INTEGRATION OF MEDICAL CLAIM PROCESSING SYSTEMS FOR NATIONAL HEALTH SECURITY OFFICE

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INTEGRATION OF MEDICAL CLAIM PROCESSING SYSTEMS FOR NATIONAL HEALTH SECURITY OFFICE

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ABSTRACT

Medical claims processing is a system that processes data of patients and medical reimbursement payments to the health service providers enrolled with the National Health Security Office of Thailand (NHSO). This research presented the problems found in the sub-system of medical claims processing including data processing, DRG Grouping, process of medical reimbursement calculation, and process of medical reimbursement payment to the health service providers. This research placed emphasis on the development of business process, application, information, and technology based on the management of enterprise architecture under the TOGAF Framework, following the NHSO's 4th development master plan. Data sets of patients making claim requests in each fiscal year had been prepared. Additionally, the budget figures for outsourcing were estimated, including the budget for system development. All such data would be statistically processed in accordance with the problems found to demonstrate an increased performance of the system after it had been developed based on the principle of enterprise architecture. The results from the analysis indicated that after the business process had been improved, processing time of all systems reduced considerably by 70 percent. The success rate of medical reimbursements made to the health service providers increased by over 10 percent due to the improvement of the medical reimbursement calculation and report-issuing system along with the decreased budget for driving the process. With the limitation of budget data collection, the researcher simply multiplied the service charge of data processing by the number of patients to show the budget amount of outsourcing. The NHSO required the agency to manage the medical claims processing in the episodic care department, which would also serve as an integration guideline for the department of continuous care in the future.

KEY WORDS : ENTERPRISE ARCHITECTURE / SECURITY HEALTHCARE / MEDICAL CLAIM PROCESSING

100 pages

การบูรณาการระบบประมวลผลการเบิกจ่ายชดเชยค่าบริการทางการแพทย์ของสำนักงานหลักประกันสุขภาพแห่งชาติ

INTEGRATION OF MEDICAL CLAIM PROCESSING SYSTEMS FOR NATIONAL HEALTH SECURITY OFFICE

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บทคัดย่อ

ระบบประมวลผลชดเชยค่าบริการทางกาแพทย์เป็นระบบที่ใช้ในการประมวลผลข้อมูลผู้ป่วยและทำการจ่ายเงินชดเชยค่าบริการคืนให้กับหน่วยบริการที่สังกัดสำนักงานหลักประกันสุขภาพแห่งชาติ กล่าวถึงสภาพปัญหาที่พบในระบบ จากกระบวนการย่อยภายในระบบที่ประกอบไปด้วยกระบวนการประมวลผล, กระบวนการทำ DRG Grouping, กระบวนการคำณวนเงินเพื่อจ่ายชดเชยค่าบริการทางการแพทย์และกระบวนการจ่ายเงินชดเชยคืนให้กับหน่วยบริการ

ในงานวิจัยชิ้นนี้มุ่งเน้นที่การพัฒนา Business Process, Application, Information and Technology ตามแนวคิดการบริหารจัดการสถาปัตยกรรมองค์กรที่อ้างอิงกับ TOGAF Framework เพื่อให้เป็นไปตามนโยบายแผนแม่บทฉบับที่4 ได้มีการวางแผนเก็บข้อมูลเพื่อใช้ในการวัดประสิทธิภาพการทำงานด้วยตัวชี้วัด เพื่อนำเข้ากระบวนการทางสถิติ ที่สอดคล้องกับสภาพปัญหาที่พบ เพื่อแสดงให้เห็นถึงประสิทธิภาพที่เพิ่มขึ้นของระบบ ภายหลังจากการพัฒนาระบบตามหลักการการบริหารจัดการองค์กร

จากกระบวนการวิเคราะห์ข้อมูลในงานวิจัยพบว่าภายหลังจากการปรับปรุงกระบวนการทางธุรกิจ ระยะเวลาในการประมวลผลของทั้งระบบลดลงมากกว่า 70% ,อัตราความสำเร็จในการชดเชยค่าบริการทางการแพทย์ให้กับหน่วยบริการเพิ่มมากขึ้น 10% จากการปรับปรุงกระบวนการคำณวนเงินชดเชยค่าบริการและระบบออกรายงาน รวมถึงงบประมาณที่ใช้ในการขับเคลื่อนกระบวนการที่ลดลง แต่เนื่องจากข้อจำกัดในการเก็บข้อมูลงบประมาณ ทางผู้วิจัยได้ออกแบบการวิเคราะห์โดยใช้ชุดข้อมูลผู้ป่วยในมาคำณวนเทียบกับอัตราค่าบริการประมวลผลของหน่วยงานภายนอกเพื่อสะท้อนงบประมาณที่จัดจ้างหน่วยงานภายนอก สำหรับระบบประมวลผลชดเชยค่าบริการทางกาแพทย์ในส่วนงาน Episodic care เพื่อเป็นแนวทางในการบูรณาการส่วนงาน Continuous care ให้เป็นไปในแนวทางเดียวกันในอนาคต

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CHAPTER I
INTRODUCTION

Integration of Medical Claim Processing Systems for National Health Security Office (NHSO)

1.1 Introduction

National Health Security Office (NHSO) is a public organization under the supervision of the Ministry of Public Health pursuant to the National Health Security Act. Its missions are to manage the health security fund for the medical service providers (the hospitals enrolled to NHSO) and provide the health services to the Thai people with maximum benefits. This research puts its emphasis on the medical claim processing from the health care units, as this processing is related to the NHSO's visions and key to health security fund management for the maximum benefits to the Thai people.

The medical claims processing can be divided into two categories based on information architecture and health care services calculation methods. Such categories include Episodic Care department and Continuous Care department. In fact, the National Health Security Office has developed some part of the information technology system used by the Episodic Care department. In addition, this research presents the roadmap of medical claims processing with co-integration between the Episodic Care department and the Continuous Care department based on gap analysis and solution in accordance with the enterprise architecture principles.

The medical claim processing for the departments begins with receiving patient's information files from the medical service providers and then being processed. The processing categorizes the patients and sorts out the medical claims based on the medical claim conditions. Subsequently, the processed information is forwarded to the funds for the calculation of medical service charges and the summary

of medical service reimbursement based on the conditions of each fund would be issued. Finally, all reports are considered by the executive for approval of reimbursement to be given to the medical service units.

1.2 Problem Statements

The medical claims processing effective in 2008 had the repetitive sub-process and required a longer time for processing which caused the problems of reimbursement between NHSO and medical service providers as the following.

1.2.1 Problem#1 The medical claims processing required 90 – 120 days of information processing and approval for reimbursement given to the medical service providers, which delayed the reimbursement payment made to the medical service providers. Such delay had affected the medical service providers' budget management, resulting in the need to improve work process, such as cancelling unnecessary functions to reduce processing time.

1.2.2 Problem#2 The sub-process of the medical claims processing was separately run by each division and they could not directly connect each other when the reimbursement calculation was made and when the report of reimbursement payment was issued. With the reimbursement payment given to the medical service providers whose patients had more than 1 health care fund, the fund could not completely verify the patient's medical service charges payment according to their benefit coverage. This situation affected the work of the medical service providers' accounting department since they could not close their accounting period as scheduled. Therefore, the application of processing needed the continual improvement to enhance the success rate of reimbursement payment given to the medical service providers.

1.2.3 Problem#3 To reduce the costs of support and to drive the medical claims processing as the Office Management's policies, the concept of expenses control for information preparation had been introduced. The information preparation was a process that the Office could not control since the National Health Security Office had outsourced the third party to manage it and it cost 5 baht per a record. Additionally, the number of patient kept increasing every year.

1.3 Objective

To have the maximum benefits of the medical claims processing by the two departments given to the NHSO, the development and integration of the system to meet the standard of information processing and trace are written with the following objectives.

1. To examine and analyze the medical claims processing for both departments in 2008 for the baseline architecture analysis of the enterprise architecture principles

2. To examine and analyze the medical claims processing for both departments for the target architecture analysis of the enterprise architecture principles and in response to the NHSO's vision of the integration of the medical claims processing

3. To collect the records of the patient who has reimbursed the medical service charges from the Episodic Care department and make a comparison of effectiveness of the improvement from the development in phase 1 and phase 2

4. To present development plan of the medical claims processing to the NHSO based on the enterprise architecture principles

1.4 Major Contribution

The expected contribution after the medical claim processing is integrated is as follows:

1. The time required for the medical claim processing is reduced by 50 percent.

2. The failure rate of the reimbursement payment is reduced by 50 percent.

3. The budget for the medical claim processing is decreased by 20 percent.

1.5 Scope of Work

To derive the maximum benefits of the medical claim processing for the NHSO, the researcher has set up the framework to analyze and measure the system effectiveness as follows:

1. The relationship among the data sets that are processed in the medical claims processing of both departments is explored, analyzed, and derived with the master plan of the work process.

2. The time used for information processing by 7 sub-processes is collected and the government's budget information that drives the medical claims processing of the Episodic Care department and the Continuous Care department is compared during 2008 – 2015.

3. The record of the patients who have reimbursed the medical service charges from the medical service providers across the country is collected. For the Episodic Care department, the information from the central database of the NHSO is used for analyzing the success rate of the reimbursement payment during 2007 – 2015.

1.6 Work Plan

ACTIVITY Plan

Activity	Dec	Jan	Feb	Mar	Apr
The process in 2008 is examined for conducting baseline analysis.	x x				
The process is examined for conducting target analysis.	x	x			
The information is collected for analyzing the effectiveness by the epi sodic care department.		x	x		
Gap analysis is conducted for the episodic care department.			x	x	
Gap analysis is conducted and solution is designed for the continuous care department.			x	x	
Data analysis and conclusion are made.				x x x	
Roadmap of compensation claims evaluation is made and presented.					x x

Figure 1.1 Activity plan

1.7 Chapter Outline

Chapter 2: Literature Review

This chapter reviews the literature concerning relevant technology. The literature review serves as a guideline for making a comparison between pros and cons of the technology or approach that would be adopted to integrate the medical claims processing to able to work together. Also, it ensures that the chosen area of study can respond to the organization's goals as well as enhancing the work effectiveness of the organization.

Chapter 3: Enterprise Architecture Analysis

This chapter talks about the overall analysis of the organization based on the enterprise architecture. The analysis begins with the baseline architecture and target architecture. Subsequently, gap analysis would be conducted to obtain the solutions for the organization to reach the future goals.

Chapter 4: Research Methodology

In this chapter, the concept of setting up the key performance indicators would be mentioned and the relationship of the information used for the analysis is also presented. In addition, the process of obtaining the information and the results is explained. The obtained information is used for the measurement of the effectiveness of the Episodic Care department as a guideline for the future development of the Continuous Care department.

Chapter 5: Discussion and Results

This chapter discusses the results of the measurement with different aspects and demonstrates the results from the research that analyzed the Episodic Care department. The results obtained from research analysis would be compared by the effectiveness between before and after the integration of the Episodic Care department. This is to support the future integration of the Continuous Care department.

Chapter 6: Conclusions and Future work

This chapter provides research conclusion explaining whether this research meets the stated goals and which parts should be improved. It also gives the direction of the future development or future roadmap.

CHAPTER II
LITERATURE REVIEW

2.1 Introduction

The chapter reviews the literature in relation to sub-components of the model of medical claims processing development in other countries, such as, Korea and Taiwan., The process of claim and reimbursement are shown to demonstrate the operation, the structure of health security system, and related concepts. Moreover, the literature review chapter covers the technology adopted for the development of database system with full efficiency of data processing and development of application.

2.2 Health security system and concepts

2.2.1 Type of Data Processing for Healthcare System

There are two types of data processing for healthcare system: paper-based and electronic-based. By comparing paper based processing with electronic-based processing for registration and retrieval tasks, it was found that electronic-based processing could work faster than that of paper-based processing at 40 percent and at 95 percent for the registration and retrieval task, respectively [1]. With electronic-based processing, the Health Information System could be developed to provide the health information more rapidly. This is the concept of data processing developed by National Health Security Office to support the business architecture for reducing time of paper-based data processing.

2.2.2 Automated Information Billing System for Healthcare

The development of information system for healthcare/health insurance billing was related to medical claims processing in a way that the data was processed electronically. The medical service units or medical service providers had to create a process of preparing the information to be transmitted to the system to build the claim

request. As a result, the information system for healthcare/health insurance billing was developed to be more user-friendly and easy when data processing was performed. By doing so, the graphic user interface (GUI) needed to be developed to support data format that was easy to perform data processing in the information system. With the web-based processing that could receive the information in the electronic form from the medical service units, such information was taken into the healthcare billing information system for reimbursement processing [4].

2.2.3 Healthcare Model

South Korea's National Health Insurance (NHI) followed the concept of work process by Japan's National Health Insurance. The National Health Insurance system of Japan consists of the administrative structure of the system, the choice about who would be covered, and the policy for mobilizing financial resources for the system. With the efforts to develop the work process of the NHI following Japan's healthcare model, the United States of America brought in the NHI's experience that took place since establishment to serve as a guideline for the development of its own healthcare insurance models [5].

2.2.4 Main Components in the Medical Claims Processing

To support the concept of effective health security, there are three main components that required the preparation of dataset within the organization: The node (the computers or mobile devices for assessing the system), the web server and the network, and the hardware [1]. Such preparation creates a quality health services, And the components of the enterprise architecture should be designed to satisfy the work of health insurance. The organization should be suitable for business architecture. For data architecture, the information architecture should be standardized along with metadata dictionary. Application architecture supports business architecture and infrastructure architecture with hardware and technology, in turn, assisting all work procedures and processing [2]. The concept and the plan of Romania's National Health Insurance states that, for the information system for the healthcare system, technology and communication tools in the health insurance system are the important factors that enable the system to provide the information with quality and run the system effectively [3].

2.2.5 Reimbursement Mechanism

There was a standard processing of weighted mean calculation called DRG Grouper. The DRG Grouper categorized similarly clinical diseases and similar medical service charges into the same groups. The similarly clinical diseases that were categorized in the same groups received the equally weighted mean and this equally weighted mean would take into the calculation of the amount of the reimbursement given to the medical service units. For example, South Korea's National Health Insurance (NHI) provided health insurance to the people and its reimbursement by the DGR system's weighted mean calculation started from year 2002 onward. This kind of weighted mean calculation was a standard that the National Health Insurance of South Korea to derive the amount of reimbursement [6] and this calculation was also adopted by Taiwan's National Health Insurance. Taiwan's National Health Insurance used the DRG System to calculate the amount of reimbursement [7].

2.2.6 Health Information System: Knowledge Sharing

Romania's development plan stated that the national information integration system (NIIS) connected the health information system for knowledge sharing and allowed such information to be accessed by the people with the legal rights to promote the medical claims processing of the health insurance. The aim of this promotion was to have health insurance with quality and speed for the nation. Initially, the system was sending and receiving the information of medical treatment through email. Then, it was developed to be an automated sending and receiving information of medical treatment, thereby resulting in the system development that met the standard of the future e-Health Enterprise Architecture Framework [3].

2.3 Technology adoption for system development

2.3.1 Oracle Exadata

The NHSO conducted data processing by using the Oracle database installed on the SPARC servers. With the limitation of Oracle's hardware and software, the parameters could not be tuned and the database could not speed up its data processing more. The idea of changing the hardware that could support the central database to the Oracle Exadata came from the hardware using the engineered system

[9]. It could be installed on the Oracle database and its speed of data processing was obviously improved for OLAP and OLTP data processing compared to other types of hardware according to the telecommunication business [8]. The telecommunication business used the database management system (DBMS) on the Oracle database software which did reduce the duration of data processing. For example, SK telecom Company is a South Korean wireless telecommunication operator that decided to implement the Exadata to be used with database of billing system with more than 500-600 billion transactions. Furthermore, the company moved the data warehouse to be processed on the Exadata. After the data warehouse had been moved to the Exadata, the performance of data processing was found to increase by 10 times.

2.3.2 Java EE Platforms

The process of software development for the applications that support core business process is known as an application for core business. The NHSO defined the development standard as the application for core business that must be developed by JAVA or Java EE platform only since it can work on cross platform.

The NHSO used a web-based application for data processing. To support the idea of using JAVA for application development, an example of application performance was given. The web-based application was compared against the applications that had been developed by .NET platform and Java EE platform. According to the performance of application developed by JAVA, response time, Throughput, CPU Utilization, Network I/O, Disk I/O, and Memory Utilization had a better performance than those applications developed by .NET [10]. Table 2.1 illustrated the test results of application by using 1-100 virtual users to show the difference of response time and memory utilization between the .NET platform-developed application and Java EE platform-developed application [11].

A comparison of response time and memory utilization between the .NET platform-developed application and Java EE platform-developed application as shown in Table 2.1

Table 2.1 Comparison of response time and memory utilization between the .NET platform and Java EE platform

Virtual users	Response Time (msec)		Memory Utilization (MB)	
	.NET Platform	Java EE Platform	.NET Platform	Java EE Platform
1	3.0680	1.0941	1031	655
20	3.4610	3.3200	1185	695
40	53.5210	3.4820	1231	748
60	56.9750	3.3610	1290	853
80	71.7410	3.8520	1325	957
100	88.4150	5.7680	1374	1085

The test results shown in the table indicated that Java EE platform-developed application had less response time than that of .NET platform-developed application by 94 percent. Moreover, Java EE platform-developed application had less memory utilization than that of .NET platform-developed application by 21 percent. Statistically speaking, 100 virtual users demonstrated a better performance of the web-based application developed by Java EE platform compared to that developed by .NET platform and supported the idea of using Java EE platform for the development of core application.

CHAPTER III
EA ANALYSIS

3.1 Introduction to EA Framework

This chapter analyzes the medical claims processing which has been performed by the episodic care department and the continuous care department. The analysis was conducted with time periods below.

Baseline architecture began in 2007 and ended in 2008.

Target architecture began in 2009 and ended in 2016. It was divided into three phases.

- Target architecture implementation phase 1**:** 2009 – 2012 Fiscal Year
- Target architecture implementation phase 2: 2013 – 2015 Fiscal Year
- Target architecture implementation phase 3: 2016 – 2020 Fiscal Year

3.2 EA Framework

The researcher employed the TOGAF framework for the analysis of the NHSO's enterprise architecture due to its methods, processes, and steps that are clearly defined by the principles of enterprise architecture.

The implementation of TOGAF framework is explained by the architecture development method (ADM) whose work process is divided into phases as shown in figure 3.1. Moreover, it allows the organization to achieve its goals as written below.

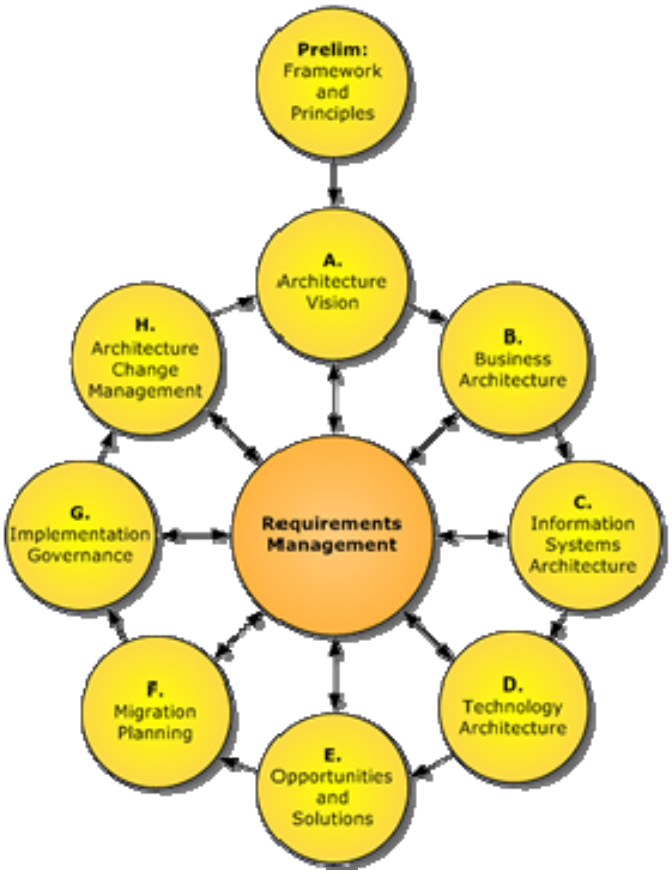

Figure 3.1 ADM of TOGAF Framework

Phase A: Architecture Vision

This phase is involved with the development of the organization's high-level aspirational vision which has been translated into the future enterprise architecture plan approved by the management team.

Phase B: Business Architecture

It discusses an approach of business development grounded on the target business architecture in response to the organizational vision. The gap found in each component is also described by its methods and solutions that allows the organization to achieve the target business architecture.

Phase C: Information System Architecture – Application Architecture

The target application architecture is a development approach that satisfies the needs of business and that leads the organization to achieve its visions. The roadmap is also provided to identify the gap between the baseline and target application architectures.

