children aged 0-2 years old with good height and good shape	PERSON NUTRITION
15	-	Percentage of children with developmental age	PERSON NUTRITION
16	-	Percentage of children who have tooth decay	PERSON DENTAL
18	-	Percentage of children aged 3-5 years old with good height and good shape	PERSON NUTRITION
19	-	Percentage of children aged 3-5 years receiving development check	PERSON NUTRITION
20	20.1	Percentage of children under 3 years old who have passed oral cavity checkup	PERSON DENTAL

Table 4.1 Summarize mapping of 43 files for answer the KPIs. (Cont.)

KPI	Sub KPI	KPI Description	Mapping with 43 files
20	20.2	Percentage of children under 3 years old who have passed brushing skills training	PERSON DENTAL
20	20.3	Percentage of children under 3 years old who are are at risk of tooth decay and have fluoride varnishes applied	PERSON DENTAL
21	-	Percentage of children aged 6-12 years old with good height and good shape	PERSON NUTRITION
24	24.1	Percentage of children Grade 1 who passed the oral examination	PERSON DENTAL
24	24.2	Percentage of children grade 1 who have been sealant in the first molar permanent tooth	PERSON DENTAL
27	-	Percentage of women aged 30-60 years who have been accumulated to cervical cancer screening in 2014	PERSON APPOINTMENT
28	28.1	The proportion of patients with breast cancer stage 1 and 2	DIAGNOSIS_OPD DIAGNOSIS_IPD
28	28.2	The proportion of patients with cervical cancer stage 1 and 2	DIAGNOSIS_OPD DIAGNOSIS_IPD
29	29.1	Percentage of people aged 15-34 years old who have been screened for diabetes and hypertension.	PERSON NCDSCREEN
29	29.2	Percentage of people aged 35-59 years old who have been screened for diabetes	PERSON NCDSCREEN
29	29.3	People aged 35-59 years old who have been screened for hypertension	PERSON NCDSCREEN
30	-	Percentage of patients with diabetes and control blood sugar levels as well	DIAGNOSIS_OPD LABFU
31	-	Percentage of patients with hypertension and control blood pressure as well	SERVICE, DIAGNOSIS_OPD LABFU
32	-	Percentage of patients with diabetes / hypertension with complications and have been attendance or forward	SERVICE DIAGNOSIS_OPD
37	-	Percentage of seniors who have been screened for diabetes / hypertension	PERSON SERVICE LABFU

Table 4.1 Summarize mapping of 43 files for answer the KPIs. (Cont.)

KPI	Sub KPI	KPI Description	Mapping with 43 files
39	-	Percentage of patients with diabetes and hypertension who were treated at health centers in the city and district	DIAGNOSIS_OPD
46	-	Percentage of patients receiving Thai medicine and standard alternative medicine	DIAGNOSIS_OPD PROVIDER

As expained in Chapter III, we use IBM Cognos BI as a BI tool in this project. The Cognos tool that is used to create data modeling and package is called "Framework Manager". This project can be divided into 2 parts which are KPIs answer part and analysis part. According to the Framwork Manager, when we created any packages, we will get physical file (*.cpf extension file). It is easy to backup and apply this file for other machine which is considered an advantage. We separate 2 packages for different purposes as explianed below,

4.3.1 Package for answering the KPIs

The purpose of this package is to answer the KPIs. So we can do something in order to have enough information to answer the KPI. This procedure is quite simple. We create view from database tool in order to have enough information such as criteria to be selected by user in the report including months, years, provinces, districts, health organization type, hospital name, etc. The below picture is an example 3 views for answering the KPI,