Phase D: Technology Architecture

It presents the technology architecture that responds to the needs of the application functions from the perspective of logical, physical, and data components in order to accomplish the visions that have been set up. In addition, the roadmap is provided to identify the gap between the baseline and target application architectures.

Phase E: Opportunities and Solutions

Phase E is concerned with the generation of the initial complete version of the architecture roadmap referring to the gap analysis derived from phase B, phase C, and phase D.

Phase F: Migration Planning

The architecture roadmap, supporting implementation, and migration plan are finalized in this phase.

Phase G: Implementation Governance

The accordance and relationship of target architecture are discussed with the confirmation from the implementation projects, including the preparedness of change management.

Phase H: Architecture Change Management

It presents the process that ensures the architecture lifecycle would remain. Moreover, the governance framework is applied.

3.3 NHSO Background

National Health Security Office, known as NHSO, is a public organization pursuant to the National Health Security Act under the supervision of a Public Health Minister. In this regard, the Public Health Minister serves as the chairman of the National Health Security Office's committee. The NHSO represents the Office of the Secretary of the National Health Security Board and the Health Service Standard and Quality Control Board. Its mission is to manage the national health security fund with maximum effectiveness and develop the health services system that allows the people to access to a quality standards service. With the effective, transparent, accountable national health security fund management that provides the maximum benefits to the

Thai people, the NHSO has been awarded with the outstanding working capital award since 2008.

Its structure is divided into two sections based on the Offices, responsibilities, and the NHSO's mission as the following.

1. Section 1: this section is responsible for the supporting work directly under the Office of the Secretary.
2. Section 2: this section is in charge of the missions stated in the strategic plan with 5 clusters as shown below.

- Strategy and Evaluation (Cluster 1) is in charge of strategic planning and coordination with outside agency.
- Fund Management (Cluster 2) is responsible for administration and regulations of claims and payment process.
- Support of Fund Management Network (Cluster 3) is responsible for the service of patients with chronic illness and health promotion groups to the Thai people.
- Supporting Work (Cluster 4) is in charge of general administration, human resources, and IT that required the support from the NSHO's all data processing.
- Branch and Participation (Cluster 5) is in charge of public relations and information provided to the NHSO and 13 NHSO branches.

Currently, the NHSO has an action plan following the 4th 2017 – 2021 strategic plan of system development. The plan placed its emphasis on the creation of health security for the Thai people. It is the policy that the government has placed its attention to. It is a mechanism of health coverage services provided to the people who are not eligible for the civil servant medical benefits, social security scheme, and medical services provided by the government. Such people are allowed to get the health coverage services at the health service providers located in the community. The health coverage services include health services and health promotion, healthcare, and rehabilitation at no cost although some diseases are costly medical charges.

The national health security has developed itself for more than 17 years. Such development has been participated by all walks of life, such as Thai people, community, local administrative organization, and public and private organizations

pursuant to the intention of the National Health Security Act B.E.2545. The National Health Security Board and the NHSO have constantly developed and driven the national health security bearing the intention of the Act in their mind. Three strategic plans serve as the operational framework approved by the Board.

The first plan was the 2003 – 2007 roadmap for universal health coverage and universal health coverage strategy. It emphasis was placed upon the coverage of health security provided to the Thai people with the mechanism of building knowledge and understanding of the people's rights and duty. The public health employees were also included along with the promotion of the services management that allowed the people to get easy access.

The second plan was the 2008 – 2011 strategic plan of universal health coverage that focused on the enhancement of effective budget management with the participation from all stakeholders and right protection of all the people. Moreover, it strengthened the internal management of the NHSO.

The third plan was the 2012 – 2016 strategic plan of universal health coverage that focused on the sustainability of the health security with the coverage of all Thai populations, participation, ownership, and harmonization. It also emphasized on the primary healthcare development and human resources.

The following sections described the framework of 4th 2017 – 2021 strategic plan of system development.

NHSO Vision:

"All Thai citizens who live in the kingdom of Thailand are protected by the universal health coverage with confidence."

NHSO Mission:

"The universal health coverage is developed based upon the empirical evidence and creative participation from all stakeholders and represents the people for quality management that allows the people to have equal access to the health service."

NHSO Goals

The NHSO's goals are classified into three groups according to the 4th master plan, as shown in Figure 3.2.

1. Coverage: effective, equitable, and responsive
2. Safe: safe financing system

3. Good: good governance

Figure 3.2 NHSO's goals

NHSO Strategy

1. Ensure the coverage and access for vulnerable and underutilization groups.
2. Ensure quality and adequacy of health services.
3. Ensure financial efficiency.
4. Ensure participation and ownership of all stakeholders.
5. Ensure good governance.
6.

The structure of the national health security fund

The services provided to the people by the national health security fund are operated by the NHSO's internal units that work together as shown in Figure 3.3.

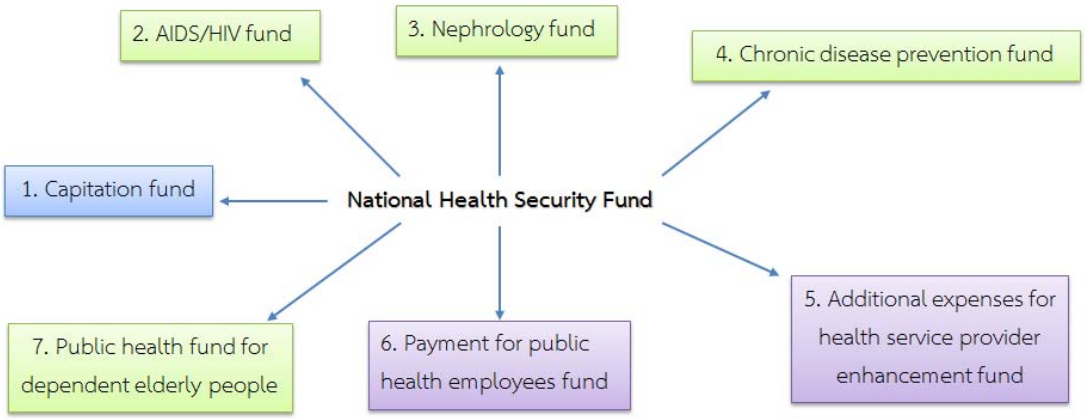

Figure 3.3 Structure of the national health security fund

The above figure illustrates the types of the national health security fund which is divided based on its services into three categories.

1. Capitation Fund for the patients with the episodic care
2. Funds for the patients with chronic illness and health promotion: AIDS Fund, Nephrology Fund, Chronic Diseases Prevention Fund, and Public Health Fund for Dependent Elderly People.
3. Fund for the support of the NHSO work which included payment for public health employees and additional expenses for effective enhancement

3.4 Business Architecture Analysis

In the business architecture analysis, the business process of medical claims processing was reviewed and compared with the business process among other business units. The problems were identified in the baseline process to derive the solutions that resulted in the target business architecture in compliance with the NHSO. The target business architecture was based upon the claims and reimbursements that occurred between the health service providers and the NHSO's IT Operation. The IT unit would perform claims processing and make the reimbursements paid to the health service providers, such as medical service charges, medical items, and medical equipment. The reimbursement was processed based on the conditions specified by each fund under the NHSO. In fact, the health service providers sent the claim requests to the NHSO's IT Operation as shown in Figure 3.4.

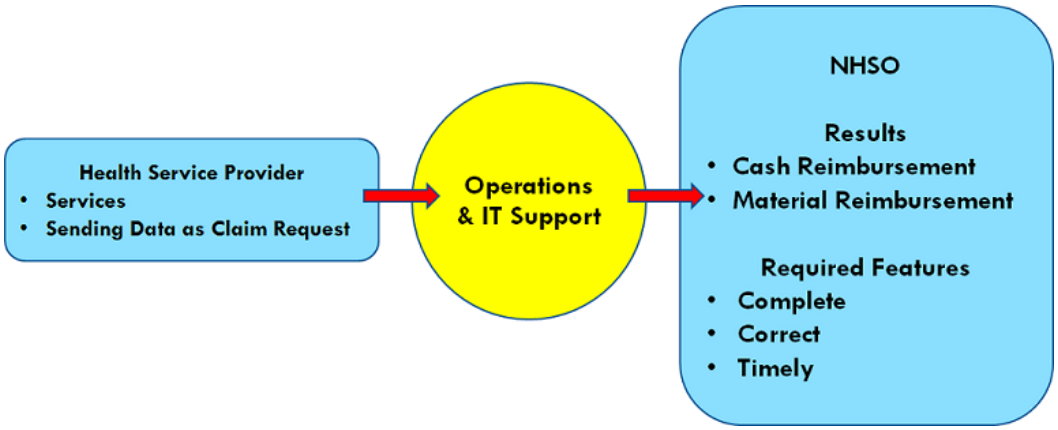

Figure 3.4 Claim and Reimbursement process

Medical claims processing is a system that performs the data analysis of the patients provided by the health service providers. It calculates the medical charges reimbursed to the health service providers under the NHSO. It processes data of 43 Files which is the database of the Thai population. Such files are used for the health promotion project for the local people who live in the areas that the NHSO branches are responsible for. The processes can be divided into two departments based on processing, activities, and data set.

1. Episodic care is responsible for the claim and reimbursement processing given to the medical service providers in relation to general patients who do not require an ongoing treatment, such as fever and gastritis.

2. Continuous care is responsible for the claims and reimbursement processing given to the medical service providers in relation to the patients with chronic diseases. Such chronic diseases include kidney disease that requires hemodialysis to be done 7 days a week and HIV-infected patients who need a medical checkup and medicine periodically. This department is also responsible for the health promotion services, example projects are the patient visit to the hospitals located in provinces and the community visit for vaccination.

In this research, the researcher has realized the problems caused by medical claims processing in the baseline architecture since it had created the delay of processing. As a result, the medical service providers received the late reimbursement by 60 – 90 days from the closing accounting period. In terms of the data preparation that hired an outsource for processing, the NHSO was not able to control the expenses incurred, leading to the integration of medical claims processing in order to obtain its maximum effectiveness and to promote the policy of fund management. This was the key to driving the NHSO to the target business architecture as written below.

3.4.1 Baseline Business Architecture

This section discusses medical claims processing system’s business process for the episodic care department and continuous care department. The analysis of the two departments’ work process is given as the following.

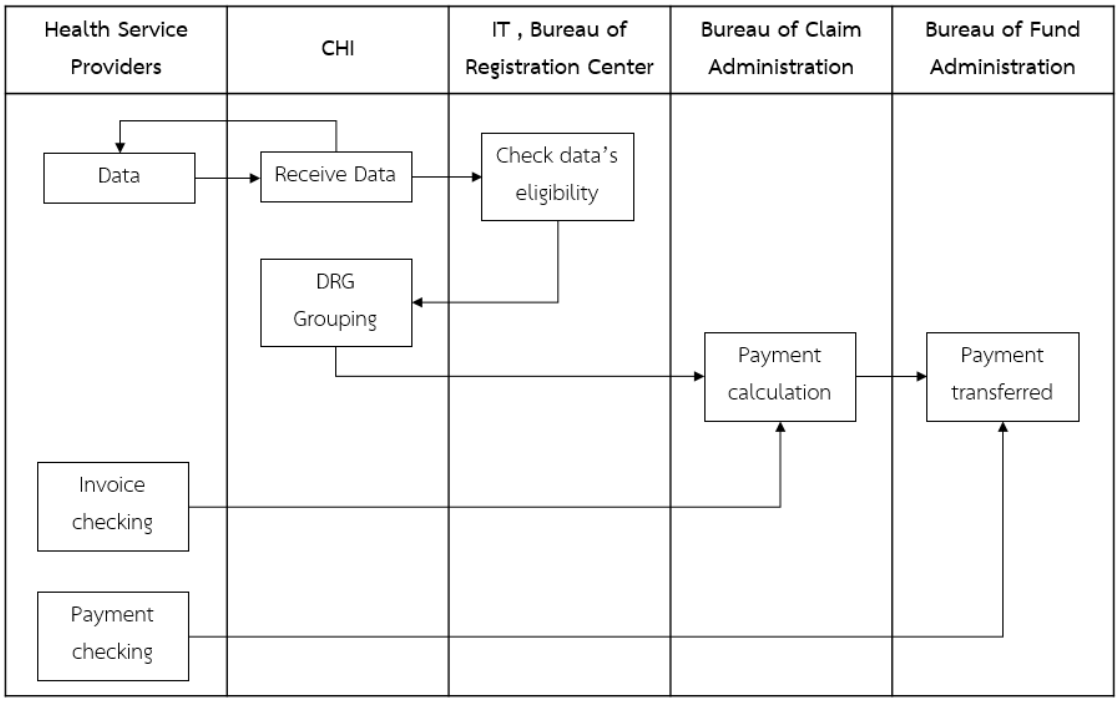

Figure 3.5 Baseline business process of the episodic care department

Figure 3.5 shows the work process from the business view of medical claim in the baseline architecture. The episodic care contained the following organizations.

1. Health service providers are the hospital enrolled to the NHSO for providing patient services.

2. Central Office for Healthcare Information is an outside agency of the NHSO.

3. Bureau of Information and Technology Management and Bureau of Registration Center are the agencies under the NHSO. Their responsibilities are to verify a patient's eligibility.

4. Bureau of Claim and Reimbursement is an agency responsible for reimbursement calculation according to the conditions of health services.

5. Bureau of Fund Administration is an agency that manages the funds, payment transfer, and treasury reserves.

For the episodic care department's medical claims processing, the Business process was explained as the following.

Step 1: The health service providers prepared the data in the standard form of 12 files and sent them to the CHI.

Step 2: The CHI received the data files from the health service provider, sorted them out, and made certain data ready for processing.

Step 3: Bureau of Information and Technology Management and Bureau of Registration Center under the NHSO received the patient information from the CHI to verify a patient's eligibility and sent the information of the eligible patient back to the CHI.

Step 4: The CHI received the information of in-patients that had already verified their medical eligibility. Then, the information was taken into the process of weighted mean calculation based on the disease treatment or DRG Grouper for reimbursement calculation.

Step 5: Bureau of Claim and Reimbursement received the information of in-patients and sent them to the reimbursement processing based on the conditions of the funds responsible for the episodic care under the NHSO. The medical claims processing was conducted by each fund only. After the reimbursement processing had been finished, summary report was issued to announce that the NHSO was in debt to the health service providers.

Step 6: Bureau of Fund Administration received the summary report from the Bureau of Claim and Reimbursement and sent the reports to the management team for approval of reimbursement transfer to the health service providers.

Step 7: The health service providers checked whether the transferred reimbursement matched the actual medical service charges.

It was found from the medical claims processing by the episodic care department in the baseline that the step 5, the reimbursement calculation given to the health service providers, required 30 – 60 days of processing. Each Fund performed data processing and issued the report separately since there was no central data processing that met the conditions of all the Funds. Consequently, the reports of reimbursement payment of each Fund and the payment transfer to the health service providers did not have similar dates of transfer which affected the medical service providers. If the patients required more than 1 Fund, the process could not manage

financial issues correctly and could not close financial statements on the due date, causing the delay of receiving reimbursement payment.

From the above explanation of the episodic care department, it obviously revealed that the reimbursement processing and issuing the reports of each Fund had been performed separately according to the conditions specified by each Fund, called business silo. It resulted in the business constraints and caused the delay of the reimbursement payment to the health service providers since the processing consumed a long period of time.

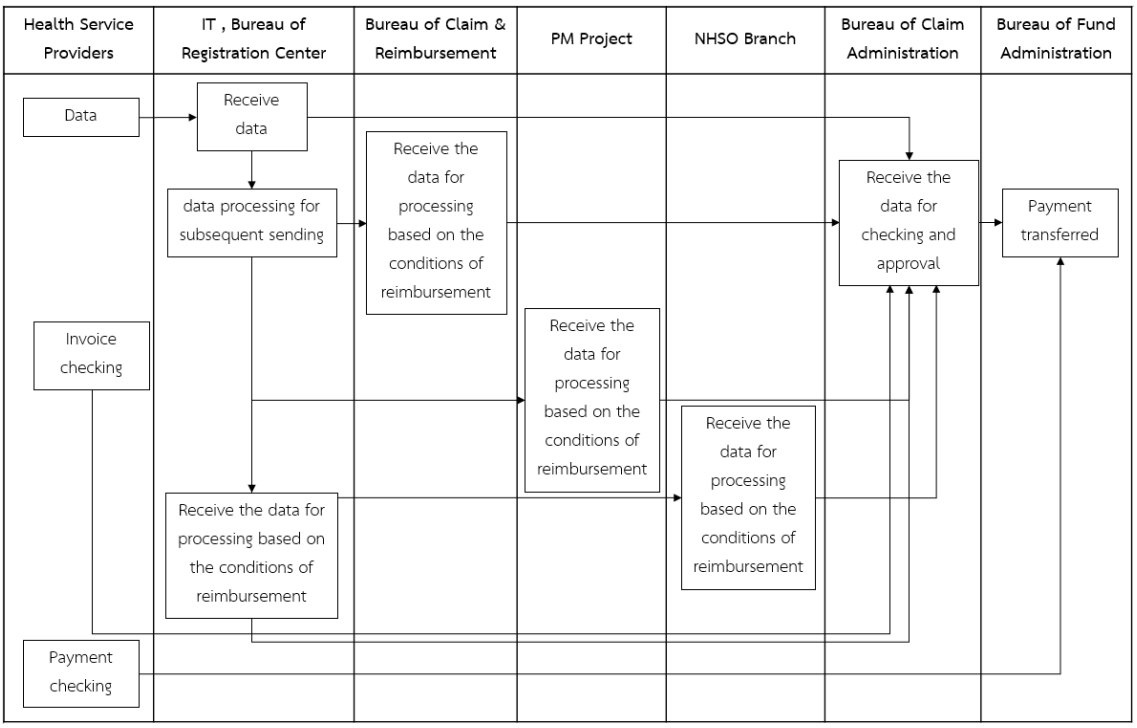

Figure 3.6 Baseline business process of the continuous care department

Figure 3.6 illustrates the work process from business perspective for medical claims in the baseline architecture. The continuous care department was involved with the following agencies.

1. Health service provider is a hospital enrolled to the NHSO that provides health service.

2. Bureau of Information and Technology Management and Bureau of Registration Center are the agencies under the NHSO. Their responsibilities are to verify a patient’s eligibility.

3. Bureau of Claim and Reimbursement is an agency responsible for reimbursement calculation specified in the conditions of health services.

4. Project Managers are under the NHSO and serving as the project manager for the health promotion project.

5. 13 NHSO branches under the NHSO are responsible for the health promotion projects in their branches.

6. Bureau of Claim Administration is responsible for the reimbursement processing according to the conditions specified.

7. Bureau of Fund Administration, developed from Bureau of Fund Management, is an agency that manages the funds, payment transfer, and treasury reserves.

For the continuous care department's medical claims processing, the business process in Figure 3.6 was presented as the following.

Step 1: The health service providers provided the information of the patients with chronic diseases according to the reimbursement structure of chronic care and population data in the standard form of 43 files. They were subsequently sent to the NHSO.

Step 2: Bureau of Information and Technology Management and Bureau of Registration Center received the 43 files data from the health service providers. Then, they were kept in the individual database and the data were processed. The processing was divided into two categories.

Category 1: The information of the patients from the chronic care department was preliminarily processed to sort out the chronic diseases that could be reimbursed according to the conditions specified by the Funds, such as AID/HIV Fund and Nephrology Fund.

Category 2: Population data was preliminarily processed which the data should be subsequently sent to which agency in case there were the health promotion projects in the local areas, such as a patient visit to the hospitals located in provinces project, a community visit to vaccination project, infection disease prevention in rural areas project.

Step 3: Bureau of Information and Technology Management and Bureau of Registration Center, Bureau of Claim and Reimbursement, Project Managers, and

the NHSO branches received the preliminarily processed data to calculate the reimbursement and the budget for the health promotion projects based on the conditions and scopes of the projects.

Step 4: Bureau of Claim Administration received the calculated reimbursement and the supporting budget from the Bureau of Information and Technology Management and Bureau of Registration Center, the Bureau of Claim and Reimbursement, Project Managers, and the NHSO branches. Then, the Bureau of Claim Administration performed the checking of the amount of reimbursement and issuing the summary report submitted to the management for approval.

Step 5: Bureau of Fund Administration received the approved reimbursement and budget and transferred them to the health service providers and related agencies.

Step 6: The health service providers checked whether the amount of transferred reimbursement of the patients from the chronic care received from the NHSO matched the actual medical services charges.

From the explanation of the work process by the continuous care department that consisted of the claim and reimbursement to the health service providers and the supporting budget for the health promotion projects, it was found that not only the types of data transmitted to the system varied but also the conditions for data processing were complex. Moreover, there was no comprehensive data processing that could calculate the complete reimbursement, as it was noted that some data sets were sent to the project manager to perform the data processing. This resulted in the externally processed data not being verified.