Results | Messages

	HOSPCODE	HOS_NAME	PID	EDC	BRESULT	YEAR	MONTH	STAV1	LBORN	STAV2	PROVINCE	DISTRICT	ORG_TYPE	UND_TYPE	REGION
1	11699	โรงพยาบาลบำรุงราษฎร์	10000	20130903	O80	2013	09	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
2	11699	โรงพยาบาลบำรุงราษฎร์	10001	20130904	O80	2013	09	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
3	11699	โรงพยาบาลบำรุงราษฎร์	10002	20130905	O80	2013	09	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
4	11699	โรงพยาบาลบำรุงราษฎร์	10003	20130906	O80	2013	09	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
5	11699	โรงพยาบาลบำรุงราษฎร์	10004	20130907	O80	2013	09	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
6	11699	โรงพยาบาลบำรุงราษฎร์	10005	20130908	O80	2013	09	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
7	11699	โรงพยาบาลบำรุงราษฎร์	10096	20131208	O80	2013	12	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
8	11699	โรงพยาบาลบำรุงราษฎร์	10097	20131209	O80	2013	12	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
9	11699	โรงพยาบาลบำรุงราษฎร์	10098	20131210	O80	2013	12	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก
10	11699	โรงพยาบาลบำรุงราษฎร์	10099	20131211	O80	2013	12	0.05	1	25	10-กรุงเทพมหานคร	39-บอกวันนา	15-โรงพยาบาลเอกชน	29000-เอกชน	กรุงเทพปริมณฑลและตะวันออก

Figure 4.5 Information on LABOR view for answering the KPI.

4.3.1.1 Percentage of postpartum hemorrhage

This KPI has details following as,

Table 4.2 Details of KPI 1.

KPI formula	(A/B)*100 A = Number of pregnant women with severe hemorrhage after vaginal delivery and cesarean section. B = All births in the same period time.
KPI Value	Not over 5%

Table 4.3 View "LABOR_KPI" information.

Column Name	**Description**
HOSPCODE	Hospital Code
HOS_NAME	Hospital Name
PID	Personal ID
EDC	Date of deliver
BRESULT	Birth result based on ICD10-TM
YEAR	Year of data
MONTH	Month of Data (Based on year data)
STAV1	Static value for KPI 1 used for calculation (0.05)
LBORN	Number of live child after deliver
STAV2	Static value for KPI 2 used for calculation (25)
PROVINCE	Hospital province address
DISTRICT	Hospital district address
ORG_TYPE	Organization type of hospital
UND_TYPE	Hospital is under which organization
REGION	Hospital region address

4.3.1.2 Rate of postpartum hypoxemia

This KPI uses data for LABOR_KPI view.

Table 4.4 Details of KPI 2.

KPI formula	(A/B)*1,000 A = Number of newborns who have apgar score at 1 minute >= 7 or birth result based on ICD10-TM are P210, P211 or P219 B = All live child after deliver
KPI Value	Not over 25 per 1000 live child newborns

4.3.1.3 Percentage of pregnant women receiving prenatal care first before or equal to 12 weeks

This KPI has details following as,

Table 4.5 Details of KPI 3.

KPI formula	(A/B)*100 A = Number of pregnant women who have first antenatal care in the hospital by gestational age before or equal 12 weeks B = All of pregnant women who have first antenatal care in the hospital
KPI Value	Not over 60%

Table 4.6 View "ANC_KPI" information.

Column Name	**Description**
HOSPCODE	Hospital Code
PID	Personal ID
YEAR	Year of data
MONTH	Month of Data (Based on year data)
GRAVIDA	Pregnant No.
GA	Gestational age
STAV	Static value for KPI 1 use for calculation (0.6)

Table 4.6 View "ANC_KPI" information. (Cont.)

Column Name	Description
PROVINCE	Hospital province address
DISTRICT	Hospital district address
ORG_TYPE	Organization type of hospital
UND_TYPE	Hospital is under which organization
REGION	Hospital region address

All the previous sections show details of source for creating package in the Framework Manager. The view that is prepared in SQL Server can be deployed immediately. So we imported all views and create package to be used in BI report in reference to the KPIs. According to below picture, we create package named "KPI_MOPH_43FILES".