Moreover, it revealed that the processing that supported some part of the continuous care work did not cover the business logic. This created many business silos, including the human tasks in the process. This human task could not control the time when data processing was performed. Besides, it could not check and refer to the correct data.

3.4.2 Target Business Architecture

The problems found from the business analysis for the baseline architecture resulted in the development of the target business architecture for the integration of medical claims processing. The implementation is then divided into

three phases. The first phase was the data preparation and DRG Grouping developed by the Bureau of Information and Technology under the NHSO to provide the development of the continuous business process. Such process included data receiving and data preparation for processing. Additionally, the process reduced the cost of outsourcing that drove the process following the concept of organizational development of the then NHSO.

In the second phase, the data processing of the episodic care department was developed in terms of data receiving, verification, and validation. It was recommended the process of issuing the reports and reimbursement payment transfer responsible by the Central Office for Healthcare Information, the Bureau of Information and Technology Management and the Bureau of Registration Center, and the Bureau of Claim and Reimbursement should be merged. If they were to be merged, the SILOs work process would be reduced. Each agency performed data processing independently, not connecting to the systems of other agencies. With the agencies merged together, the NHSO was able not to rely on outsourcing since the expenses incurred by the outsourced agencies could not be controlled. The cost of data preparation service responsible by the CHI was 5 baht per record (Agreement made between the NHSO and the CHI in 2003). The data preparation was transferred to the IT Bureau, lightening the expense burden of medical claims processing of the episodic care department by 20 – 30 million baht per year of annual budget.

The third phase was the development of the continuous care department to get prepared for the integration of the episodic care. From the business perspective, it indicated that business logics had been applied to certain process of the two departments, called common service. It was the connecting point of business of the two departments.

The details of the target business architecture could be described by the business process figure with the implementation in phase 1, phase 2, and phase 3.

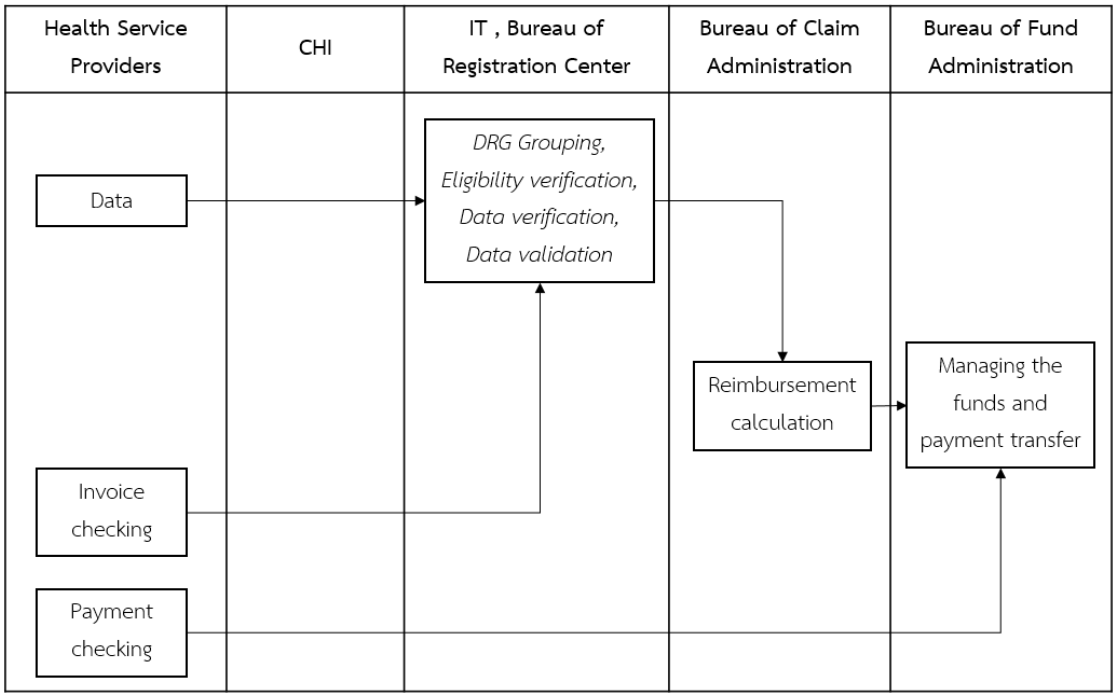

Figure 3.7 Business process of episodic care phase 1

Figure 3.7 demonstrates the work process of medical claims from the business perspective that was developed with the business architecture in phase 1. The episodic care department consisted of the following agencies.

1. Health service provider is a hospital enrolled to the NHSO to provide health service.

2. Central Office for Healthcare Information (CHI) is an external agency.

3. Bureau of Information and Technology Management and Bureau of Registration Center are the agencies under the supervision of NHSO. Their responsibilities are to verify a patient's eligibility.

4. Bureau of Claim Administration is responsible for the calculation of reimbursement based on the conditions specified.

5. Bureau of Fund Administration is an agency that manages the funds, payment transfer, and treasury reserves.

Data processing of the episodic care department in phase 1 was explained based on business process as shown in Figure 3.7 as follow:

Step 1: The health service providers prepared the data in the form of 16 files and transmitted it to the IT Bureau and Registration Center.

Step 2: The IT Bureau and Registration Center imported the data from the health service providers to sort them out and make eligibility verification, data verification, data validation.

Step 3: The Bureau of Claim Administration imported the data of the eligible to calculate the reimbursement based on the conditions specified in the funds under the NHSO responsible for the episodic care. The data processing was performed within each of the funds only. After the data processing of the reimbursement had been finished, the summary reports of the reimbursement would be issued to announce the NHSO was in debt to the health service providers.

Step 4: The Bureau of Fund Management received the reports from the Bureau of Claim Management. Subsequently, the Bureau of Claim Management sent the documents to the management for approval of reimbursement transfer to the health service providers.

Step 5: The health service providers checked whether the amount of transferred reimbursement of the patients from the chronic care received from the NHSO matched the actual medical services charges.

After the development of the system in phase 1, it was found that the process of claim and reimbursement from the beginning of data preparation and transmission for processing to the health service providers receiving the reimbursement payment from the NHSO had been decreased, such as data preparation and DRG Grouping. For the baseline architecture responsible by the CHI, the results derived from the process that was cut off were that the NHSO could save the budget of outsourcing the outside agencies for doing data processing and DRG Grouping by 20 – 30 million baht per year. Moreover, such cut-off produced the continuous data processing as the original business flow in the baseline architecture had been responsible by two agencies agency in charge of data preparation, verification, and DRG Grouping. However, the first phase had cut off the responsible agencies and merged the three steps together (data preparation, eligibility verification, and DRG Grouping). These merged steps were transferred to the IT Bureau and Registration Center under the NHSO.

From the analysis of work process in phase 1, step 3 and step 4 were found that they supported the business process that worked like business silos. The business logics was adopted by each fund to calculate the reimbursement calculation independently, resulting in the issue of the reports by the funds on different dates. Furthermore, the different dates of issuing the reports affected the health service providers with more than 1 fund for reimbursement could not manage their financial issues correctly, close their accounting statements on a specified time, and received their imbursement payment late. This problem was found in the baseline architecture, resulting in the development of data processing and issuing the reports, which was discussed in the next implementation phase.

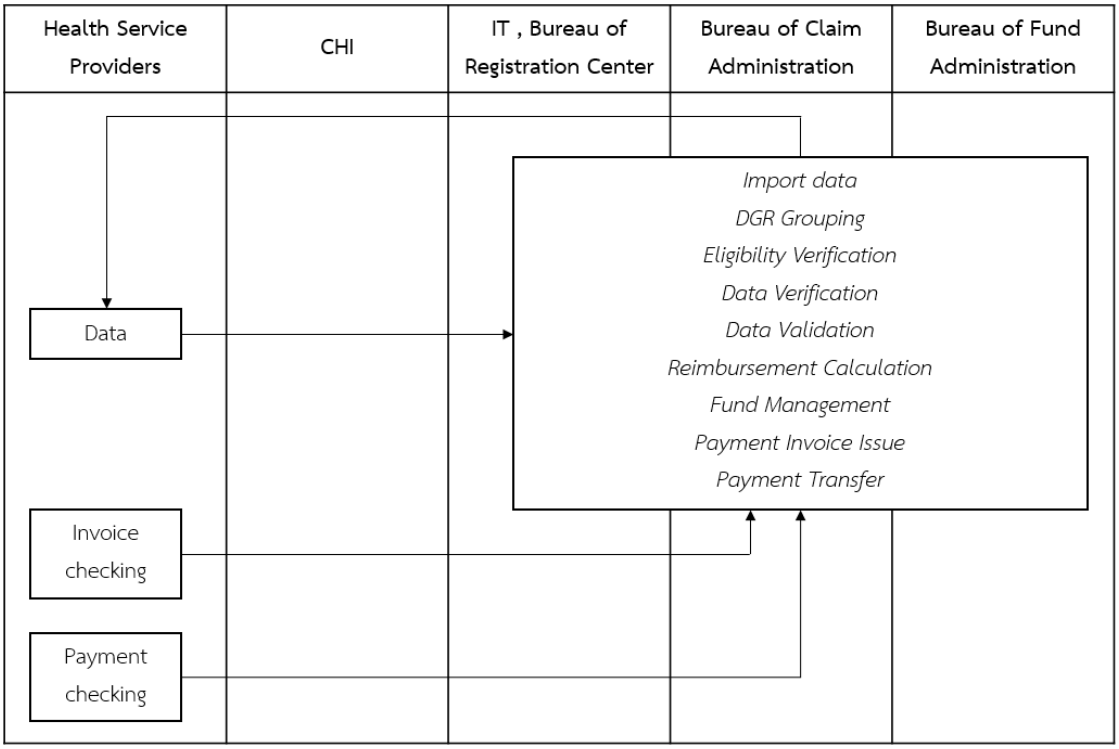

Figure 3.8 Business Process of the episodic care phase 2

Figure 3.8 illustrates the work process of medical claim from the business perspective in the target architecture phase 2. The episodic care department was related to the following agencies.

1. Health service provider is a hospital enrolled to the NHSO to provide health service.

2. Central Office for Healthcare Information (CHI) is an external agency.

3. Bureau of Information and Technology Management and Bureau of Registration Center are the agencies under the NHSO. Their responsibilities are to verify a patient's eligibility.

4. Bureau of Claim Administration is responsible for creating the business logic for the reimbursement calculation for the funds and the funds apply it for processing.

5. Bureau of Fund Administration controls the process of payment transfer and manages the treasury reserves of the funds via the central processing of the IT Bureau.

The work process of the episodic care department in phase 2 was explained with the business process as show in Figure3.8 as follow.

Step 1: The health service providers prepared the data of the patients in the standard form of File 16 and transmitted it to the IT Bureau and Registration Center.

Step 2: The NHSO imported the data from the health service providers and subsequently performed data processing in the following sub-processes.

Step 2.1: the IT Bureau and Registration Center imported the patient data for processing, conducting eligibility verification and DGR Grouping.

Step 2.2: Bureau of Claim Administration used the processing system, applying the business logic to calculate the reimbursement given to the health service providers. Then, one summary report of reimbursement returned to the health service providers was issued. The summary report contained the conditions specified by the funds and submitted it to the management for approval. The processing system used by the Bureau of Claim Administration belonged to the IT Bureau.

Step 2.3: Bureau of Fund Administration used the system that belonged to the IT Bureau to transfer the reimbursement to the health service providers with approved information of the reimbursement.

Step 3: The health service providers checked whether the amount of transferred reimbursement of the patients from the chronic care received from the NHSO matched the actual medical services charges.

According to the explanation of the work process of the episodic care department, it was found the work processes of each fund similar to business silos

were eliminated, reducing the process of reimbursement calculation based on the conditions specified by the funds. Business logics were involved in the reimbursement calculation by the funds and applied to the system to decrease repetitive process of the reports that were not issued at the same time by each fund. The reports from all the funds would be combined in one report and issued at the same time. Besides, the continuous processing was also created and the data could be checked from all processes.

After the business process was applied in phase 2, the business process grouping was built to make the internal process of medical claim standardized for common process. The common process was prepared for the future integration between the continuous care department and the episodic care department, which was described in the target business architecture in phase 3.

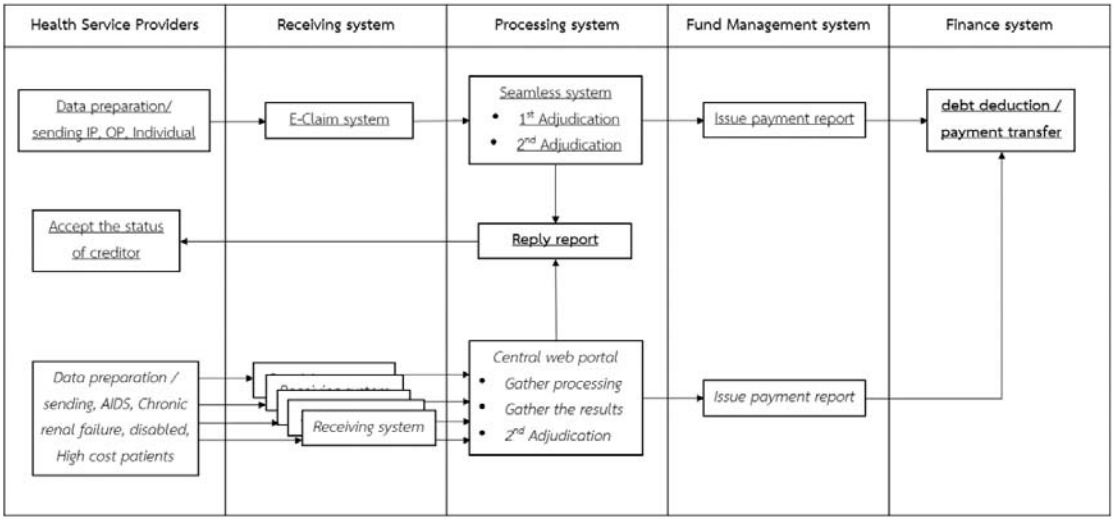

Figure 3.9 Business Process of medical claim processing of the two systems

Figure 3.9 illustrates the work process of medical claim from the business perspective for the target architecture. The episodic care department is underlined while the continuous care department is italicized. Likewise, the shared process is bolded and underlined with the following related agencies supporting.

1. Health service provider is a hospital enrolled to the NHSO to provide health service.

2. Receiving system is a system developed for receiving the patient data from the health service providers. Then, the received data would be sorted out based on the patient categories for claim and reimbursement of the episodic care department. Such categories include in-patients and out-patients. Claim and reimbursement of the continuous care department are for the AIDS/HIV patients, patients with kidney disease and chronic illness, and the health promotion agency.

3. Processing system is a system of reimbursement calculation for the health service providers and other agencies based on the specified conditions of reimbursement. The system covers the issue of individual summary report based on the conditions specified by the funds in order to confirm the status of creditor and debtor between the NHSO and the agencies that submit the claim requests.

4. Fund management system is a system developed to issue the summary report of reimbursement payment. The data is gathered from all the funds approved by the management team.

5. Finance system is a system developed to transfer the reimbursement payment to the health service providers stated in the summary reports from Bureau of Fund Administration.

The following is an explanation of medical claims processing of the episodic care department and continuous care department as in the business process as show in Figure 3.9 as follow.

Step 1: The health service providers prepared the patient data according to the category of claim and reimbursement as the following.

Step 1.1: The health service providers provided the data of in-patient and out-patient in the standard form of File 16 while that of individual population is in the standard form of File 43. Then, such data would be transmitted to the medical claims processing of the episodic care department.

Step 1.2: The health service providers provided the data of the patients with chronic care, such as AIDS/HIV and kidney disease. Then, the data is transmitted to the medical claim processing of the episodic care department.

Step 2: The receiving system conducted by the IT Bureau and the NHSO receives the data from the health service providers to sort out the patient categories and normalize the data for data processing.

Step 2.1: E-claim system was developed from the original receiving system by the IT Bureau. The original system was used in the baseline architecture to sort out and categorize the patients received from the health service providers that support the data processing of the episodic care department.

Step 2.2: The receiving system by the continuous care department is comprised of various sub-processes since the data architecture of the chronic care patients is different, depending on the diseases and medical treatment. Therefore, the receiving system was designed to receive the data in accordance with the claim and reimbursement system of each disease that the funds support. Such diseases include AIDS/HIV and kidney disease.

Step 3: The receiving system responsible by the IT Bureau and the NHSO was developed with the emphasis placed on controlling the harmonious systems for data processing to create the continuous processing. The continuous processing includes eligibility verification, DRG Grouping, the reimbursement calculation, and summarizing process of claims and reimbursement based on the conditions specified by the funds and individual data. The data processing is divided into 2 systems, depending on the population and processing.

Step 3.1: Seamless system was developed from the concept of merging the continuous processing. The 1st adjudication consists of subsystem of eligibility verification, DRG Grouping, and the reimbursement calculation based on the conditions specified by the funds. The 2nd adjudication receives the data that were processed with eligibility verification and reimbursement based on the conditions specified by the funds. It gathers the data derived from the conditions of claims and reimbursement specified by the funds and such data are exported to be a summary report. The summary report is sent back to the health service providers to confirm the status of creditor and debtor between the health service providers and the NHSO, which is called the reply report. The report is submitted to the management for approval. The seamless system supports only the episodic care department only.

Step 3.2: The central web portal was developed from the concept of combining the data processing of the chronic care patients to serve as the center of data processing that can be checked. The first step is to perform data processing of the chronic care patient according the diseases reimbursed by the health service providers and subsequently calculate the amount of reimbursement, which is similar to the process of the 1st adjudication by the seamless system and the 2nd adjudication that issued the reply report of summarizing the medical expenses to the health service providers.

Step 4: The Fund Management system receives the data of the amount of reimbursement and such data would be concluded with total amount refereeing to the health service providers to issue a summary report of account balance.

Step 5: The receiving system receives the summary report of account balance from the fund management system to transfer the reimbursement to the health service providers.

It was found from the explanation of medical claims processing in target architecture for two departments that their business process had the actors responsible for data processing and declared as the system, which was different from baseline architecture whose actors were the officials or the agency in charge of sub-systems. Such difference demonstrated the changes in data processing system that brought in the business logic to each development process to develop the data processing system. The system was developed to support work process in each step and create a continuity of internal data processing from the beginning until the end. For example, process of data preparation and data processing of DRG Grouping was initially responsible by the CHI in baseline architecture. Once the data processing system had been replaced, the responsible agency was changed to the IT Bureau under the NHSO and sub-processes were grouped into one process to allow a continuous data processing within the system. For instance, issuing the reports was originally independently made by different funds. However, the issue of reports was changed into the reply report system in baseline architecture to connect to the process of payment transfer that could support data processing for episodic care department and continuous care department perfectly. In other words, the process that supported work process of these two departments was a common service designed to be able to

correspond to other processes. Moreover, it was a cost-saving for system development since the services were reusable for one-time system development.

For the continuous care department, the data processing systems and checking system of each sub-unit that separately calculated medical reimbursement in baseline architecture were combined. This was because certain business logic used for data processing was not supported with work process coordination under the central portal in target architecture to reduce repetitive data processing and facilitate a checking system. In addition, it created a continuous data processing and provided an easy checking of the performance for the continuous care department. Besides, some steps of issuing the reports were deleted. The original version of issuing the reports had been made separately by the funds. The new system of issuing the reports was replaced with the reply report system in target architecture to allow the issue of reports to be linked and checked from the central portal

1.4.3 Business Architecture - Gap Analysis

This section presents the gap analysis of medical claims processing between baseline and target business architectures. The solutions based on business perspective are provided, as in Table 3.1.

Table 3.1 Gap analysis for business architecture.

Baseline	Target	Gap	Solution
The amount of medical reimbursement was calculated based on the conditions and work process of the funds for the business process of the episodic care department.	The business process of the episodic care department gathered the amount of medical reimbursement and then was moved to the center.	Update	New business flow should be developed to combine medical reimbursement processing with the center.

Table 3.1 Gap analysis for business architecture. (cont.)

Baseline	Target	Gap	Solution
The preliminary data processing and DRG Grouper of the episodic care department was responsible by the CHI. Data preparation was made by the CHI and sent to the NHSO.	The business process of the episodic care department was supported by a system to reduce the outsourcing expenses.	Update	Business flow of issuing the report was changed and the funds were asked to combine their amount of medical reimbursement within a report to allow the verification of the eligible with more than 1 fund.
The process of issuing the reimbursement transfer to the health service provides by the episodic care department could not be checked with the patients reimbursed from more than 1 fund.	The process of issuing the reimbursement transfer to the health service provides by the episodic care department could be checked with the patients reimbursed from more than 1 fund.	Update	Business flow of issuing the report was changed and the funds were asked to combine their amount of medical reimbursement within a report to allow the verification of the eligible with more than 1 fund.
The access to the data processing to check the continuous care department required the coordination with the responsible funds only.	The data processing to check the continuous care department can be accessed via the central portal.	Update	Business flow of access to the data and data verification was made through the central portal.

3.5 Application Architecture Analysis

This part analyzes the application architecture that supports the data processing of the patients, process of medical reimbursement calculation, and other processes of the medical claim processing. In addition, the information flow is illustrated. The researcher studied and analyzed the application architecture in the baseline architecture. The results from the analysis would serve as a guideline for the development of the applications of the episodic care and continuous care department that resulted in the target application architecture that supports the target business architecture. The analysis is explained in the following topics.

3.5.1 Baseline Application Architecture

This section discusses about application architecture that supports internal medical claims processing in baseline architecture for the episodic care department and the continuous care department is discussed. Furthermore, the analysis of the work process of the two departments is given.

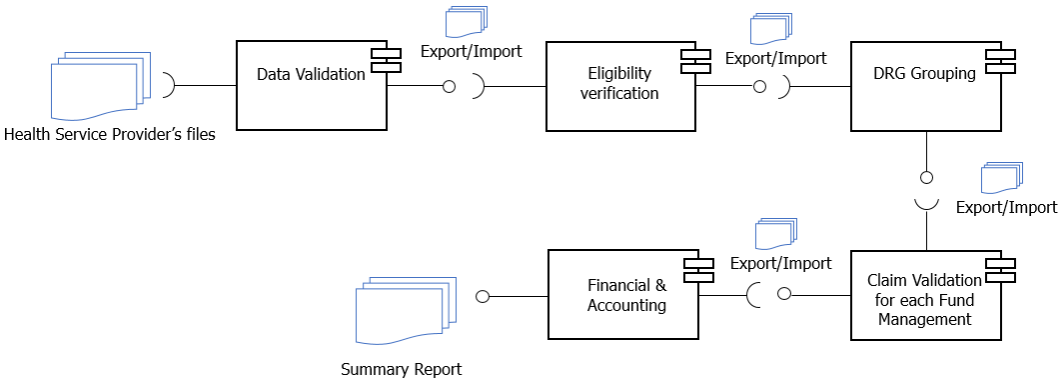

Figure 3.10 Component diagram of episodic care department in the baseline architecture

Figure 3.10 illustrates 5 applications that support the episodic care department's medical claim processing for the use in the baseline architecture with the following details.

Application 1: Data Validation

This application validates the data of the patients from the health service providers and imports the data to the FoxPro database that supports only the .dbf format responsible by the CHI as in the baseline business architecture.

Application 2: Eligibility Verification

The application verifies the eligible patients and the data received are validated by the CHI in the .dbf format used as an input for processing. The data sets that were verified eligibility would be exported and transmitted back to the CHI for processing responsible by the IT Bureau and Registration Center of the NHSO.

Application 3: DRG Grouping

This application was to calculate the weighted mean by DRG Grouping that considers similarly clinical disease. It receives the data from the IT Bureau and is used as an input to calculate the weighted mean of the patients. Then, the data with weighted mean would be exported to the application to calculate the medical reimbursement and the CHI is responsible for this process.

Application 4: Claim Validation (for each fund management)

It calculates the medical reimbursement from the weighted mean derived from the DRG Grouping responsible by the CHI. Medical reimbursement is calculated based on the conditions specified by each fund. The data processing would happen in all funds since each fund has its own application for reimbursement calculation. After the reimbursement calculation is finished, the funds would issue a summary report submitted to the management for approval. Finally, the approved report would be sent to the Finance & Accounting application to make an account and transfer the reimbursement to the health service providers.

Application 5: Financial & Accounting

The application manages the balance of the funds that support the reimbursement for the patients in the episodic care department as well as transferring the reimbursement to the health service providers. The application receives the summary reports of the approved reimbursement payment and the accounting system would process such data and transfer the reimbursement payment to the health service providers.

It was found from the application that supported the episodic care department in the baseline, the processing by the application could not run continuously as it had not been designed and developed to connect to other applications that could work together. In particular, this affected the application that supported the medical reimbursement calculation and the process of issuing the reports that were separately processed by the funds. In addition, the time for processing of issuing the reports could not be controlled and the health service providers' accounting could not check the amount of reimbursement according to the close of the accounting cycle.

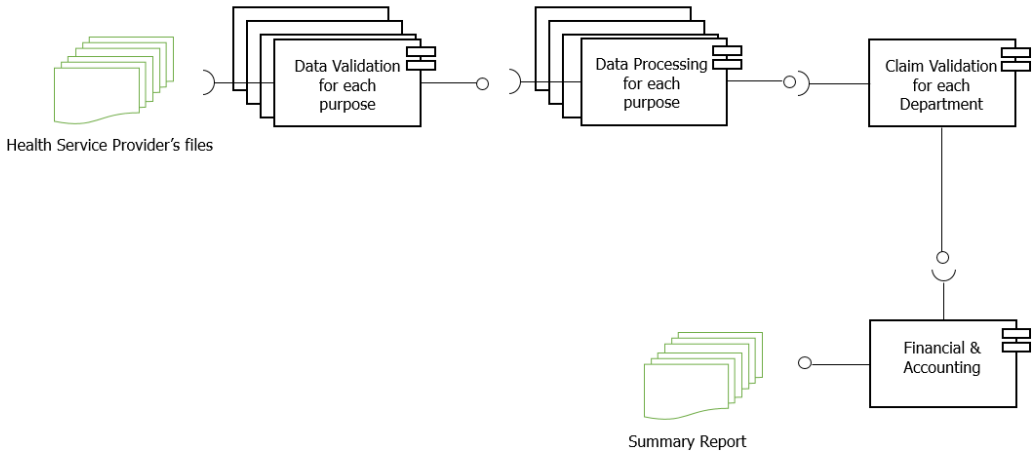

Figure 3.11 Component diagram of continuous care department in the baseline architecture

Figure 3.11 demonstrates the application that supported the continuous care department's medical reimbursement processing for the use in the baseline architecture. The continuous care department has the process of medical reimbursement calculation and various data sets which are explained as the following.

Application 1: Data Validation (for each purpose)

It receives the data from the health service providers and subsequently sort out them. The applications are divided into two categories depending on the data categories.

Category 1 It is a data category of the chronic care patients: AID/HIV, chronic renal failure, tuberculosis, and disabled.

Category 2 It is population data used for health promotion.

Application 2: Data Processing (for each purpose)

The application receives the sorted-out data and imports them to the system to calculate the medical reimbursement. The data is processed based on its category, such as the application for AID/HIV reimbursement calculation, the application for chronic renal failure reimbursement calculation, and the application for population data analysis to create health promotion.

Application 3: Claim Validation (for each department)

It calculates the medical reimbursement for the chronic care patients and for the agency in charge of health promotion to issue the reports submitted to the management for approval.

Application 4: Financial and Accounting

The application manages the balance of the funds that support the reimbursement for the patients in the continuous care department as well as transferring the reimbursement to the health service providers. The application receives the summary reports of the approved reimbursement payment and the accounting system would process such data and transfer the reimbursement payment to the health service providers.

For the continuous care department, there are many applications that receive and process the data and calculate the medical reimbursement. However, it is necessary the applications should be divided according to the business logics used for data processing category. In fact, there are certain business processes that do not have their own applications, such as process of budget calculation for the establishment of the health promotion projects in the areas. As a result, the responsible employees have to export the data and process them by their offline system which does not allow the checking the working status.

The problems found in the continuous care department lead to the concept of the application development that meets the work process of the NHSO and that creates the central system to integrate the connection to all applications used for medical claim processing in chronic care and health promotion projects. This allows the checking of such data as described in the next section of the target application architecture.

3.5.2 Target Application Architecture

As discussed previously, baseline application architecture leads to the development of target application architecture in medical claims processing system for the episodic care department and the continuous care department with the following details.

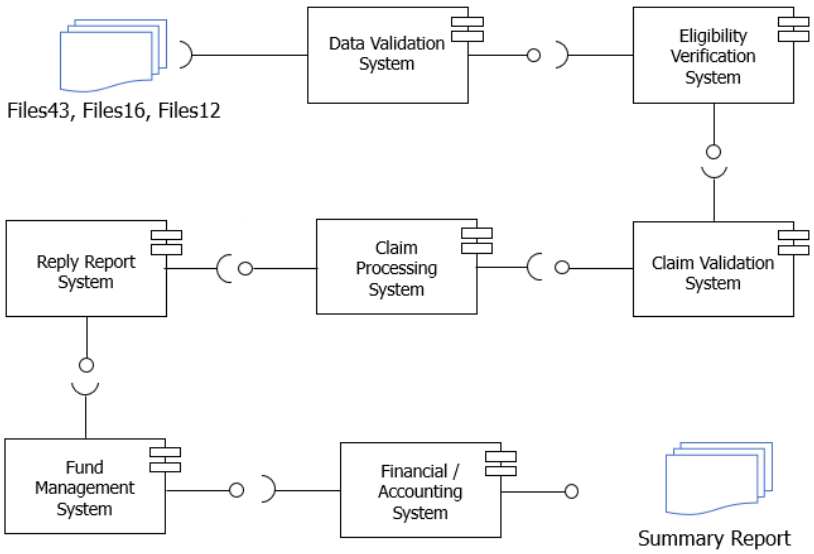

Figure 3.12 Component diagram of episodic care department in the target architecture

Figure 3.12 shows the application grouping based on the service principles in the form of standard module that supports the business architecture target of the NHSO in the episodic care department with 7 modules as the following.

Module 1: Data Validation System

The system validates the preliminary data of the patients and inserts them to the database which includes the sub-application as follows:

- e-Claim Online Module Validation: it validates the architecture and size of the patient files received from the health service providers.
- e-Claim Online Module Data Insertion: it inserts the data on the patient to the central database for processing.

Module 2: Eligibility Verification System

The system verifies the eligibility by using the application of e-Claim Online Module Eligibility Verification. The application verifies which type of medical coverage the patients are eligible for and what fund the patients are eligible for. It would read them from the population database and record the verified eligible patients in the database.

Module 3: Claim Validation System

The system validates the conditions of the medical claim processing that is supported by the e-Claim Online Module Claim Processing application. It validates the

conditions of payment according the announcement by the funds and saves the results from the checking whether it can be paid on the database.

Module 4: Claim Processing System

The system calculates the medical reimbursement with the sub-applications.

- e-Claim Online Module First Adjudication: it calculates the amount of the medical reimbursement paid based on the correctly checked conditions.
- e-Claim Online Module Second Adjudication: it organizes the payment data into the electronically-formatted reports and submit the reports to the management for approval.

Module 5: Reply Report System

The system issues the approved reports of medical reimbursement supported by the e-Claim Online Module Reply Report application. Its duty is to sending the notifications of the approved reports of medical reimbursement from the second adjudication to the health service providers.

Module 6: Fund Management System

The system creates a claim request and makes a document for signature after the reports of medical reimbursement has been approved from the second adjudication with the following sub-applications.

- e-Budget Module e-form: it retrieves the data from the database approved by the management to create the electronic reports for printing and signature.
- e-Budget Module Fund Processing: it checks the account balance of the annual budget of the funds to control the status of treasury reserves to remain positive. In addition, the application allows the funds to be checked.

Module 7: Financial/Accounting System

The system transmits the approved payment of medical reimbursement from the second adjudication to the financial system for payment. This process is supported by the SAP application.

In the target application, it was found that each of the application modules has a continuous data processing and contains the sub-applications within the similarly working modules. Import/export process of the patient data sets during processing is

reduced. The application development of the system-to-system connection is focused. Various categories of data are cut off by the development of the validation system to check whether the data are corrected as well as saving them on the database. For data processing in baseline architecture, the data validation is responsible by the CHI that uses file format different from that of the NHSO.

The medical reimbursement payment to the health service is separately calculated according to the conditions specified by the funds. However, the business logic is applied in the target architecture to calculate the medical reimbursement and insert it to the system. Consequently, the process of issuing the reports and payment summary can be made by all the funds, at the same time. This minimizes the impacts on the health service provides in case the delay of payment takes place. Moreover, it decreases the problems caused by the health service providers' accounting that cannot confirm the medical reimbursement details of the patients who are eligible for more than 1 fund payment.

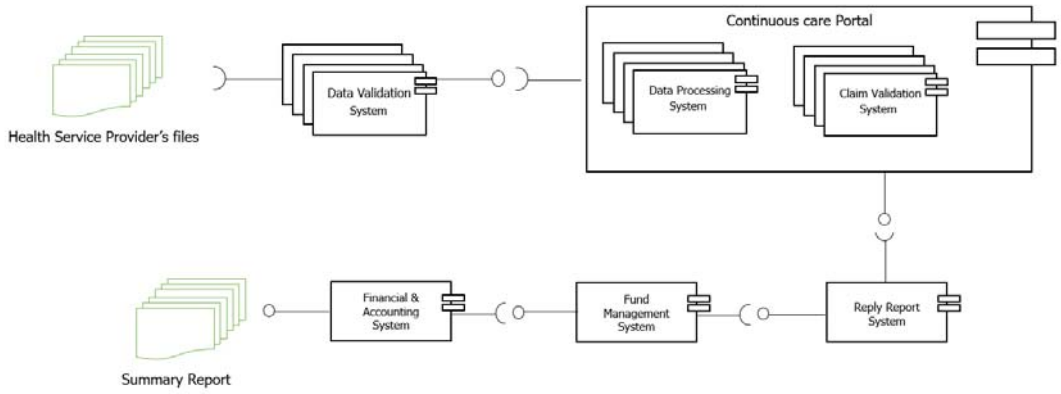

Figure 3.13 Component diagram of continuous care department in the target architecture

Figure 3.13 shows the application grouping based on the service principles in the form of standard module that supports the business architecture target of the NHSO in the continuous care department with 5 modules as the following.

Module 1: Data Validation System

The system receives the data for preliminary validation to sort out data category and insert them to the central database.

Module 2: Continuous Care Portal

The central portal for the continuous care department was developed with aim to serve as the center of gathering data processing system and the results from the data processing, keeping them in the same place. This process facilitates the checking of the data status and the approved results via the central portal. This portal also has its own submodules as presented below.

Submodule 1: Data Processing System

The system performs preliminary data processing that has been sorted out. Then, the data was sent to the claim validation system to calculate the medical reimbursement according to the specified conditions.

Submodule 2: Claim Validation System

The system receives the preliminarily processed data from the data processing system and subsequently performs the data processing by the following submodules.

Submodule 2.1 First Adjudication: performing the calculation of medical reimbursement of the chronic care patients and the expenses for the health promotion projects.

Submodule 2.2 Second Adjudication: organizing the payment data into the electronically-formatted reports and submission to the management for approval.

Module 3: Reply Report System

The system issues the approved reports of medical reimbursement supported by the e-Claim Online Module Reply Report application. Its duty is to sending the notifications of the approved reports of medical reimbursement from the second adjudication to the health service providers.

Module 4: Fund Management System

The system creates a claim request and makes a document for signature after the reports of medical reimbursement has been approved from the second adjudication with the following sub-applications.

- e-Budget Module e-form: it retrieves the data from the database approved by the management to create the electronic reports for printing and signature.

- e-Budget Module Fund Processing: it checks the account balance of the annual budget of the funds to control the status of treasury reserves to remain positive. In addition, the application allows the funds to be checked.

Module 5: Financial and Accounting System

The system transmits the approved payment of medical reimbursement from the second adjudication to the financial system for payment. This process is supported by the SAP application.

For the continuous care in the target architecture, it was found that there are some business processes similar to those of the episodic care from the beginning of receiving the data from the health service providers, preliminary data processing, and medical reimbursement calculation to the process of reimbursement transfer to the health service providers. Such similar processes include the processes of medical reimbursement calculation and reimbursement transfer to the health service providers. The standard module was designed to support the business process to be in line with the work process of the episodic care department in order to standardize the system and facilitate the future system management.

The target application architecture was designed to support the target business architecture of the continuous care department. The department has created the portal system to serve as the center of accessing to the processed data and of medical reimbursement calculation for the chronic care patients and the health promotion projects. This central portal serves to standardize the data validation and access to the processed data. Besides, there is an application developed for the expense calculation of the health promotion projects that cover processing and reduce the export of data to be processed offline.

1.5.3 Application Architecture - Gap Analysis

In this section, baseline application architecture is compared against target application architecture in medical claims processing for gap analysis. The solutions based on application perspective are also given in Table 3.2.

Table 3.2 Gap analysis for application architecture.

Baseline	Target	Gap	Solution
none	The episodic care department has its own application for receiving the data from the health service providers and performing preliminary data processing.	Create	An application should be developed to support the functions and data-receiving process and performing preliminary data processing by using the JAVA language.
none	The episodic care department has its own application for making DRG Grouper.	Create	An application should be developed to support the functions of DRG Grouper.
The episodic care department's application that supports the processes cannot be connected to send the data among the processes, resulting in the data processing that cannot continuously work.	The episodic care department's application that supports the processes can be connected to send the data among the processes, resulting in the continuous data processing	Update	The existing application should be developed to connect and send the data, including the work status during data processing.
The episodic care department's application that supports the medical reimbursement calculation separately processes the data to calculate the medical reimbursement according to the conditions specified by the funds.	Claim processing system is updated to be able to calculate the medical reimbursement according to the conditions specified by the funds.	Update	The claim processing system should be created by the development of new application using the JAVA language referring to the business logic applied to calculate the medical reimbursement according to the conditions specified by the funds.

Table 3.2 Gap analysis for application architecture. (cont.)

Baseline	Target	Gap	Solution
The process of medical reimbursement calculation by the episodic care department is a process of issuing the report by the funds responsible for the medical reimbursement payment to the health service providers.	The Reply Report System gathers the reports of the medical reimbursement calculation from all the funds and combines them into one report for the episodic care department.	Create	New application of issuing the summary report should be developed by the JAVA language.
none	The continuous care department has its own portal for access to the data processing and checking the medical reimbursement calculation.	Create	The Portal System should be developed for the continuous care department to standardize the access to the summary reports of the medical reimbursement calculation and facilitate the checking since the department involves many agencies and the complicated conditions of the medical reimbursement calculation.
The application that issues the summary reports of the medical reimbursement calculation and the reimbursement of the health promotion projects by the continuous care department separately issues the reports by the agencies responsible only for the medical reimbursement calculation, resulting in the amount of the reimbursement that cannot be checked.	none	Terminate	The original version of issuing the reports should be replaced with the Reply Report System for the episodic care department to have a standard of issuing the summary reports and facilitate the checking of amount of the reimbursement.

3.6 Data Architecture Analysis

In this section, the data sets used in the medical claims processing are presented and the data flow sets from the health service providers sending the data sets of patients for claim requests to the health service providers receiving the reimbursement payment are also shown. Those data sets include their detailed information and file types and the researcher divided the data set into four categories: baseline data architecture for episodic care, baseline data architecture for continuous care, target data architecture for episodic care continuous care that was supported the target business architecture implementation phases 1, 2 and 3.

3.6.1 Baseline Data Architecture

This section discusses the data sets that support the functions of the medical claim processing for episodic care and continuous care in the baseline architecture.

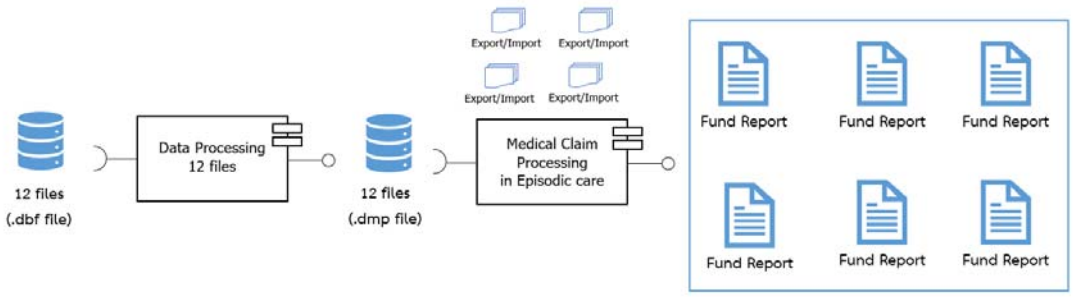

Figure 3.14 Baseline data architecture of data processing for episodic care

Figure 3.14 shows the data sets used in the episodic care and the baseline contained data sets that were similar to and different from the processes.

1. File 12 Data Set (the.dbf file format)

This type of data set was made by the health service providers and the data set included the detailed information of the patients, their diseases, and treatment methods. Then, the data set was sent to the CHI to sort out the data as shown in the data processing 12 files application and this data set would be sent to the NHSO for medical claim processing.

2. File 12 Data Set (the.dmp file format)

This data set was made by the NHSO for the medical claim processing. The preliminarily processed file 12 data sets were received from the CHI and inserted into the system. Then, the .dbf file type was converted to the .dmp file format to insert to the system of the NHSO, as the CHI and NHSO used different file formats for data processing.