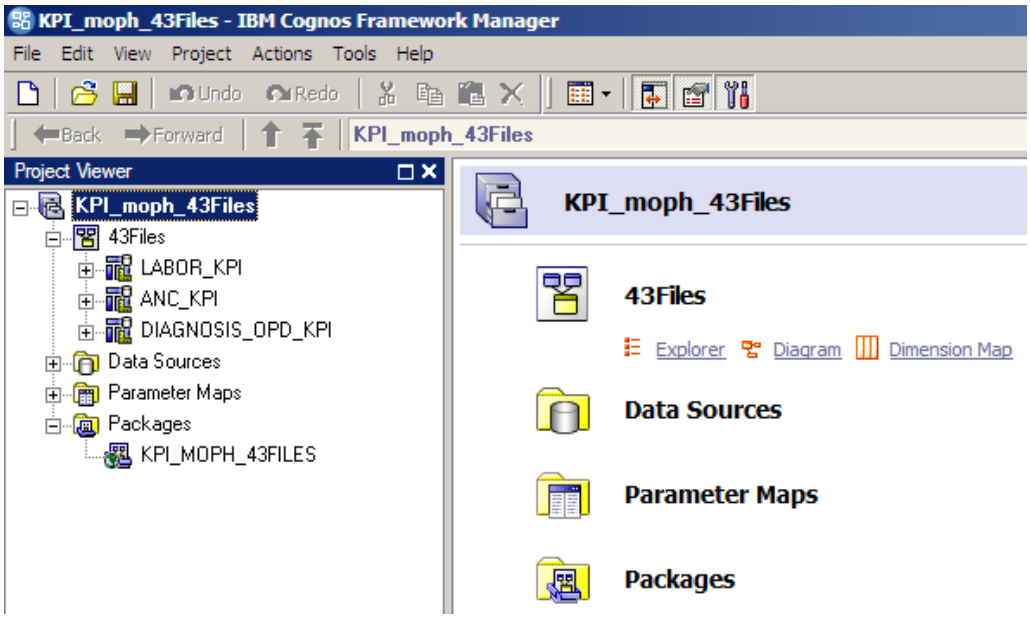


Figure 4.6 Package for answer the KPIs.

4.3.2 Package for analysis report

The package concept is data dimension for analysis in the report. Each dimension was caused by some tables in the database. First, we need to know what perspective that we want in the report. In this project, we need to analyze cost, service

price that patient paid and price for service, drugs or medical equipment that cannot be claimed in the hospital. The perspective of this analysis report is prepared as explained below,

4.3.2.1 Time

Time data can be categorized by Year, Quarter and Month. The data source is "M_CALENDAR" table.

Table 4.7 Table "M_CALENDAR" information.

Column Name	Description
ID	Calendar ID concatenate between year and month
YEAR	Year of data
QUARTER	Quarter of data
MONTH	Month of Data

4.3.2.2 Area

Area of the hospital can be categorized by Region, Province and District. The data source is "M_AREA" table.

Table 4.8 Table "M_AREA" information.

Column Name	Description
AMP_CODE	District code
PROV_CODE	Province code
AMP_T	District name
PROV_T	Province name
ZONE_T	Region code
REGION_T	Region name

4.3.2.3 Fee charge

The fee charge type is recorded when patients are attending at the hospital. The data source is "M_ FEE_CHARGE" table.

Table 4.9 Table "M_FEE_CHARGE" information.

Column Name	Description
FCODE	Fee code
FDESC	Fee name

4.3.2.4 Health security type

The health security type lists the claim type for patients. The data source is "M_INSTYPE_ADM" table.

Table 4.10 Table "M_ INSTYPE_ADM" information.

Column Name	Description
INCODE	Health security code
INDESC	Health security name

4.3.2.5 Ward / Department

The ward hierarchy is the list of department in the hospital that patients are attending. The data source is "M_WARD_CLINIC_ADM_APP" table.

Table 4.11 Table "M_WARD_CLINIC_ADM_APP" information.

Column Name	Description
W_CODE	Ward / Department code
W_DESC	Ward / Department name

4.3.2.6 Organization type

Organization type is the list of hospital type. The data source is "HEALTH_ORG_INFO" view.