3. Data Export/Import

It was found from the data processing of the medical claim processing for the episodic care that the sub-processes could not connect each other; therefore, the process of data export/import through the application occurred. Data processing in the sub-processes created the data duplicate in the system.

4. Fund Report

The fund report gathers the detailed information of data processing to make a medical claim processing approved by the management of each fund. Then, the fund report would send it for reimbursement transfer to the health service providers.

It was found from the data set flown in the system for the episodic care that the data set sent to the CHI by the health service providers for processing were the same data set that the NHSO inserted into the system for processing. The difference lied in the format since the CHI used Microsoft Visual FoxPro while that of the NHSO was the Oracle Database. Moreover, the summary reports of medical claim processing were required to convert the file type by the fund. These summary reports were issued separately by the funds which resulted in a large number of summary reports. Besides, the relationship of the patients eligible for more than 1 fund per claim request could not be found. It affected the health service providers' accounting that was not able to be closed on the accounting cycle as scheduled. This was caused by the health service providers that could not check and confirm the data of patients eligible for more than 1 fund as a specified time.

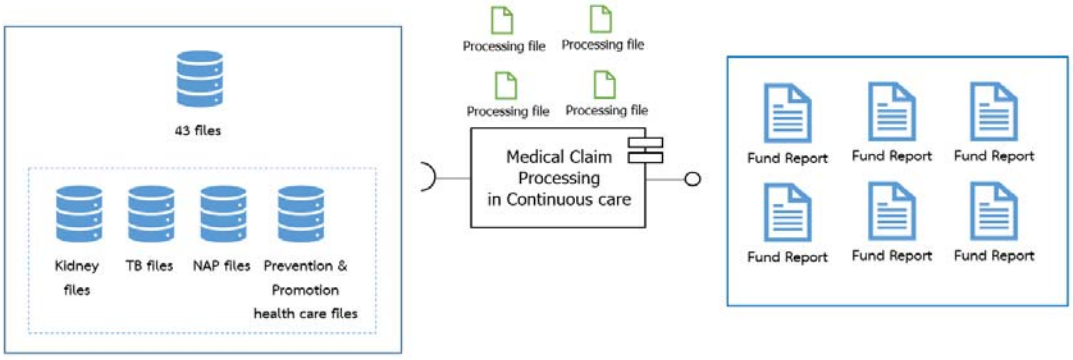

Figure 3.15 Baseline data architecture of data processing for continuous care

Figure 3.15 illustrates the data sets used in the continuous care and the baseline contained data sets flown in the processes as follows:

1. 43 Files

It is the data set sent to the NHSO for data processing and defining the prevention and healthcare promotion projects. The data set includes the patients eligible for the medical claims provided by the NHSO.

2. Chronic Care Data Set

The chronic care data set sent by the health service providers is used for the medical reimbursement calculation. Each type of data set is unique in detail and architecture. The NHSO has its own application for receiving each type of data set as follows:

2.1 Kidney Files

The data set for the patients with chronic renal failure is prepared by the health service providers.

2.2 TB Files

The data set for the patients with tuberculosis is prepared by the health service providers.

2.3 National AIDS Program (NAP) Files

The data set for the patients with AIDS/HIV infection is prepared by the health service providers.

2.4 Prevention & Promotion Health Care

The data set for the prevention and healthcare promotion projects is prepared by 13 NHSO branches.

3. Processing File

The data set is created during the processing. The medical reimbursement calculation for the continuous care department cannot perform data processing continuously and some data set is created from the process of data export from the center to be processed offline. This is because the application does not support the function but supports certain conditions such as the reimbursement calculation for the healthcare promotion projects by the NHSO branches.

4. Fund Report

The fund report gathers the detailed information of data processing to make a medical claim processing approved by the management of each fund. Then, the fund report would send it for reimbursement transfer to the health service providers.

From the explanation of the data set flown in the system of the continuous care department, it revealed that data set of the patients with chronic care varies since each process of chronic disease has different medical treatment and the creation of data set is also different. As a result, it is necessary to separately design data set and data receiving system for processing.

Moreover, the process of medical reimbursement calculation has a variety of data set as its data processing cannot support the business logic application. The data was exported from the center to be processed offline, and newly imported/exported data cannot be traced, resulting in the data duplicate in the processing system. The data exported from processing is read as the new data set when reimported.

3.6.2 Target Data Architecture

As mentioned earlier, baseline data architecture results in the development of target data architecture within medical claims processing system for the episodic care department and continuous care department as follows:

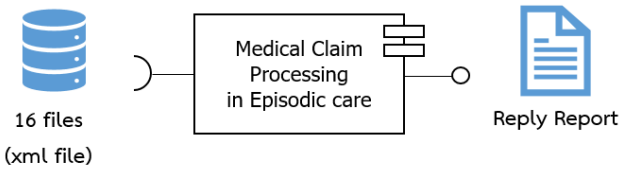

Figure 3.16 Target data architecture of data processing for episodic care

Figure 3.16 illustrates the data sets used in the continuous care and the baseline contained data sets flown in the processes as follows:

1. 16 Files (xml file format)

This type of data set was developed from the 12 files (.dbf file) used in the baseline, prepared by the health service providers. The data set is sent to the NHSO for data processing. The 16 files are in the xml format, transmitted to the NHSO's data processing via the web application interface by uploading the xml file to the system. The data set is encrypted before it is sent to the data processing of the NHSO to calculate the medical reimbursement.

2. Reply Report

The Reply Report summarizes the amount of medical reimbursement paid to the health service providers, developed from the Fund Report. From the baseline perspective, the Reply Report is a summary report of the medical reimbursement payment from the funds. It is processed by the same system and combines the medical claim data of the patients eligible for the funds in one summary report. This allows the health service providers to check and confirm the details of medical reimbursement of each patient through the Reply Report. In addition, the accounting cycle can be closed as scheduled.

According to the explanation of the data set and the data flow in the medical claim processing for the episodic care in the target, the problems of the data duplicate found in the baseline have been fixed. The problems were fixed by the application development that enabled the connection to the episodic care department to have a continuous data processing. In terms of issuing the Fund Report in the baseline, the data processing was developed to support the business logic applied to the medical reimbursement calculation of the funds to be included in the same system.

The system can issue the Reply Report to summarize the medical reimbursement of all the funds in one report.

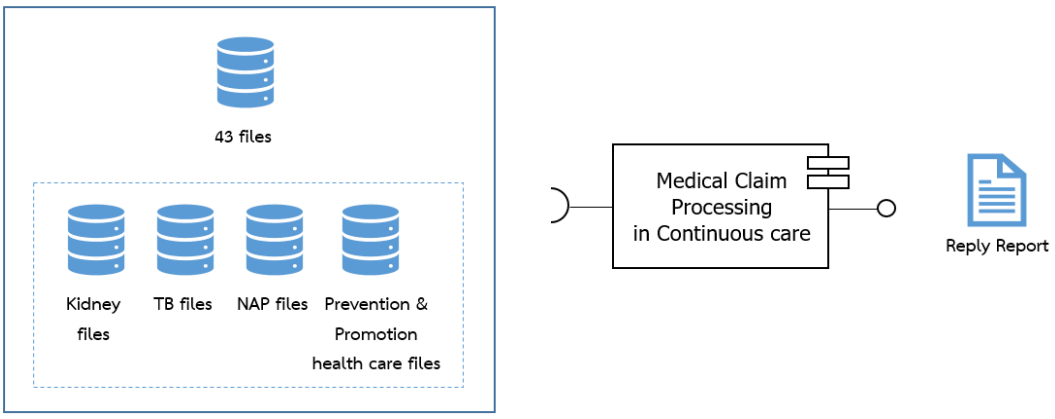

Figure 3.17 Target data architecture of data processing for continuous care

Figure 3.17 demonstrates the data sets used in the continuous care for the target architecture as the following.

1. 43 Files

It is the data set sent to the NHSO for data processing and defining the prevention and healthcare promotion projects. The data set includes the patients eligible for the medical claims provided by the NHSO.

2. Chronic Care Data Set

The chronic care data set sent by the health service providers is used for the medical reimbursement calculation. Each type of data set is unique in detail and architecture. The NHSO has its own application for receiving each type of data set as follows:

2.1Kidney Files

The data set for the patients with chronic renal failure is prepared by the health service providers.

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The data set for the patients with tuberculosis is prepared by the health service providers.

2.3 National AIDS Program (NAP) Files

The data set for the patients with AIDS/HIV infection is prepared by the health service providers.

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The data set for the prevention and healthcare promotion projects is prepared by 13 NHSO branches.

3. Reply Report

The Reply Report summarizes the amount of medical reimbursement paid to the health service providers, developed from the Fund Report. From the baseline perspective, the Reply Report is a summary report of the medical reimbursement payment from the funds. It is processed by the same system and combines the medical claim data of the patients eligible for the funds in one summary report. This allows the health service providers to check and confirm the details of medical reimbursement of each patient through the Reply Report. In addition, the accounting cycle can be closed as scheduled.

According to the explanation of the data set and the data flow in the medical claim processing for the continuous care in the target, the problems of the data duplicate found in the baseline have been fixed. The problems were fixed by the application development that include the medical reimbursement calculation of all the funds in the same system. There is no need of data export from the center to be processed offline, making it more reliable and traceable. Furthermore, it allows the issuing process of summary reports by the funds or the Fund Report in the baseline to be developed in the form of the Reply Report. The summary reports of the medical reimbursement from the funds can be included in one report which is the same standard of data processing as that of the episodic care department.

3.6.3 Data Architecture - Gap Analysis

In this section, baseline data architecture is compared against target data architecture of medical claims processing for gap analysis. Additionally, the solutions based on data perspective are provided in Table 3.3.

Table 3.3 Gap analysis for data architecture.

Baseline	**Target**	**Gap**	**Solution**
The data set received from the health service providers in the episodic care department is in the 12 Files of the .dbf format.	none	Terminate	The 12 Files should be terminated as the NHSO has changed its data storage.
none	The data set received from the health service providers in the episodic care department is in the 16 Files of the xml format.	Create	The data set of 16 Files should be replaced by the 12 Files as the data format has been changed in response to the standard of sending the data from the health service providers.
The data set is created during the processing and sent to the application for processing. The data duplicate can be found in this system for the episodic care department and continuous care department.	none	Terminate	The creation of data set to be sent to other applications in the system for processing should be terminated. The application developed by the system is able to send the data in the target architecture.

3.7 Technology Architecture Analysis

This section discusses the infrastructure and technology that support the application and data process of the medical claim processing of the episodic care department and continuous care department in the baseline technology architecture and target technology architecture that supports the target business architecture implementation phases 1, 2 and 3.

3.7.1 Baseline Technology Architecture

According to the application that supports the functions of the episodic care department in the baseline, the system that supports the application and the related database are found not to have any standards from the similar technology perspective. Moreover, there is no security standard that supports the data sending among the agencies as shown in the following two diagrams, Figures 3.18 and 3.19.

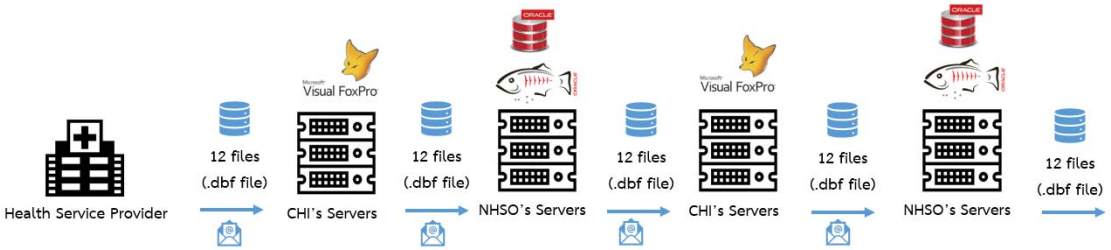

Figure 3.18 Application and data technology of data processing for the episodic care in the baseline system (1)

Figure 3.18 illustrates the process of data receiving from the health service providers through the preliminary data processing to the insertion of data to the medical reimbursement calculation with the following steps.

Step 1: The health service providers sends the data in the form of the 12 Files via email to the CHI.

Step 2: The CHI receives the patient data from the health service providers and inserts it to the system for processing that has the application developed from Microsoft Visual FoxPro that supports the functions of the application. In this process, there is a constraint of data processing that does not support the file larger than 2 GB. Moreover, it supports only the .dbf file format. After finishing data processing and sorting, the CHI exports the data in the form of the .dbf file and sends it to the NHSO.

Step 3: The NHSO receives the preliminarily processed data from the CHI via email and converts the file format from .dbf to the format that can be processed by the system of the NHSO. Then, the NHSO performs data processing of patient eligibility supported by the Oracle Database and the application developed by the JAVA language installed and working on the Glassfish application server on the Solaris operating system. After eligibility verification is finished, the NHSO exports the data and converts it to the format of .dbf file. Then, the data is sent back to the CHI for DRG Grouping.

Step 4: The CHI receives the data of verified eligibility from the NHSO through email and inserts it to the system for processing. DRG Grouping has an application developed by Microsoft Visual FoxPro similar to the functions of application in Step 2. After the DRG Grouping is made, the CHI exports the data in the format of .dbf file and sends it to the NHSO for processing.

Step 5: The NHSO receives the data processed by the DRG Grouping from the CHI through email and converts it from the format of .dbf file to the file format that can be inserted to the system of NHSO to calculate the medical reimbursement.

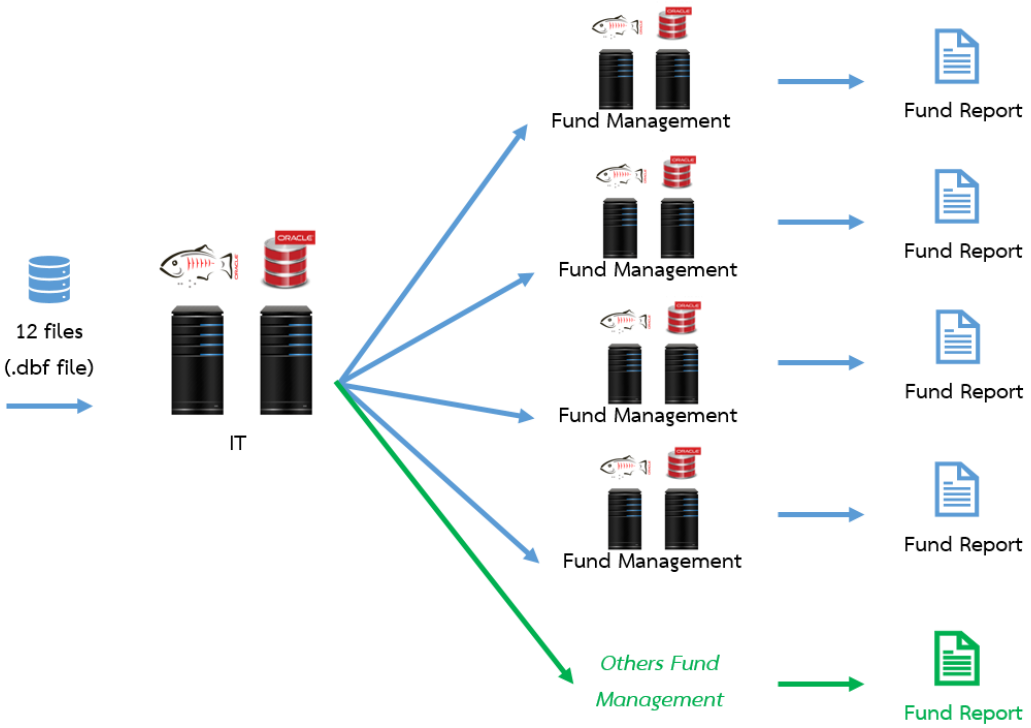

Figure 3.19 Application and data technology of data processing for the episodic care in the baseline system (2)

Figure 3.19 illustrates the steps of data processing for the medical reimbursement calculation for the episodic care that continues from Figure 3.18 as the following explanation.

Step 6: After the data processed by the DRG Grouping is received from the CHI and inserted it to the system of the NHSO, the data is exported in the format of .dbf file for the medical reimbursement calculation and sent to the responsible agency. The process of data export is supported by the Oracle Database and the application for processing developed by the JAVA language installed and working on the Glassfish application server on the Solaris operating system.

Step 7: Bureau of Claim Administration is responsible for checking the conditions of medical reimbursement for the patients. The Bureau receives the data processed by the DRG Grouping from the central system of the NHSO. The received data comes in the format of .dbf file through email for processing. This process is responsible by the different agencies according to the reimbursement principles and fund management of the NHSO. As in Figure 3.19, the data is exported for reimbursement calculation and issuing the Fund Report based on the number of funds. Then, the reports are submitted to the Bureau of Claim Administration for accounting issue. In this process, the Oracle Database supports the functions of the database and the application of processing developed by the Delphi (Pascal) language installed and working on the IIS application server on the Windows server operating system.

According to the explanation of baseline technology that supported the application and data for the episodic care department, the internal process of data processing system had no standard of adopting the corresponding technology. How the technology had been chosen depended on the agency. For example, the CHI chose Microsoft Visual FoxPro for development and data processing which allowed the connection to the NHSO that used the JAVA language for developing the application installed on the GlassFish application server. Meanwhile, Bureau of Claim Administration under the NHSO used the Delphi language to develop the application installed on the IIS application server. Converting file to the system created the import/export process from all systems and sent to the responsible agency for data processing. Consequently, data set in processing was not continuous and data duplicate was created in all systems that had its own internal data processing. This also

included the functions of database using oracle software installed on the hardware whose CPU chip was SPARC. The SPARC chip's parameters were tuned to reduce the duration of database for data processing as much as possible as recommended by the Oracle. However, the speed was not enough for the overall data processing. Thus, the NHSO decided to change a new set of hardware for database to improve the duration of time for data processing which was mentioned in target architecture.

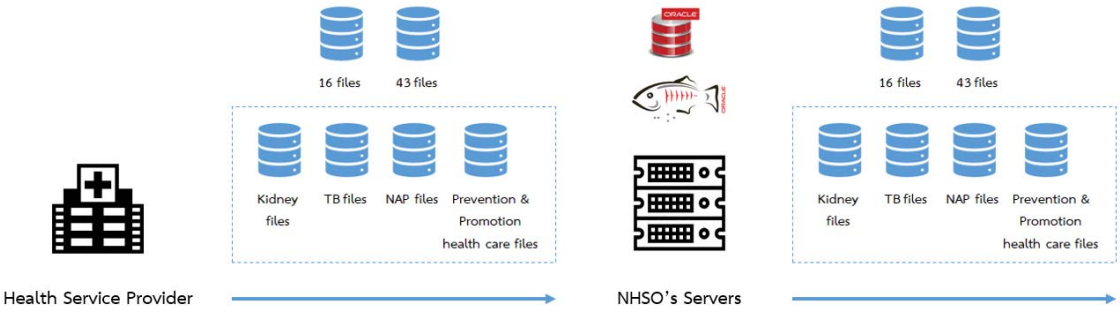

Figure 3.20 Application and data technology of data processing for the continuous care in the baseline system (1)

Figure 3.20 shows the receiving process of data from the health service providers and data insertion to the processing system for the continuous care as follows:

Step 1: The health service providers prepare the data set of 43 Files, Kidney Files, NAP Files, and Prevention and Healthcare Promotion Files. Then, these files are sent to the NHSO's system to perform medical claim processing by uploading the 43 Files via the NHSO's website and the data set of the patient with chronic care via the application that functions specifically as receiving the data and performing data processing.

Step 2: The NHSO's data processing system receives the data set from the health service providers and input them to the system for performing preliminary data processing, sorting out the data and sending them to the agencies responsible for data processing.

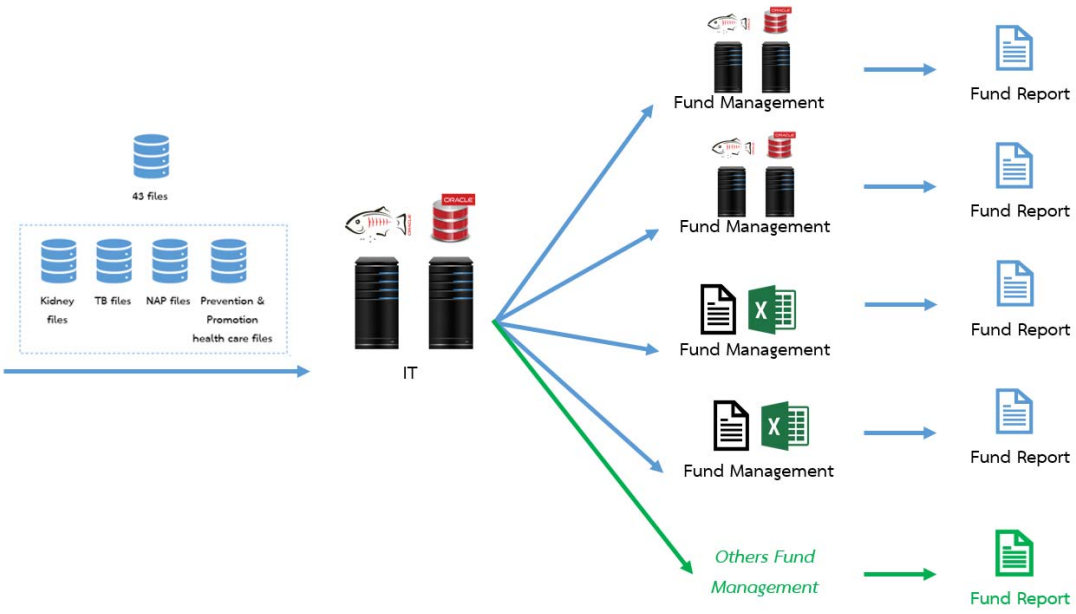

Figure 3.21 Application and data technology of data processing for the continuous care in the baseline system (2)

Figure 3.21 illustrates the steps of data processing for the medical reimbursement calculation for the continuous care that continues from Figure 3.20 as the following explanation.