Table 4.12 View "HEALTH_ORG_INFO" information.

Column Name	Description
HOS_CODE	Hospital code
HOS_NAME	Hospital name

Table 4.12 View "HEALTH_ORG_INFO" information. (Cont.)

Column Name	Description
ORG_TYPE	Organization type of hospital
UND_TYPE	Hospital is under which organization
BED_NO	Number of bed
STATUS	Hospital status
ADDRESS	Hospital address
PROVINCE	Hospital province address
DISTRICT	Hospital district address
MOO	Hospital moo address
HOS_CODE_OLD	Hospital code (This reference code is still used in 43 files.)
ORG_NETWORK	Hospital network
SERVICE_LEVEL	Level of treatment
OPENED_DATE	The opening of the hospital
ORG_SIZE	Hospital Size (Small, Medium, Large)
SERVICE_AREA	Service areas of the hospital

4.3.2.7 Measure

The measure needs to be analyzed. In this project, we need to analyze cost, service price that patient paid and price for service, drugs or medical equipment that cannot be claimed in the hospital which occur by attending Out Patient Department (OPD) in the hospital. The data source is "CHARGE_OPD_ANALYSIS" view which are created from the table "CHARGE_OPD" in 43 files.

Table 4.13 View "CHARGE_OPD_ANALYSIS" information.

Column Name	Description
HOS_CODE	Hospital code
PID	Personal ID
MONTH_SERVICE	Service month (Format is "YYYYMM")
WARD	Ward / Department code
CHARGEITEM	Medical equipment for patients to be used and recorded the expense of the patient to pay
QUANTITY	Quantity of medical equipment
INSTYPE	Claim type

Table 4.13 View "CHARGE_OPD_ANALYSIS" information. (Cont.)

Column Name	Description
COST	Cost, including medications, medical supplies and medical service
PAY	Price, including medications, medical supplies and medical service
PAYPRICE	The amount charged because the costs are not reimbursable

We imported these tables and views into the Framework Manager. In order to make it easier to manage data and content, we separate them into 2 parts which are Analysis_Src and Presentation Layer.

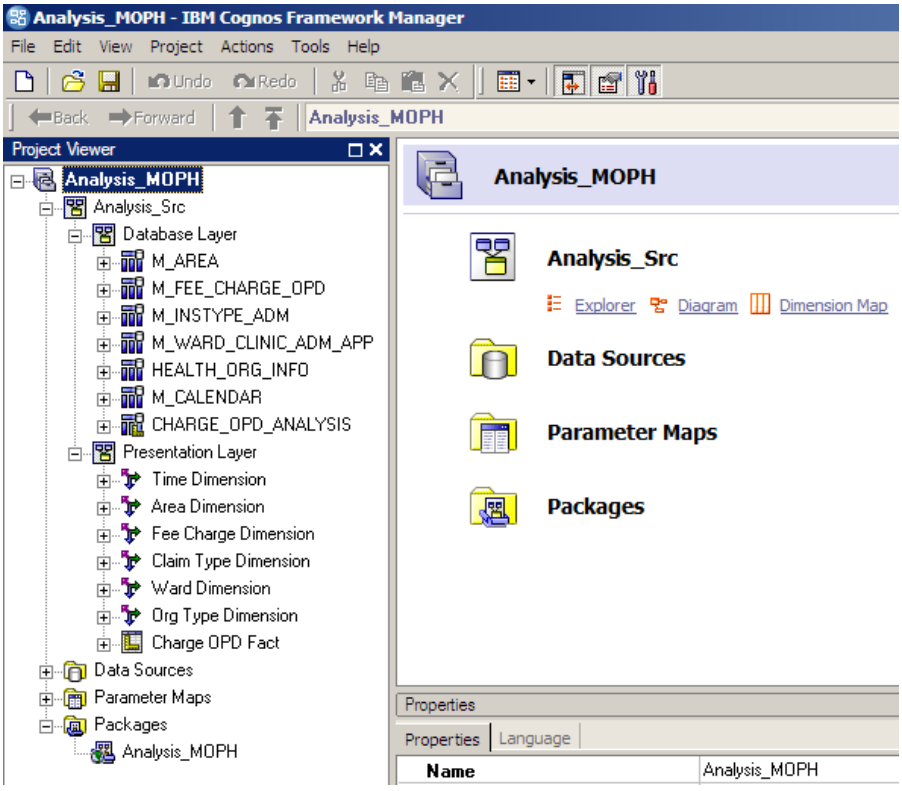


Figure 4.7 Package for analysis report.