Step 3: After the NHSO receives the data from the health service providers, it performs preliminary data processing to sort out the data and send it to the responsible agencies. The data sent to the agencies are exported in the format of the excel files and the .dmp files and send them to the responsible agencies to calculate the medical reimbursement via email.

Step 4: The agency responsible for the medical reimbursement calculation receives the data from the NHSO's central system. The data was preliminarily processed and sorted out. Such data are calculated for the medical reimbursement according to the conditions of the claim specified by the funds. Some agency used the data from the excel file to perform data processing offline. Then, the data are imported to the central system and saved when the data processing is finished. Moreover, some agency inputs the data in the format of the .dmp file supported by the Oracle Database that can perform data processing within the system. When every agency has finished calculating medical reimbursement, the Fund Report would be issued and sent to the

Bureau of Fund Management. Finally, the Bureau of Fund Management transfers the reimbursement to the health service providers and related agency.

According to the explanation of baseline technology architecture that supports the functions of the application and the data for the continuous care, the technology that supports the application cannot cover all business processes because some part of data processing has to import the data into the Excel file or Text file to perform offline data processing. This process is not traceable and the connection among the applications that support the receiving system and process of medical reimbursement calculation cannot be made. The data are subsequently submitted using system-to-system and the data import/export occurs for data processing.

The problems found in the baseline technology architecture resulted in the concept of the application development. The application was developed to support the business process that covers the conditions of the reimbursement. It can connect and forward the data among the agencies with system-to-system. Additionally, the language and technology should be appropriately selected for the development that perfectly fits the continuous care department. The application should continuously perform data processing since receiving the data from the health service providers and inputting it to the system to submitting the summary reports of the amount of reimbursement, including transfer the payment to the health service providers and the related NHSO branches.

3.7.2 Target Technology Architecture

Target technology architecture of medical claims processing for the episodic care department and continuous care department explains the development of infrastructure that supports the functions of the system and the infrastructure is designed to create the maximum benefits to the system.

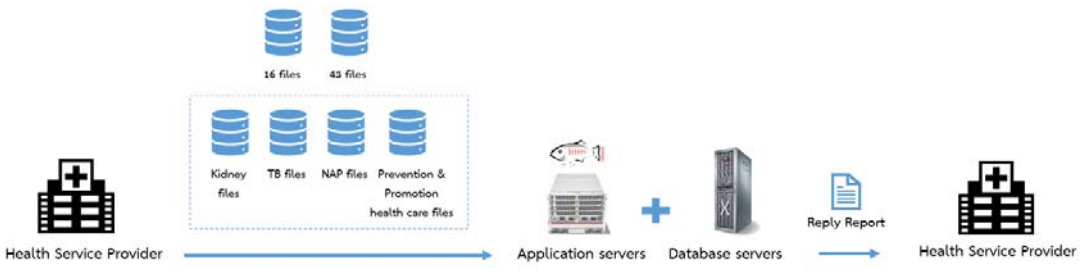

Figure 3.22 Target technology architecture of application and data processing for medical claim processing system

Figure 3.22 illustrates the functions of the application and process of data processing in the medical claims processing system for the episodic care department and continuous care department whose infrastructure is suitable for the support of the data processing of the system. It can be described according to the components in the system below.

1. Data sending/receiving system from the health service providers

The data sets for two departments can be sent by the health service providers. Such data set includes 16 Files, 43 Files, Kidney Files, TB Files, NAP Files, and Prevention and Promotion of Healthcare. They can be sent through the web application prepared by the agency responsible for the data set. The data sent must have the code for maintaining the data security and protection of data hacked by the outsiders, creating the standard of data preparation and submission to the NHSO.

2. Application that supports the functions of the system

The application that supports the data processing and that issues the reports of medical reimbursement was developed by the JAVA language. It was installed on the Glassfish application server on the UNIX operating system, building the standard of the application development in the same direction. In addition, it is easy to connect for data exchange of processing of application with system-to-system.

3. Database used in the system

The new hardware was replaced on the database system to support data processing of reimbursement calculation, and the database system of reimbursement calculation was moved to the new set of hardware. The new set of hardware was the Oracle Exadata which had been created for the Oracle database to work at its full

capacity, reducing the time duration of data processing in sub-process by 35 percent. The reduction in time of data processing was measured by the operation in the first adjudication for the episodic care department that had moved the database system to work on the Exadata in target architecture implementation phase 2 of the medical claims processing development.

3.7.3 Technology Architecture - Gap Analysis

In this section, baseline technology architecture is compared against target technology architecture of medical claims processing for gap analysis. Moreover, the solutions based on the data perspective are given in Table 3.4.

Table 3.4 Gap analysis for technology architecture

Baseline	Target	Gap	Solution
For the episodic care department, the process of preliminary data processing receives the data set of patients from the health service providers and DRG Grouper for the calculation of weighted mean has an application developed from Microsoft Visual FoxPro not conforming to the development principles of technology by the NHSO. The core business must be developed by the JAVA language.	none	Terminate	The system developed from Microsoft Visual FoxPro should be terminated and the new system should be developed to support the business process using the JAVA language. This practice conforms to the development standard.

Table 3.4 Gap analysis for technology architecture (cont.)

Baseline	Target	Gap	Solution
none	For the episodic care department, the preliminary data processing is received from the health service providers and DRG Grouper is for the calculation of weighted mean. The JAVA application was installed and functioned on the Glass application server.	Create	The application should be created to support the patient data processing and DRG Grouper. It should use the JAVA language to develop in accordance with the standard of the development of the core business application of the NHSO.
The CHI and NHSI do not access to the data with codes which provide the chance for the outsiders to hack the data. This process happens during the data sending/receiving among the health service providers.	The process of data sending/receiving between the health service and the NHSO was developed to allow the encryption to secure the data and no risk of data hacked.	Update	Encryption protects the process of data sending/receiving that can increase the security during the data exchange between the health service providers and the NHSO.
The Oracle Database was installed to support the data processing for the episodic care department and continuous care department on the SPARC server.	The Oracle Database was installed to support the data processing for the episodic care department and continuous care department on the Oracle Exadata.	Update	Hardware should be changed to support the database system for the episodic care department and the continuous care department to enhance the effectiveness of database system.

CHAPTER IV
RESEARCH METHODOLOGY

4.1 Introduction

This is an empirical research that aims to prove the concept of the development of medical claims processing system in the implementation phas1 and implementation phase 2 for the episodic care department. The development of medical claims processing is involved with business layer, application, data layer, and technology layer, demonstrating how effectively these layers can improve work process and data processing and in what direction it can improve. In addition, the key performance indicators are defined to reflect the suitability and be in accordance with the problems found in the medical claims processing system, ranging from the baseline architecture to the target architecture during the implementation phase 1 and implementation phase 2 for the episodic care department. In the end, its ultimate goal is to serve as a development guideline for the continuous care department in the future and such development was described in the following sections.

4.2 Population and sample

The data are analyzed with the aim to prove that the developed concept can fix the problems of work system that have occurred. Referred to the problem statement mentioned in Chapter 1 and the key performance indicators of the implementation phase 1 and implementation phase 2, the data sets for the analysis are obtained from the NHSO’s central database that gathers the data processed through medical claims for the episodic care department. Time processing is determined by the working group which includes Bureau of Insurance Information Administration or the IT Bureau. It starts from the baseline architecture analysis and ends at the target architecture implementation phase 2.

4.3 Data Collection

The data sets obtained are used for the analysis of overall working system after it is developed. The following are the details of problem statements written in Chapter 1.

4.3.1 Problem Statement #1 It talked about the medical claims processing that required a very long time in each step and which caused the delay of reimbursement transfer to the health service providers. Consequently, the researcher designed the data collection of time that each sub-system used for data processing in part of the episodic care department in the baseline architecture and target architecture implementation phase 2. Such data were used for the comparison of time processing before and after the system had been developed. It was also found that data collection form IT system, such as the data set that could specify time stamp of medical claims processing was difficult. The data of time processing and related data were not perfectly linked which resulted the difficulty of data gathering. Instead, the researcher decided to adopt an in-depth interview with highly-experienced staff in charge of the system and the officials of the IT Bureau that operates the actual work of baseline architecture. Moreover, it was referred to the manual guide of medical claims processing system of the 2007 – 2010 fiscal year with the following interviewees.

- Ms. Pornpimol Sirimai
- Mr. Grid Phonprisan
- Ms. Pitima Boonyaridpukdee
- Mr. Wisit Tundon
- Mr. Wachira Ketkaew
- Mr. Walun Krongsut
- Mr. Srisompop Kongsuk

Besides, the data collection of target architecture implementation phase 1 and phase 2 adopted an in-depth interview with highly-experienced staff in charge of the system and the operation officials who worked with the system. Since the data sets with the details of processing time were saved on the central database of the IT Bureau, it was found that there was a huge amount of data and it was very difficult to gather the time stamp data used for this research.

For data collection by the in-depth interview with the officials in charge of the system, the questions that would provide the expected results are stated as follows:

- How many days are required for data preparation received from the health service providers, starting from the health service providers that sent the data to the CHI for preliminary processing to the patient data sent to the NHSO to make eligibility verification?

- How long is it required for making eligibility verification by the NHSO and DRG Grouping? The process started from the NHSO receiving the preliminarily processed data from the CHI and inserting them to the system for eligibility verification. Then the verified patient data were sent back to the CHI for DRG Grouping.

- How long is it required for reimbursement calculation? The process started from the Bureau of Claim Administration receiving the verified patient data. The verified patient data were processed for medical reimbursement and a summary report of medical reimbursement for the funds.

- How long is it required for the checking of the data and medical reimbursement transfer? The process started from the Bureau of Fund Management receiving the summary reports of medical reimbursement from the Bureau of Claim Administration. Then, the Bureau of Fund Management checked the accuracy of the reports submitted to the management for approval of payment and transfer to the health service providers.

4.3.2 Problem Statement #2 It presented the connection problems of sending the data to each application that supported the processing in the sub-system. In addition, it demonstrated the details of medical reimbursement processing that was separately performed according to the principles of that fund. As a result, the health service providers could not check and confirm the data of medical reimbursement of the patients eligible for more than 1 Fund, which affected the health service providers unable to close accounting cycle. The researcher designed the data collection from the database of “Claim” that saved the medical claims processing specifically for the in-patients. The in-patients eligible for the claim and reimbursement from the Funds of the NHSO could be divided based on the rights of admission, beginning at the baseline architecture and ending at the target architecture implementation phase 2 from the

operation officials. The operation officials, in charge of medical claims processing, exported the data set from the database “Claim” in the format of the excel files and the text files. These two files would be analyzed and compared by the number of admission with medical reimbursement from more than 1 Fund whose data could not be checked. For baseline architecture, the data sets reflected the accounting problems of the health service providers and the number of admissions that were paid with medical reimbursement from more than 1 Fund. The target architecture implementation phase 2 was compared by the success ratio of medical reimbursement paid to the health service providers with the aim to show the effectiveness of processing system. Through the business process, the application development that supported the sub-systems resulted in the integration of medical claims processing system.

4.3.3 Problem Statement #3 It was concerned with the budget that drove the medical claims processing whose work process had been improved. Additionally, the responsible persons of business process and processing had been also improved to be in accordance with the policy of the cost reduction by the NHSO. Such costs were reduced in terms of data preparation process and data processing of DRG Grouping whose expenses could not be controlled. The NHSO did not have a system to support such processes; instead, the CHI, an outside agency, was outsourced to perform the data processing. For this problem, the researcher selected the in-patients with the medical claim processing in the baseline architecture by the operation staff in charge of the system. The costs of outsourcing the CHI on an annual basis were 5 baht per record. Such outsourcing costs were agreed upon the management between the NHSO and the CHI. The figure was part of the annual budget that drove the medical claims processing for the episodic care department, reflecting a decrease in the budget when the NHSO had developed the system of data preparation and data processing by the DRG Grouping on its own.

According to the annual budget for outsourcing, the researcher realized that the outsourcing expenses could be compared with the investment budget of the development of preliminary data processing and DRG Grouping to reflect the payback period of the system based on the cost effectiveness and payback period principles.

4.4 Data Analysis

After the data sets were defined for collection and analysis according to the problem statements in Chapter 1, the data analysis was divided into three parts based on the data sets obtained from the NHSO.

4.4.1. Time data of processing for the episodic care department

The researcher collected the data of time required for processing through the interview with the operation officials in charge of data processing for the episodic care department in baseline architecture and target architecture implementation phase 2. The data was collected according to the 4 sub-systems: data preparation received from the health service providers, eligibility verification and DRG Grouping, medical reimbursement calculation, and the checking of data and reimbursement transfer.

In comparison of the time used for data processing in the sub-systems between baseline architecture and target architecture, the calculation is presented as the following.

Variable X represents the time of sub-system of data processing for baseline architecture.

Variable Y represents the time of sub-system of data processing for target architecture.

$$Percentage\ of\ reduced\ time\ for\ data\ processing = \frac{(X \quad Y)}{X} \times 100$$

4.4.2 Success ratio data of reimbursement payment to the health service providers

The researcher collected the data from the operation officials responsible for the episodic care department at the IT Bureau of the NHSO. The dataset for baseline architecture data processing was in records from fiscal year of 2007to fiscal year of 2009. The dataset for target architecture implementation phase 1 was in the text files from the fiscal year on 2010 to the fiscal year of Jan-May 2013. It included dataset of patients who were eligible for the medical claims, medical reimbursement already paid to the health service providers based on the records for the fiscal years, and the number of Funds that paid the reimbursement according to the records. Sample of the dataset as show in Figure 4.1.

```
IPACC;SUBSTR(STMMS,1,2);COUNT(DISTINCTFUNDCODE)
0n04GI;53;1
0n04GL;53;1
0n04GM;53;1
0n04GP;53;1
0n04GQ;53;1
0n04GR;53;1
0n04GS;53;1
0n04GU;53;1
0n04GW;53;1
0n04GX;53;2
0n04GY;53;1
```

Figure 4.1 Example of dataset in baseline architecture

According to the example dataset in Figure 4.1, the third column has the number of 1 and 2 which indicated the number of Funds that have paid the reimbursement to the patients in that record and cannot be calculated to find the success ratio of medical reimbursement paid to the health service providers. Since the dataset is in the text files with size of 250 MB, the researcher imported such data to the Oracle Database with the 12c version to perform data processing and built the SQL loader script, namely, d.ctl as show in Figure 4.2.

```
[oracle@db12c ~]$ cat d.ctl
load data
infile '/home/oracle/BF_SEAMLESS.txt'
into table bfseamless
fields terminated by ';'
(admission,year,fund)
[oracle@db12c ~]$
[oracle@db12c ~]$
```

Figure 4.2 SQL loader script for importing text file to database

After the dataset has been imported to the database, the researcher used the SQL command for query of desired data from the database and summarized the number of the patients eligible for the claims and reimbursement. The following table as show in Table 4.1 illustrates the number of Funds that have paid the medical reimbursement for the 2007-2012 fiscal years and Jan-May of the 2013 fiscal year.

Table 4.1 Example of summary data in the fiscal year of 2007-2013

Number of Fund	**Number of Record**						
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**Jan-May 2013**
1	4,433,028	4,606,518	4,443,301	5,003,559	5,399,705	5,425,744	3,548,515
2	443,001	561,675	792,390	557,406	531,085	567,596	400,112
3	10,577	3,468	56,492	9,606	20,706	7,293	4,033
4	34	42	792	51	146	126	36
5	-	-	7	-	-	-	1
Summary	4,886,640	5,171,703	5,292,982	5,570,622	5,951,642	6,000,759	3,952,697

The dataset of the target architecture implementation phase 2 received from the episodic care department was in the excel files, showing the number of patients with medical reimbursement in the 2013-2015 fiscal years. It also included the details of the Funds that made the medical reimbursement payment and the number of patients who received the medical service charges from the Funds in Figure 4.3 and Figure 4.4.

SUBSTR(RUN_N	FUND_AF	COUNT(TRAN_ID)
2013	HC03,IP02	219
2013	IP01,DM04	82
2013	AE01,HC04	11
2013	AE01,DM04	19
2013	HC05,IP01	2
2013	IP02	148,300
2013	AE01,HC09	905
2013	HC04,IP01	60
2013	AE03	243
2013	DM01	443
2013	AE01,HC03	18
2013	AE02	28
2013	AE07,HC09	1
2013	AE08,IP01,DM04	3
2013	AE01,HC03,HC09	1
2013	DM09,HC09	76,228

Figure 4.3 Dataset example received from the episodic care department in the baseline architecture for the 2013 fiscal year

SUBSTR(RUN_N	FUND_AF	COUNT(TRAN_ID)
2014	IP01	6,710,513
2014	AE08,IP01	310,976
2014	AE01	617,601
2014	DM09,HC09,AE08	49
2014	IP01,DM04	4,811
2014	AE01,DM05	9
2014	AE08,HC03,IP02	10
2014	HC09	7
2014	HC03,IP01,HC09	2
2014	AE01,HC09,IP02	2
2014	HC03,HC09,IP01,DM04	4
2014	HC03,HC09,DM05	1
2014	AE06	2,797
2014	HC03,IP01	7,116
2014	HC04,IP01	2,452
2014	DM01,HC09	59

Figure 4.4 Dataset example received from the episodic care department in the baseline architecture for the 2014 fiscal year

From the above explanation, Figure 4.3 and Figure 4.4 demonstrate the dataset received from the operation officials, it was found that this dataset could not be used for finding the success ratio of the health service providers' medical reimbursement. Therefore, the researcher had to summarize this dataset to derive total number of patients who received the reimbursement. The following table is the number of Funds that have paid the reimbursement in the fiscal year of 2013 – 2015.

Table 4.2 Example of summary data in the fiscal year of 2013-2015

Number of Fund	**Number of Record**		
	Jun-Dec 2013	**2014**	**2015**
1	672,461	7,646,653	4,594,309
2	113,283	835,203	1,098,718
3	348	7,788	126,873
4	1	52	1,856
5	-	-	25
Summary	786,093	8,489,696	5,821,781

From the data of EA analysis in Chapter 3, the researcher designed the measurement of success ratio of medical reimbursement in the baseline architecture and compared it with the target architecture. The patient data was divided into two groups: patients who have already received the medical reimbursement from 1 Fund and patients who have not received the medical reimbursement from more than 1 Fund. This patient data would reveal the success ratio of the medical reimbursement payment since the data processing of the baseline architecture in medical reimbursement transfer to the health service providers was successful specifically on the patients eligible for 1 Fund. However, the data of patients who have not received the medical reimbursement from more than 1 Fund could not be checked as the systems of data processing, issuing reports, and data storage have not been connected. To reflect the success ratio of medical reimbursement to the health service providers, the formula and variables are demonstrated below.

Variable X represents the record of patients who received the medical reimbursement from 1 Fund in the fiscal year.

Variable Y represents the record of patients who received the medical reimbursement from more than 1 Fund in the fiscal year.

Variables Z represents the record of all patients who received the medical reimbursement from the fiscal year.

$$Percentage\ of\ success\ ratio\ of\ medical\ reimbusement = \frac{X+Y}{Z} \times 100$$

4.4.3 Budget data of outsourcing an outside agency for data processing

The NHSO is not allowed to provide the historical outsourcing budget, the researcher decided to use surrounding data that can reflect the outsourcing budget to manage data processing for the episodic care department. The data was gathered from the patients who received the medical reimbursement from the fiscal year of 2007 and 2009. Moreover, the data in 4.4.2 was used for the calculation of outsourcing the CHI handling the data processing for the NHSO and the outsourcing budget costs 5 baht per a record (The budget was agreed upon the management between the CHI and the NHSO.).

$$Amount\ of\ money\ outsourcing\ the\ CHI = Number\ of\ the\ in-patients\ receiving\ reimbursement \times 5$$

After the amount of money spending on outsourcing the CHI for handling data preparation in each fiscal year has been obtained, it is further calculated to find the payback period of the newly developed system. The calculation is performed based on the principles of benefit-cost analysis and payback period.