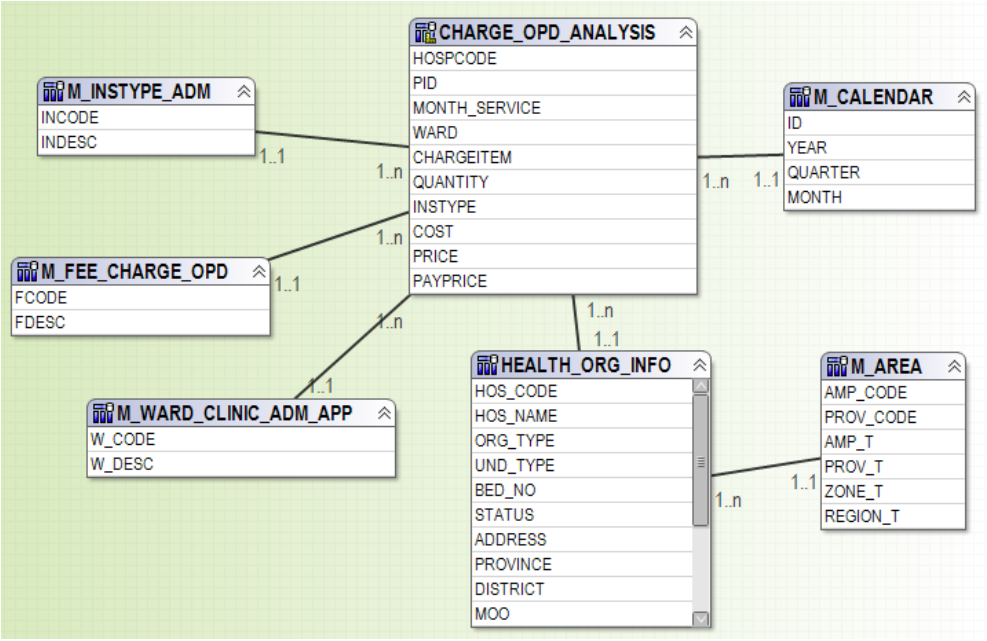


Figure 4.8 Analysis diagram.

4.4 Business Intelligence Reports

After finish creating packages for generating reports on the BI system in previous part, we separate them into 2 parts which are KPI report and Analysis report as below,

4.4.1 KPI reports

The KPI reports of this project are created by Report Studio tool. The design concepts of these reports are simple in order to read and understand meaning of number on the report. Besides, we are able to choose details of criteria on report. There are 3 areas of KPI reports as below,

4.4.1.1 Upper area

We generated 6 drop-down list criteria which are Year, Month, Organization type, Region, Province and District including Finish button. The Month dropdown-list is subcategory of year data. The district dropdown-list is subcategory of province and region.

4.4.1.2 Middle area

The middle area is presented using gauge chart format including 2 pointers. The blue pointer represents the actual value of the data source and the red pointer represents the KPI value of each KPI.

4.4.1.3 The bottom area

The bottom area shows explanation in text which represents values of the blue and red pointer.