- **Interest Value** (i) is an inflation rate at a point in time, expressed in percentage.
- **Number of time period** (n) indicates the number of years taken into the payback period calculation.
- **Future Value (FV)** is an amount of investment in the system development, money spending on outsourcing the CHI and the negative cash flow is put in the initial investment.
- **Present Value (PV)** expresses the amount of money whose variable rate is in line with the interest value.
- **Net Present Value (NPV)** is a summation of money with the calculation of variable rate in line with the interest value, reflecting a new value the system can make.

The payback period calculation can reveal that after the NHSO has developed its own system and terminated the contract with the CHI, in what fiscal year does the cash flow turn positive from the negative cash flow of the operating activity of outsourcing in the baseline architecture and the cash flow of the system development in the target architecture? This is to show the benefit-cost analysis of the system that results in the NPV reflecting the trend of expense reduction in response to the policy from the management.

$$PV = \frac{FV}{(1+i)^n}$$

$$NPV = \sum PV$$

4.5 Limitation

It was found that data collection method does not conform to the best practices with the following details.

- Data set used in the sub-system of medical claim processing in the baseline architecture cannot be found from the time stamp of the dataset in the central database. With the huge size of dataset, the officials are not able to retrieve the data of time for data processing from the system. The researcher decided to conduct data collection by means of in-depth interview with the operation staff in charge of medical claim processing and to be in accordance with the processing standards of the system. Moreover, the researcher refers the time for data processing of the processes to the manual guide of medical claims processing management stated in the 2007 – 2009 fiscal year as well as making the data more reliable.

- For data set used in the sub-system of medical claims processing in the baseline architecture, the operation staff in charge of medical claims processing showed an example of the time stamp data; however, the operation staff did not retrieve the data of time for processing since the size of the data stored in the central database is large, making it difficult to export the data. The officials decided to provide the data by interview approach.

- The processed patient data in the baseline architecture of in the 2007 – 2009 fiscal year saved on the central database is difficult to find the relationship among the data and the dataset is huge which does not allow the data to be exported in the text file. As a result, the researcher has been given the excel file.

- The dataset of budget for outsourcing investment in the outside agency handling the baseline architecture in the 2007 – 2009 fiscal year could not be provided since such investment is a confidential business information. Thus, the researcher needs to find additional features of money spent on outsourcing the CHI for data preparation. It was found that the service rate of the CHI for data preparation is 5 baht per a record. The service has been agreed upon the management between the CHI and the NHSO. The researcher has to find the amount of money that reflects the true outsourcing budget that drives medical claims processing. The calculation is as follows: the number of records of all in-patients receiving reimbursement is multiplied by the service rate of the CHI.

4.6 Proposed KPIs

This section discusses the proposed key performance indicators based on the problem statement in Chapter 1. These KPIs measured the success of the organization and the system is developed as specified in the target architecture implementation phase 1 and phase 2 as the following.

4.6.1 KPI#1 It is expected medical claims processing time reduces by 30 – 45 days.

This research indicates the processing time for each of sub-systems reduces, resulting in more effective medical claims processing and making a faster reimbursement payment to the health service providers.

4.6.2 KPI#2 It is expected the reimbursement payment affecting the health service providers decreases by 50 percent.

This research demonstrates the effects on the health service providers in case the data of patients eligible for more than 1 Fund that cannot be checked are decreased. The success rate of medical reimbursement payment to the health service providers increases. The percentage of reimbursement payment to the health service providers reduces.

4.6.3 KPI#3 It is expected the budget that drives annual medical claims processing reduces by 20 percent.

This research reveals the budget figures that the NHSO has spent on outsourcing the outside agency in baseline architecture during the 2007 – 2009 fiscal year to reflect the amount of money that has been lost in driving medical claims processing. Besides, it also reflects the idea of expenses reduction of outsourcing. The variable rate of data processing that outsources the CHI is in line with the number of patients and claim requests are directly sent to the NHSO which is the amount of money that the NHSO cannot control.

CHAPTER V
RESULT AND DISCUSSION

5.1 Introduction

This section presents the results from the data set processing from the guideline in Chapter 4. The results are then concluded and divided according to the KPIs. The timing for data collection is as follows:

- Baseline architecture: 2007 – 2008 Fiscal Year
- Target architecture implementation phase 1**:** 2009 – 2012 Fiscal Year
- Target architecture implementation phase 2: 2013 – 2015 Fiscal Year

5.2 Results of KPI#1

The results from data collection in Chapter 4 measured the KPI#1 stating the processing time of medical claims service in baseline architecture comparing with target architecture implementation phase 1 and phase 2. The data was separately collected according to the nature of sub-processes as shown in the following tables.

5.2.1 Process of data preparation received from the health service providers

This section demonstrates the processing time of data preparation received from the health service providers for different time periods of data collections as shown in Tables 5.1 – 5.3.

Table 5.1 Processing time of data preparation received from the health service providers in baseline architecture:

Baseline Architecture	**Processing Time (Day)**
2007 Fiscal Year	30 days
2008 Fiscal Year	30 days

Table 5.2 Processing time of data preparation received from the health service providers in target architecture implementation phase 1:

Target Architecture (Implementation phase1)	**Processing Time (Day)**
2009 Fiscal Year	1 day
2010 Fiscal Year	1 day
2011 Fiscal Year	1 day
2012 Fiscal Year	1 day

Table 5.3 Processing time of data preparation received from the health service providers in target architecture implementation phase 2:

Target Architecture (Implementation phase2)	**Processing Time (Day)**
2013 Fiscal Year	0.25 day
2014 Fiscal Year	0.25 day
2015 Fiscal Year	0.25 day

Data set of the processing time of data preparation received from the health service providers covering baseline architecture and target architecture implementation phase 2 can be summarized in the graph for a better understanding of comparison as shown in Figure 5.1.

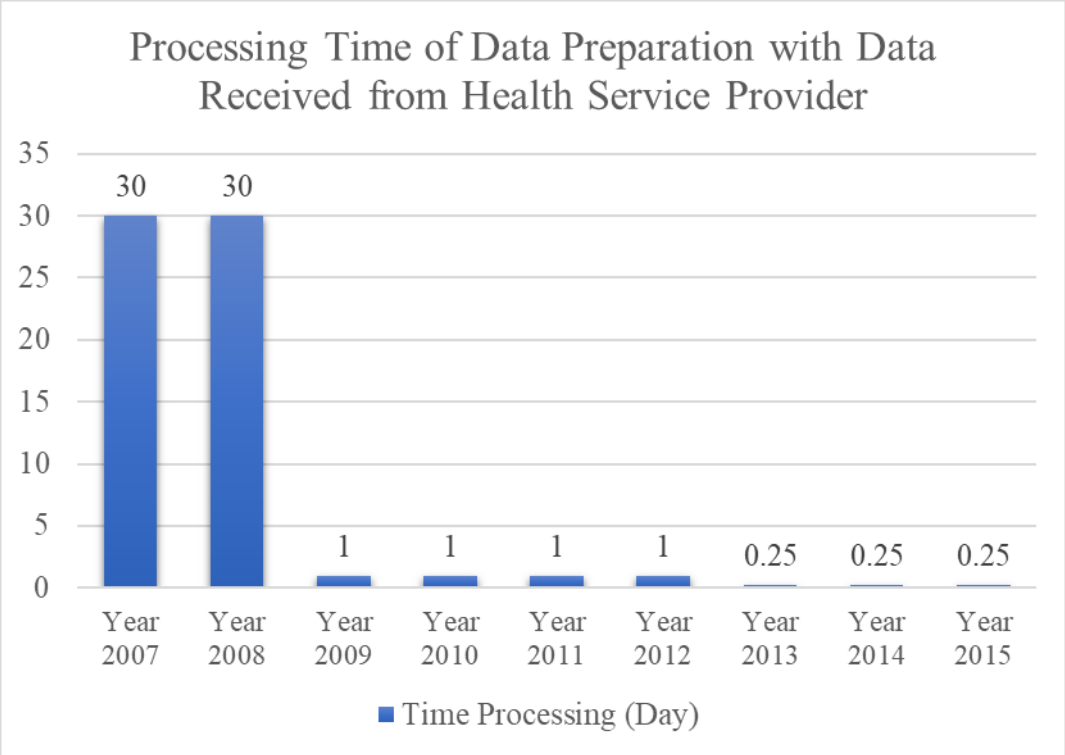

Figure 5.1 Graph that summarized processing time of data preparation process

Figure 5.1 illustrates the processing time of data preparation process with the data received from the health service providers. The data can be calculated to derive processing time and the comparison was made between baseline architecture and target architecture to reflect the development of medical claims processing. The researcher cited 3 examples for making a comparison based on the changes shown in the graphs with the calculation method stated in Chapter 4 as the following.

- A comparison between 2007 fiscal year and 2008 fiscal year was made to reflect the reduced rate of processing time between baseline architecture and target architecture implementation phase 1.

From the equation of the reduced processing time in percentage:

$$Percentage\ of\ reduced\ processing\ time = \frac{(X - Y)}{X} \times 100$$

Variable X represents the processing time for data preparation process with the data received from the health service providers in 2007 fiscal year.

Variable Y represents the processing time for data preparation process with the data received from the health service providers in 2009 fiscal year.

Then, plug in the variable values into the equation:

$$Percentage\ of\ reduced\ processing\ time\ = \frac{(30-1)}{30} \times 100$$

It can be concluded from the equation that the reduced processing time for data preparation with the data received from the health service providers between 2007 fiscal year in baseline architecture and 2009 fiscal year in target architecture implementation phase 1 was 96.67 percent.

- A comparison between 2009 fiscal year and 2014 fiscal year was made to reflect the reduced rate of processing time between target architecture implementation phase 1 and target architecture implementation phase 2.

From the equation of the reduced processing time in percentage:

$$Percentage\ of\ reduced\ processing\ time = \frac{(X-Y)}{X} \times 100$$

Variable X represents the processing time for data preparation process with the data received from the health service providers in 2007 fiscal year.

Variable Y represents the processing time for data preparation process with the data received from the health service providers in 2014 fiscal year.

Then, plug the variable values into the equation:

$$Percentage\ of\ reduced\ processing\ time\ = \frac{(1-0.25)}{1} \times 100$$

It can be concluded from the equation that the reduced processing time for data preparation with the data received from the health service providers between 2007 fiscal year in target architecture implementation phase 1 and 2014 fiscal year in target architecture implementation phase 2 was 75 percent.

- A comparison between 2007 fiscal year and 2014 fiscal year was made to reflect the reduced rate of processing time between baseline architecture and target architecture implementation phase 2.

From the equation of the reduced processing time in percentage:

$$Percentage\ of\ reduced\ processing\ time = \frac{(X-Y)}{X} \times 100$$

Variable X represents the processing time for data preparation process with the data received from the health service providers in 2007 fiscal year.

Variable Y represents the processing time for data preparation process with the data received from the health service providers in 2014 fiscal year.

Then, plug the variable values into the equation:

$$Percentage\ of\ reduced\ processing\ time = \frac{(30 - 0.25)}{30} \times 100$$

It can be concluded from the equation that the reduced processing time for data preparation with the data received from the health service providers between 2007 fiscal year in baseline architecture and 2014 fiscal year in target architecture implementation phase 2 was 99.17 percent.

5.2.2 Eligibility verification and data processing of DRG Grouping

This section illustrates the processing time of eligibility verification and data processing of DRG Grouping for different time periods of data collections as shown in Tables 5.4 - 5.6.

Table 5.4 Processing time of eligibility verification and data processing of DRG Grouping in baseline architecture:

Baseline Architecture	**Processing Time (Day)**
2007 Fiscal Year	30 days
2008 Fiscal Year	30 days

Table 5.5 Processing time of eligibility verification and data processing of DRG Grouping in target architecture implementation phase 1:

Target Architecture (Implementation phase1)	**Processing Time (Day)**
2009 Fiscal Year	1 day
2010 Fiscal Year	1 day
2011 Fiscal Year	1 day
2012 Fiscal Year	1 day

Table 5.6 Processing time of eligibility verification and data processing of DRG Grouping in target architecture implementation phase 2:

Target Architecture (Implementation phase2)	**Processing Time (Day)**
2013Fiscal Year	1 day
2014 Fiscal Year	1 day
2015 Fiscal Year	1 day

Data set of the processing time of eligibility verification and data processing of DRG Grouping starting from baseline architecture to target architecture implementation phase 2 can be summarized into the graph for a better understanding of comparison as shown in Figure 5.2.

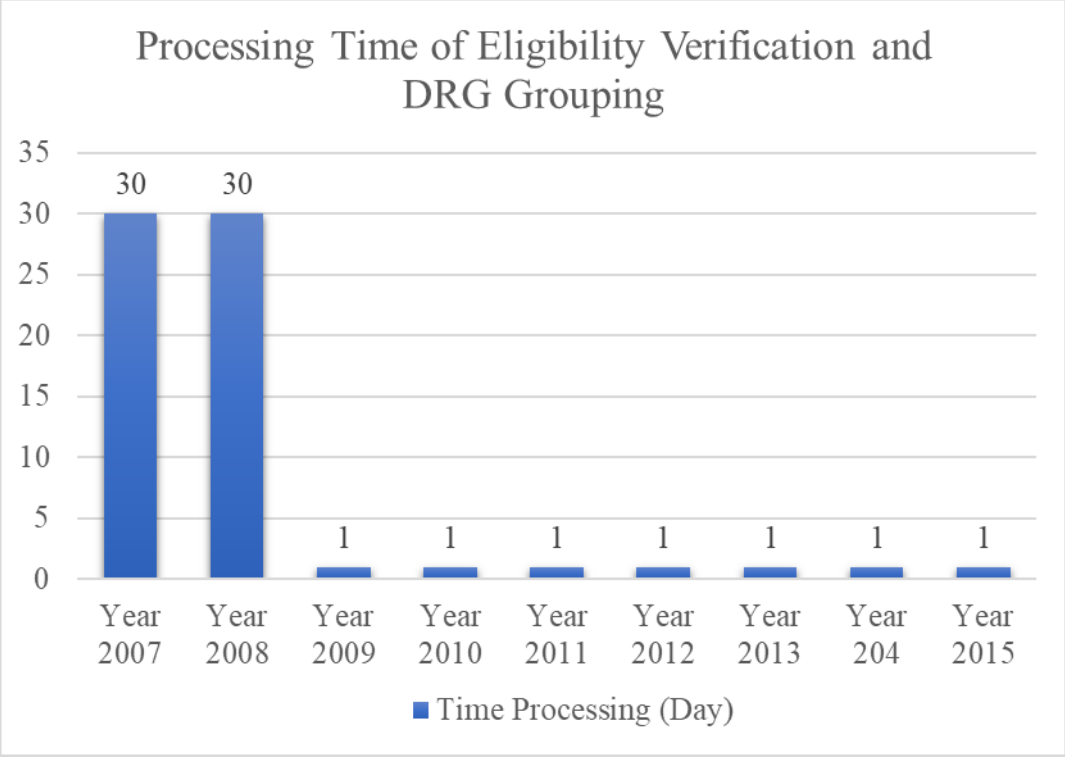

Figure 5.2 Graph that summarized processing time of eligibility verification and DRG Grouping

Figure 5.2 illustrates the processing time of eligibility verification and DRG Grouping. The data can be calculated to derive processing time and the comparison was made between baseline architecture and target architecture to reflect the development of medical claims processing according to the calculation method stated in Chapter 4 as the following.

From the equation of the reduced processing time in percentage:

$$Percentage\ of\ reduced\ processing\ time = \frac{(X - Y)}{X} \times 100$$

Variable X represents the processing time for data preparation process with the data received from the health service providers in 2007 fiscal year.

Variable Y represents the processing time for data preparation process with the data received from the health service providers in 2012 fiscal year.

Then, plug the variable values into the equation:

$$Percentage\ of\ reduced\ processing\ time = \frac{(30 - 1)}{30} \times 100$$

It can be concluded from the equation that the reduced processing time for eligibility verification and data processing of DRG Grouping between 2007 fiscal year in baseline architecture and 2012 fiscal year in target architecture was 96.67 percent.

5.2.3 Process of reimbursement calculation

This section demonstrates the processing time of reimbursement calculation process for different time periods of data collections as shown in Tables 5.7 - 5.9.

Table 5.7 Processing time of reimbursement calculation process in baseline architecture:

Baseline Architecture	**Processing Time (Day)**
2007 Fiscal Year	30 days
2008 Fiscal Year	30 days

Table 5.8 Processing time of reimbursement calculation process in target architecture implementation phase 1:

Target Architecture (Implementation phase1)	**Processing Time (Day)**
2009 Fiscal Year	30 days
2010 Fiscal Year	30 days
2011 Fiscal Year	30 days
2012 Fiscal Year	30 days

Table 5.9 Processing time of reimbursement calculation process in target architecture implementation phase 2:

Target Architecture (Implementation phase2)	**Processing Time (Day)**
2013 Fiscal Year	1 day
2014 Fiscal Year	1 day
2015 Fiscal Year	1 day

Data set of processing time of reimbursement calculation process starting from baseline architecture to target architecture implementation phase 2 can be summarized into the graph for a better understanding of comparison as shown in Figure 5.3.

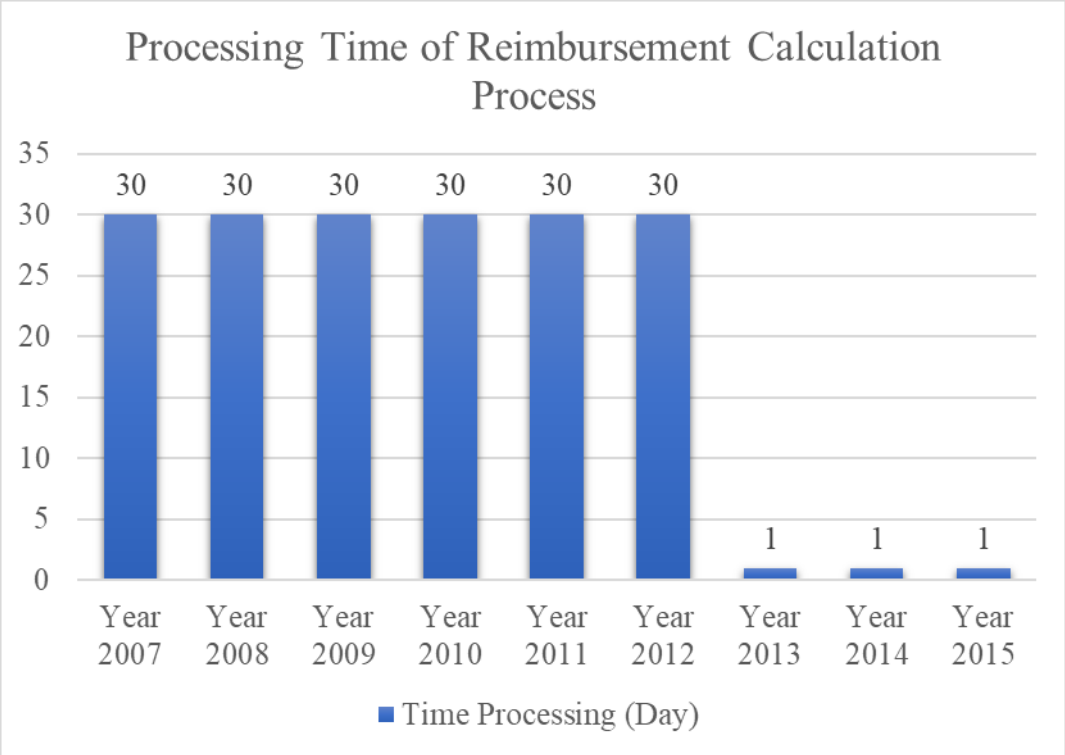

Figure 5.3 Graph that summarized processing time of reimbursement calculation

Figure 5.3 illustrates the processing time of reimbursement calculation process. The data can be calculated to derive processing time and the comparison was made between baseline architecture and target architecture to reflect the development of medical claims processing according to the calculation method stated in Chapter 4 as the following.

From the equation of the reduced processing time in percentage:

$$Percentage\ of\ reduced\ processing\ time = \frac{(X - Y)}{X} \times 100$$

Variable X represents the processing time for reimbursement calculation process with the data received from the health service providers in 2007 fiscal year.

Variable Y represents the processing time for reimbursement calculation process with the data received from the health service providers in 2013 fiscal year.

Then, plug the variable values into the equation:

$$Percentage\ of\ reduced\ processing\ time = \frac{(30 - 1)}{30} \times 100$$

It can be concluded from the equation that the reduced processing time for reimbursement calculation process between 2007 fiscal year in baseline architecture and 2013 fiscal year in target architecture was 96.67 percent.

5.2.4 Process of data checking and payment transfer

This section illustrates the processing time of data checking and payment transfer for different time periods of data collections as shown in Tables 5.10 - 5.12.

Table 5.10 Processing time of data checking and payment transfer in baseline architecture:

Baseline Architecture	**Processing Time (Day)**
2007 Fiscal Year	30 days
2008 Fiscal Year	30 days

Table 5.11 Processing time of data checking and payment transfer in target architecture implementation phase 1:

Target Architecture (Implementation phase1)	**Processing Time (Day)**
2009 Fiscal Year	30 days
2010 Fiscal Year	30 days
2011 Fiscal Year	30 days
2012 Fiscal Year	30 days

Table 5.12 Processing time of data checking and payment transfer in target architecture implementation phase 2:

Target Architecture (Implementation phase2)	**Processing Time (Day)**
2013 Fiscal Year	1 day
2014 Fiscal Year	1 day
2015 Fiscal Year	1 day

Data set of the processing time of data checking and payment transfer starting from baseline architecture to target architecture implementation phase 2 can

be summarized into the graph for a better understanding of comparison as shown in Figure 5.4.

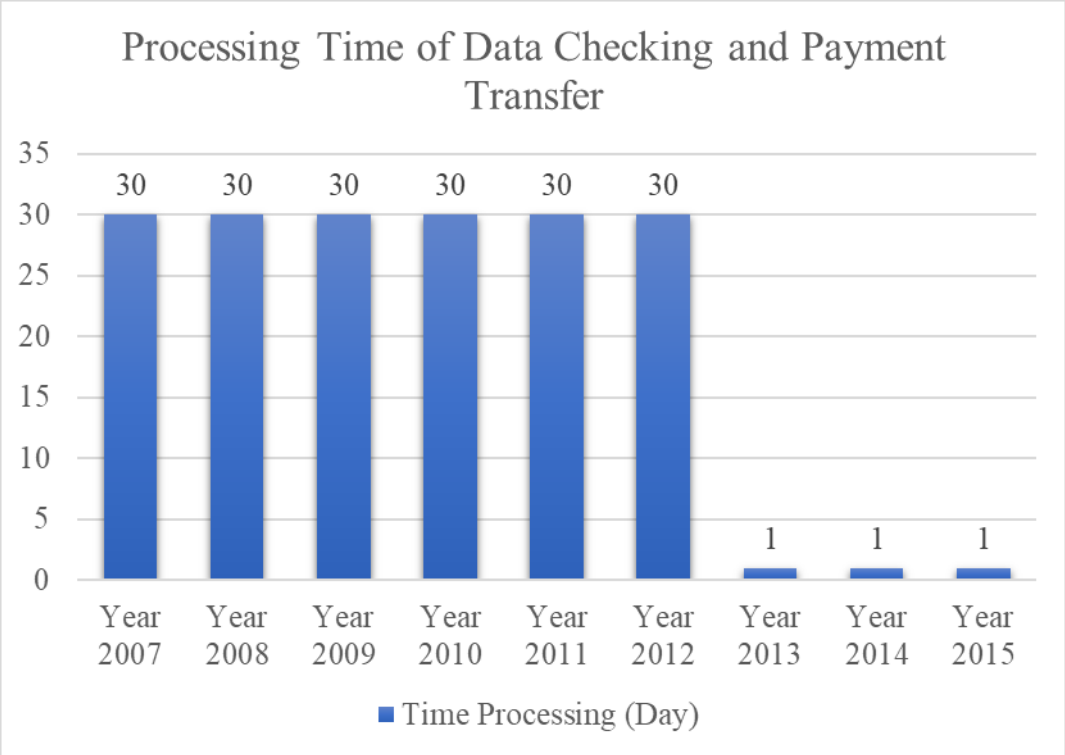

Figure 5.4 Graph that summarized processing time of data checking and payment transfer

Figure 5.4 illustrates the processing time of data checking and payment transfer process. The data can be calculated to derive processing time and the comparison was made between baseline architecture and target architecture to reflect the development of medical claims processing according to the calculation method stated in Chapter 4 as the following.

From the equation of the reduced processing time in percentage:

$$Percentage\ of\ reduced\ processing\ time = \frac{(X - Y)}{X} \times 100$$

Variable X represents the processing time for reimbursement calculation process with the data received from the health service providers in 2007 fiscal year.

Variable Y represents the processing time for reimbursement calculation process with the data received from the health service providers in 2013 fiscal year.

Then, plug the variable values into the equation:

$$Percentage\ of\ reduced\ processing\ time = \frac{(30-1)}{30} \times 100$$

It can be concluded from the equation that the reduced processing time for reimbursement calculation process between 2007 fiscal year in baseline architecture and 2013 fiscal year in target architecture was 96.67 percent.

5.3 Results of KPI#2

The results from data collection process and data processing which had been stated in Chapter 4 to measure the KPI#2 were related to the success rate of reimbursement payment to the health service providers of medical claims processing. Such results in baseline architecture and target architecture implementation phase 1 and phase 2 would be also compared and their data were separately collected based on the time of system whose business process was different in baseline architecture and target architecture. Then, the collected data were summarized into Table 5.13 that illustrates the success rate of reimbursement payment to the health service providers. The number of patients who were paid the reimbursement from 1 Fund and the number of patients who were paid from more than 1 Fund would be compared with the number of patients eligible for the reimbursement (a group of patients that the health service providers made claim requests to the NHSO) by the calculation of success rate of reimbursement payment to the health service providers within the fiscal year as shown in Table 5.13.

Table 5.13 Success rate of reimbursement paid in each fiscal year

Fiscal Year	Number of patients receiving all imbursements	Number of patients eligible for reimbursement from 1 Fund	Number of patients receiving reimbursement from 1 Fund	Number of patients eligible for more than 1 Fund	Number of patients receiving reimbursement from more than 1 Fund	Success rate of reimbursement payment (%)
2007	4,886,640	4,433,028	4,433,028	453,612	0	90%
2008	5,171,703	4,606,518	4,606,518	565,185	0	89%
2009	5,292,982	4,443,301	4,443,301	849,681	0	84%
2010	5,570,622	5,003,559	5,003,559	567,063	0	89%
2011	5,951,642	5,399,705	5,399,705	551,937	0	90%
2012	6,000,759	5,425,744	5,425,744	575,015	0	90%
2013	4,738,790	4,220,976	4,220,976	517,814	113,632	91%
2014	8,489,696	7,646,653	7,646,653	843,043	843,043	100%
2015	5,821,781	4,594,309	4,594,309	1,227,472	1,227,472	100%

From the data in Table 5.13, the researcher cited two examples for the calculation of success rate of reimbursement payment in baseline architecture and target architecture with the following details.

Example 1: Find the success rate of reimbursement payment in fiscal year of 2007.

From the equation of success rate of reimbursement payment:

$$Success\ rate\ of\ reimbursement\ payment\ in\ percentage = \frac{X+Y}{Z} \times 100$$

Variable X represents the number of records of patients who were paid with the reimbursement by 1 Fund in fiscal year of 2007: 4,433,028.

Variable Y represents the number of records of patients who were paid with the reimbursement by more than 1 Fund in fiscal year of 2007: 0.

Variable Z represents the number of records of patients who were paid with all reimbursements in fiscal year of 2007: 4,886,640.

$$Success\ rate\ of\ reimbursement\ payment\ in\ percentage\ in\ fiscal\ year\ of\ 2007 = \frac{4{,}433{,}028 + 0}{4{,}886{,}640} \times 100$$

Example 2: Find the success rate of reimbursement payment in fiscal year of 2015.

From the equation of success rate of reimbursement payment:

$$Success\ rate\ of\ reimbursement\ payment\ in\ percentage = \frac{X + Y}{Z} \times 100$$

Variable X represents the number of records of patients who were paid with the reimbursement by 1 Fund in fiscal year of 2014: 4,594,309.

Variable Y represents the number of records of patients who were paid with the reimbursement by more than 1 Fund in fiscal year of 2014: 1,227,472 Data set and data processing are linked together so the researcher can check the data of patients who were paid with the reimbursement by more than 1 Fund.

Variable Z represents the number of records of patients who were paid with all reimbursements in fiscal year of 2014: 5,821,781.

$$Success\ rate\ of\ reimbursement\ payment\ in\ percentage\ in\ fiscal\ year\ of\ 2015 = \frac{4{,}594{,}309 + 1{,}227{,}472}{5{,}821{,}781} \times 100$$

5.4 Results for KPI#3

The results from data collection process and data processing stated in Chapter 4 to measure the KPI#3 were concerned with the budget for outsourcing the CHI for handling data preparation and data processing of DRG Grouping. Such results showed the amount of budget for outsourcing the CHI in baseline architecture and in target architecture, indeed. The researcher calculated the budget for outsourcing the CHI in case the NHSO continues its outsourcing contract with the CHI as shown in Table 5.14. Demonstrating the amount of budget was italicized and underlined according to the number of patients who were paid with reimbursement that was shown in Table 5.13 at section 5.3.

Table 5.14 Budget for outsourcing the CHI

Fiscal Year	Number of patients paid with reimbursement	Budget for outsourcing
2007	4,886,640 patients	24,433,200 baht
2008	5,171,703 patients	25,858,515 baht
2009	5,292,982 patients	*26,464,910 baht*
2010	5,570,622 patients	*27,853,110 baht*
2011	5,951,642 patients	*29,788,210 baht*
2012	6,000,759 patients	*30,003,795 baht*
2013	4,738,790 patients	*23,693,950 baht*
2014	8,489,696 patients	*42,448,480 baht*
2015	5,821,781 patients	*29,108,905 baht*

Example of calculating the budget for outsourcing the outside agency in fiscal year of 2007

From the equation of budget of outsourcing the CHI:

$$\text{Amount of budget for outsourcing the CHI} = \text{Number of patients paid with reimbursement} \times 5$$

Variable 1: The number of patients who were paid with reimbursement in 2007 fiscal year is 4,886,640.

Then, plug the variable values into expression:

$$Amount\ of\ budget\ for\ outsourcing = 4{,}886{,}640 \times 5$$

5.5 Discussion about KPIs

5.5.1 Discussion about KPI#1

The results in section 5.2 indicated the processing time of each sub-processes. The researcher had divided sub-processes according to time of baseline architecture and target architecture phase 1 and phase 2 with the following details of system development.

- Process of data preparation, eligibility verification, and DRG Grouping reduced from 30 days to only 1 day or by 96.67 in percentage since target architecture

implementation phase 1 had developed the application that supported their functions within the organization. Moreover, target architecture implementation phase 2 was continually developed and spent only .25 day for data processing or reduced by 99.17 percent compared to that of baseline architecture.

- It was found from the process of medical reimbursement calculation and payment transfer for processing time in target architecture phase 2 reduced by 1 day from 30 days. When compared to processing time of baseline architecture, target architecture phase 2 decreased by 96.67 percent since target architecture phase 1 had been developed to specifically support data preparation, process of eligibility verification and data processing of DRG Grouping. Moreover, the system of medical reimbursement calculation and process of data checking and payment transfer in target architecture implementation phase 2 was developed.

From the analysis of the relationship of the results in section 5.2 versus time, it was found that the reduced processing time in each sub-system was related to the time of system development in baseline architecture and target architecture phase 1 and phase 2, respectively. Target application was developed in part that supported data preparation, process of eligibility verification and data processing of DRG Grouping, in the beginning. Subsequently, the application that supported medical reimbursement calculation and data checking and payment transfer would be developed to make the overall time of medical claims processing improved, starting from the first process to the last process.

5.5.2 Discussion about KPI#2

The results in section 5.3 indicated that the reimbursement of medical services was in line with the time periods spent on the development of the target architecture in phase 1 and phase 2 as shown in Figure 5.5.

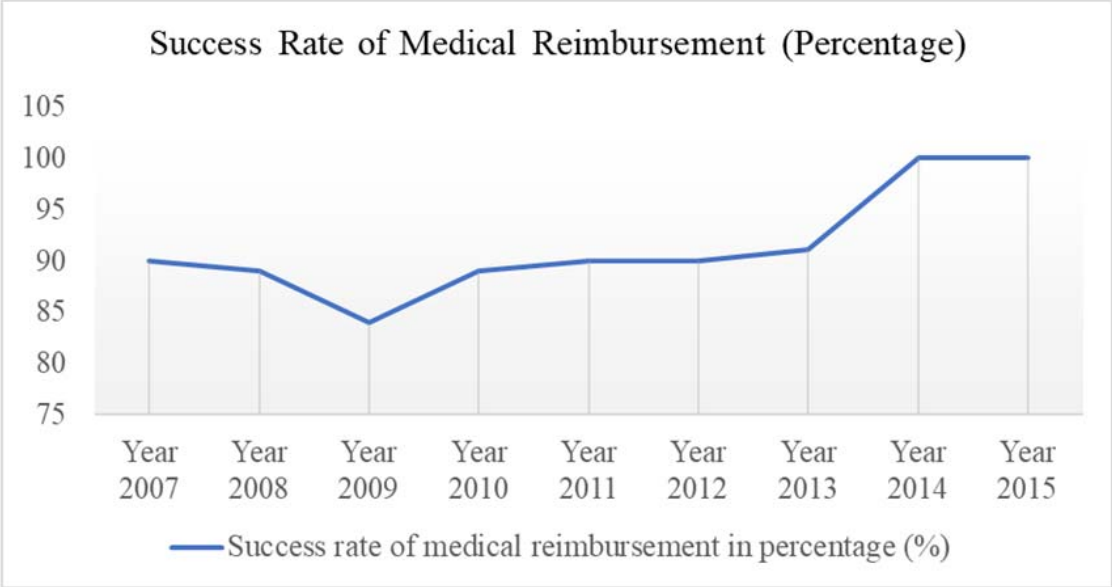

Figure 5.5 Trend of success rate of medical reimbursement

Figure 5.5 illustrates the success rate of medical reimbursement for the health service providers in each fiscal year. It was found that success rate of business architecture was almost similar to that of target architecture phase 1. In addition, success rate tended to go up in target architecture phase 2 which demonstrated the effectiveness of medical reimbursement to the health service providers in the right direction.

5.5.3 Discussion about KPI#3

From the results in section 5.4, it indicated that the amount of budget for outsourcing the CHI for baseline architecture was 50,291,715 baht. Furthermore, the amount of budget for outsourcing the outside agency during the fiscal year of 2009 – 2015 was 185,254,370 baht which was high. As a result, an attempt to reduce the expenses incurred by medical claims processing was made by the development of applications that supported data preparation, eligibility verification, and data processing of DRG Grouping by their own. Such applications were developed to decrease the budget for outsourcing the CHI and such budget should be invested in the development of new system, instead. The budget that the NHSO spent on investing in developing the system could be compared with the budget for outsourcing the CHI for baseline architecture. In case the NHSO needed to outsource the CHI for target

architecture, the break-even analysis was required to be conducted as in Table 5.14 at section 5.4.

CHAPTER VI
CONCLUSION AND FUTURE WORK

6.1 Introduction

This chapter draws a conclusion concerned with the KPIs from the data collected in Chapter 4. Then, the data were analyzed in Chapter 5, revealing the development trend of medical claims processing and how the results conformed to the KPIs. Moreover, the chapter presented the NHSO's roadmap that became a foundation for future work.

6.2 Conclusion of KPIs

The results in Chapter 5 can be concluded according to the KPIs defined in Chapter 1 as follows:

6.2.1 KPI#1: it is expected that processing time reduces by 70 percent, demonstrating the idea of business process development that perfectly matched work process. Additionally, the IT work was developed to support this new business process that promoted the effective data processing for the NHSO.

6.2.2 KPI#2: it is expected that medical reimbursement payment to the health service providers is effective. The results from the research of KPI#2 indicated a 10 percent increase in fiscal year on average. This showed the problems that have occurred between the NHSO and the health service providers. After the NHSO had developed the process of medical reimbursement calculation and the process of Reply Report to allow all data to be connected, it helped fix the problems of patients eligible for over 1 Fund as well as making a better performance of overall medical reimbursement payment. This is to promote the idea of integrating all parts in the organization to connect to each other by system-to-system and be able to identify the master data in the system.

6.2.3 KPI#3: the budget for outsourcing the outside agency in fiscal year of 2007 and 2008 was 50 million baht, leading to the idea of terminating the outside agency and creating a new system implemented in the organization. The creation of the new system should be made internally. The researcher collected the investment data in system development to find its break-even point. Furthermore, the payback period and benefit-cost analysis are included. However, the NHSO cannot provide the actual budget spent on the new system development, since the investment figures are confidential to the organization. As a result, the researcher could not estimate the budget that drives medical claims processing. Nonetheless, the readers can calculate the break-even point following the break-even point calculation in Chapter 4 if the data of investment in the new system development are available.

6.3 Roadmap for NHSO

The topic of this research is an integration of medical claims processing systems for the NHSO. It is expected to provide the effective integration of system related to the business process and be able to link the data to processing from the starting point to the end of the process. The idea was to develop business process in line with the relevant agency. The IT should be developed to support the new business process. Furthermore, the application and information of the related systems were developed in accordance with the new business process. The new goals for system development and integration are defined in line with the development policy of the NHSO based on the 4th master plan of development effective in the early 2017. The gap analysis and solutions are employed to close the gaps based on the management of enterprise architecture. The NHSO can apply such principle to develop and integrate other parts in the organization with aim to have a complete and continuous system according to the TOGAF Framework stated in Chapter 3.

The roadmap demonstrated the development of medical claims processing. It is the system that affects the NHSO's core business. The development plan must be defined in the short term in addition to the long term. Such development included end of life checking (EOL), end of support (EOS) of the software and hardware used in the system. In case the hardware is nearly reaching the EOL or the EOS has a plan of

changing a new hardware, it needs replacement. Likewise, in case the software is nearly reaching nearly reaching the EOL or the EOS has a plan of changing a new software, it needs replacement. This is to allow effective and continuous work process which also reduces the risks of the system that contains hardware and software that are not supported by the health service providers.

In the future, if the continuous care department and episodic care department are integrated to have the same type of services under the medical claims processing systems based on the development principle of target architecture phase 3, the NHSO will be able to develop the tracking systems for both departments. All processes can be accessible and traceable from the staff. The health service providers are also allowed to access to the tracking system to check the status of services provided by the NHSO. Besides, it promotes governance in accordance with the NHSO's goals and operation.

6.4 Future Research

This research placed its emphasis on the performance analysis of changed medical claims processing for the episodic care department. The system was integrated to illustrate the department development step by step. Besides, other systems are also included for working consistently and continually to serve as a model for the continuous care department that has the same direction of development. The readers can apply this concept and measurement process to the continuous care department.

This research put its emphasis on the efficiency of changed medical claims processing for the episodic care department, as it was an integration of the systems to demonstrate the steps of development. Additionally, the systems were made to work together continuously and such integration served as a model for the continuous care department to have a similar direction of development. The readers could apply the concepts and process of measurement written in this paper to the development of work process for the continuous care department in the future. The details of relationship between three KPIs and target architecture implementation phase 1, phase 2, and phase 3 are shown in Table 6.1.

Table 6.1 Relationship between KPI and target architecture

KPI	Target Architecture phase1	Target Architecture phase2	Target Architecture phase3
KPI#1 Duration of data processing	Duration of data processing was reduced by 48.33 percent compared to that of baseline architecture for the episodic care department.	Duration of data processing was reduced by 94.75 percent compared to that of target architecture in phase 1 for the episodic care department.	Duration of overall data processing was reduced by 50 percent compared to that of baseline architecture for the continuous care department.
KPI#2 Success rate of medical reimbursement	Success rate of medical reimbursement payment to medical service providers was stable at 89-91 percent per a fiscal year when compared to baseline architecture for the episodic care department.	Success rate of medical reimbursement payment to medical service providers grew by 98-100 percent per a fiscal year when compared to baseline architecture and target architecture in phase 1 for the episodic care department.	Success rate of medical reimbursement payment to medical service providers grew by 98-100 percent per a fiscal year when compared to baseline architecture for the continuous care department.
KPI#3 Reduction of budget for driving the data processing system	The cost of outsourcing was reduced by 20 million baht per a fiscal year according to the figures in 5.4 of chapter 5.	The investment of Exadata was made to develop the efficiency of data processing system and cost recovery was expected in the future. The readers could calculate the break-even point of the system as in 4.4.3 of chapter 4.	The investment in hardware for database was saved since phase 2 had already installed Exadata. The continuous care department's database system could be installed and processed on Exadata.

Table 6.1 indicates that KPI#1 and KPI#2 could be used for measurement based on the concept of data collection, and data processing written in Chapter 4 could be applied to the continuous care department in target architecture phase 3. However, KPI#3 could be used to measure target architecture phase 1 only, as the information of

investment by the NHSO could not be publicly disclosed. As a result, the calculation of break-even point was not able to be made. The readers may adopt the concept of development and integration of two departments based on the development standard and adjust certain hardware or applications for the two departments. Besides, it helped reduce the investment of medical claims processing development and served as a guideline for operation in accordance with the organization’s cost saving stated in the master plan.

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