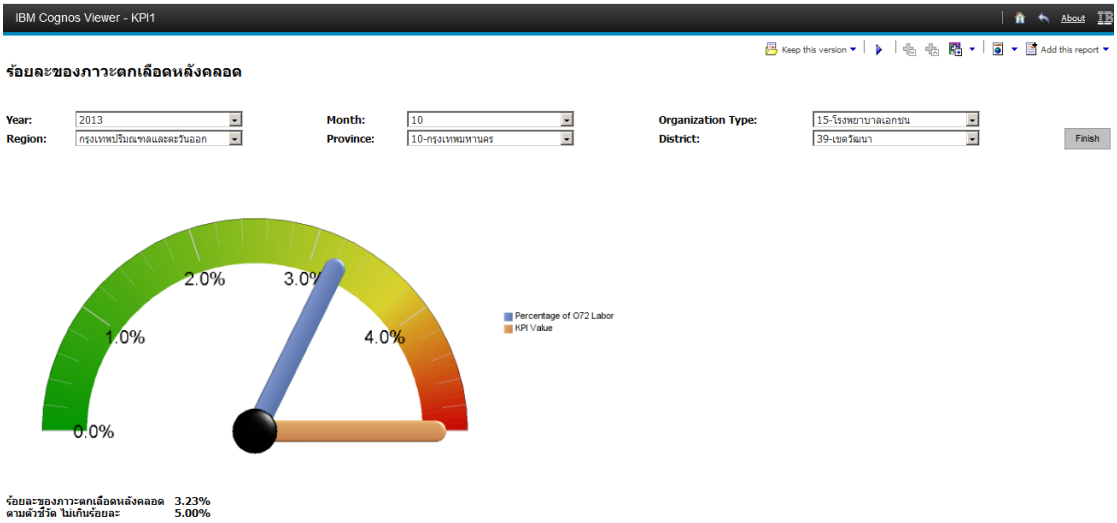


Figure 4.9 Result of KPI number 1.

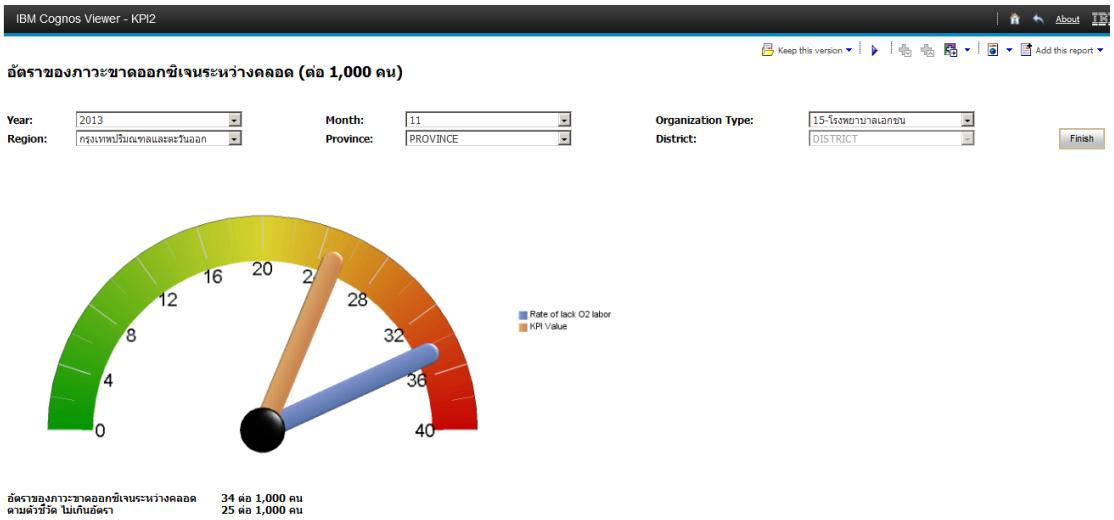


Figure 4.10 Result of KPI number 2.

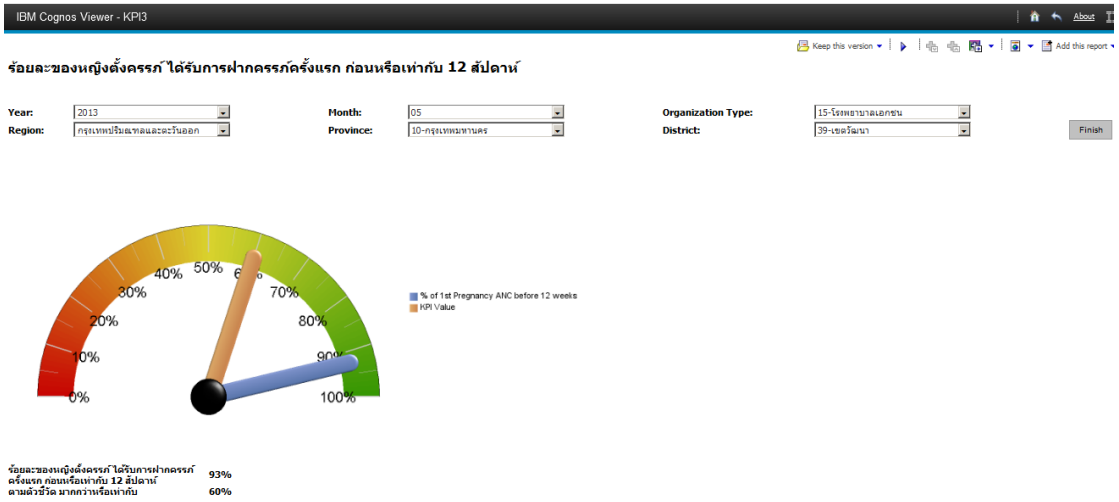


Figure 4.11 Result of KPI number 3.

4.4.2 Analysis reports

The analysis report of this project is created by Analysis Studio tool. The design concept of this report is simple in order to read and easy to move data dimension to view different meaning of information. This tool allows drag dimension data which are stacked in the row and column. Besides, the report users can swop row and column as they want. Including they can drill-down and drill-up each dimension based on the available information.

The below analysis report is Charge OPD analysis report. The meaning of this report is to analyze cost (COST), service price that patient paid (PRICE) and price for service, drugs or medical equipment that cannot be claimed in the hospital (PAYPRICE) by ward or department of the hospital and by organization type and by time period.

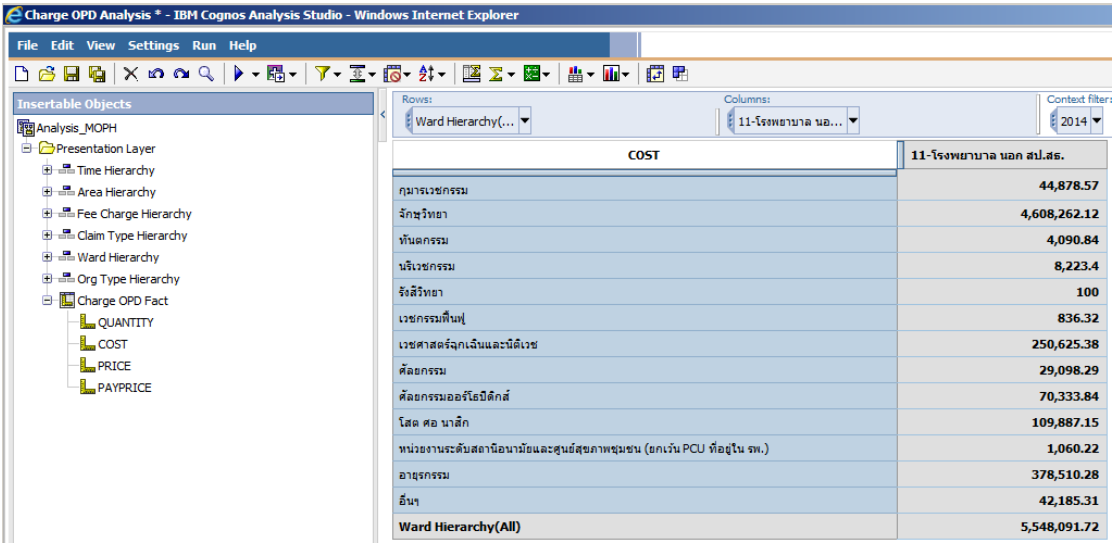


Figure 4.12 Charge OPD analysis report.

4.5 Conclusion

This chapter presents how to import data source, how to create data modeling and package and how to create and design concept of business intelligence reports.

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusions

Implementing BI is used to analyze the data to view the information in the past. It will help us to understand the possibilities of what can be the problem and how to fix it. However, before we do that we must have complete and accurate information and good data processing to achieve. In this project, we found some issues and some questions about forty-three data source files for answer KPIs of the Ministry of Public Health in Thailand. I will explain in the following below topics as,

1) The forty-three data source files don't have some data of each health organization. There is a possible that each health organization has different approaches to treatment. Example, Metta Pracharak Hospital (Wat Rai Khing) is eye specialized hospital. Some hospital is first-level hospitals which only treat the underlying disease such as a cold, headache, fever, cough and so on. Whenever they found patients with complex diseases and no specialist in the hospital. It has to be forwarded to the hospital with the availability of the treatment. The information or data about this case of patient will not found in the system.

2) There is some possible that patient will have medical record in many hospitals. Some patients treat with a doctor in this time. Then the doctor move to work at another hospital. The patient may move from old hospital to treat at the hospital that doctor is working. So, counting the patients in each hospital nationwide. The information is not accurate when collect data from the total number of patients across the country. Because of each hospital keep patient records separately. This reason causes the records of the patient redundancy. We may found the population of the patients more than the total actual population of the country. Including we cannot expect the data from any hospitals to keep the unique record.

3) For some KPIs need information that is not forty-three files. Example the KPI named percentage of child that has good height and good shape. We need

information extended for tell us that how child is good shape and specific number of are appropriate height and weight for each age range of child. This information need to be store in the system, not be in the paper.

4) The forty-three files are used to answer KPIs less than half of them. Beside the most of KPIs need information from survey, other systems and information from other organization which is related. Example information from Provincial Health Office, Bureau of Health Administration, Department of Mental Health, National Cancer Institute, Healthcare Accreditation Institute (Public Organization) and so on including information from CMI database and GFMIS system. It can be seen that we need multiple data sources for answer the 66 KPIs.

5) To continue from 4, for many other data sources that use people to record the data. There is a possibility human error will occur. So the information does not match the actual data in reality. When there is more information. The analysis or answer questions of KPIs may be incorrect.

5.2 Recommendations

Back to basic of the data collection for the answer the KPI. We need to know how to store data in order to get good information. We would like to suggest in the context of how to bring public health data that use to answer KPIs based on the good data collection including systems and data suitable for analysis and planning as follows,

1) The accuracy of the information, according to what we explained in the previous topic about other data sources besides forty-three files. Especially data sources that use people to record the data. We can automate these manual activities. Example survey information, at the present time online survey is more popular than before. Because it is easy to manage and bring them apply to the other activities. Example to find some values in statistics, to be integrated with other information including calculation.

2) The information is always updated. We mean that each health organization should have own database, data warehouse and health system support.

The system should be the same for all health organizations. All of system should be stable and always available in order to get the correct information and forward them to the competent authority immediately without people to resolve or to do manually. People should do only maintenance the system to be available.

3) The complete of the information, in term of the complete of the forty-three files information should have extension information for calculate the answer of KPIs, for example, the measurement of children's growth as we explained in the previous section.

4) The information must credibility and verifiable. The forty-three data source files have a numerical data such as cost and price of OPD/IPD charge. This information should reconcile with source system before sending these information to the others. Besides combining multiple data source into a single place will help to make it easier to verify the information and manage information more effectively.

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BIOGRAPHY

NAME	Mr. Paiboon Udomkaewkanchana
DATE OF BIRTH	December 28, 1983
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Mahidol University, 2003-2007 Bachelor of Engineering (Computer Engineering) Mahidol University, 2013-2015 Master of Science (IT Management)
HOME ADDRESS	48/124 m.5 Bangkruai Nontaburi Thailand E-mail : illusion_j@hotmail.com
EMPLOYMENT ADDRESS	Krungthai Bank Public Company Limited 10 Sukhumvit Klongtoey Bangkok