A WEB APPLICATION FOR AN ANALYTICAL SERVICES SYSTEM: CASE STUDY IN INSTITUTE OF NUTRITION, MAHIDOL UNIVERSITY, THAILAND.

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ABSTRACT

The objectives of this research were to improve the business processes and development a web application for an analytical services system (WAS) by using web-based technology and a relational database. The Institute of Nutrition at Mahidol University, Thailand, was employed as a case study. The web application was expected to provide better operations and management for the analytical services system.

The WAS consisted of 5 functions; Ordering, Sample Analysis, Nutrition Labeling Assessment, Reporting and Status Tracking. The system was developed using the Microsoft Windows Server 2003 operating system, Internet Information Services (IIS) as a web server, Microsoft SQL Server 2005 as a database management system, and ASP.NET as a server side script language for interface design.

The study demonstrated that a web application for an analytical services system has the ability to manage analytical services to make data more accurate, reduce incorrect data, enable reports that analyze results and track the status of work in process, and reduce lead-times of the nutrition labeling process.

KEY WORDS: BUSINESS PROCESS IMPROVEMENT/ WEB TECHNOLOGY/ FOOD ANALYTICAL SERVICES

107 pages

เว็บแอปพลิเคชั่นสำหรับระบบงานบริการวิเคราะห์ กรณีศึกษา สถาบันโภชนาการ มหาวิทยาลัยมหิดล

A WEB APPLICATION FOR AN ANALYTICAL SERVICES SYSTEM: CASE STUDY IN INSTITUTE OF NUTRITION, MAHIDOL UNIVERSITY, THAILAND.

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บทคัดย่อ

การวิจัยนี้มีจุดมุ่งหมายเพื่อปรับปรุงกระบวนการธุรกิจและพัฒนาระบบสารสนเทศสำหรับงานบริการวิเคราะห์ โดยใช้เทคโนโลยีเว็บเบส และฐานข้อมูลเชิงสัมพันธ์ โดยใช้สถาบันโภชนาการ มหาวิทยาลัยมหิดลเป็นกรณีศึกษา เว็บแอปพลิเคชั่นที่ได้จากการวิจัยนี้มีเป้าหมายในการบริหารจัดการระบบงานบริการวิเคราะห์ให้ดีขึ้น

เว็บแอปพลิเคชั่นสำหรับระบบงานบริการวิเคราะห์ ประกอบด้วย 5 ส่วนหลัก ได้แก่ การออกคำสั่งขอรับบริการ การวิเคราะห์ตัวอย่าง การประเมินคุณค่าทางโภชนาการ การออกรายงาน และการติดตามสถานะของงานบริการ การพัฒนาระบบใช้ระบบปฏิบัติการ Microsoft Windows Server 2003, Internet Information Services (IIS) เป็น Web Server, Microsoft SQL Server 2005 เป็นระบบจัดการฐานข้อมูล และ ASP.NET เป็น Server Side Script สำหรับส่วนติดต่อผู้ใช้

ผลที่ได้จากการศึกษาคือ เว็บแอปพลิเคชั่นสำหรับระบบงานบริการวิเคราะห์ที่สามารถจัดการงานบริการวิเคราะห์ โดยให้ข้อมูลที่ถูกต้อง ลดความผิดพลาดของข้อมูล สามารถออกรายงานผลการวิเคราะห์และติดตามสถานะของงานในกระบวนการได้ โดยลดเวลาการทำงานของกระบวนการจัดทำฉลากโภชนาการลงได้

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CHAPTER I
INTRODUCTION

1.1 Introduction and Background

Food is one of the four factors that are important to human life. Food has been useful and valuable thing to complete nutrition. Theoretically, food must be clean, safe and free from contaminant harming the human body. I In food production, the process of it must focus on quality control before sending food products to consumers. Food analysis is a process of quality control which food industry must perform regularly.

Food analysis about nutrient and contaminant is a step that is essential to quality control in food and beverage industry. To enhance the quality of the food product to meet the standard required by law such as registration for product license and nutrition labeling in The Food Act B.E.2522 of The Ministry of Public Health as well as the Packaging and Labeling Act launched by the U.S. Food and Drug Administration (USFDA) which requires that manufacturers have to notify the name and the quantity of 14 nutrients on the food label now and being cover 35 other nutrients in the nearest future, thus, food processors need to know components or nutrients in their products through the process of food analysis in the production process and quality control before selling the products.

The Institute of Nutrition, Mahidol University (INMU) provides analytical services for public and private agencies according to the Food Act of the Ministry of Public Health. The service is accepted by the Food and Drug Administration of the Ministry of Public Health as INMU laboratory can analyze food samples for registration. At present, the laboratory has capacity to analyze more than 25 different types of foods and offer analytical services and full nutrition labeling for the USA and Thailand.

Current services, INMU can not satisfy customer services and deliver the analysis report delayed. This study will analyze the INMU's services and improve the process under the business process modeling and reengineering approach. Business process reengineering is one approach for redesigning the way of work done to achieve the organization's mission and reduce costs. Within the framework of reengineering, it focuses on the organization's business processes with the aim of achieving dramatic improvements in critical performance measures, such as cost, quality, service, and speed [1].

In order to reengineer the business process, the techniques such as time-based analysis, systems re-engineering tools and the application of information technology are an important element in an integration of activities to apply the supply chain management as well as to the customer administration cycle in service industries [2] while the information integration is important in current situation for competition in the global market. If the enterprises receive incorrect or delayed information, they will not be able to deliver high quality services, or reduce lead-time in production and management [3]. The World Wide Web has become a convenient way to access information because the Internet browser integrates different network services into a common easily accessible user interface [4]. The internet and intranet can serve the organization, customers and suppliers in order to tracking by Web-based approach. Therefore, the staffs are able to know the status of orders and where the orders are in the process, or whether they are ready. Moreover, the operators can track the status quickly and accurately in supply chain integration. The internet and intranet could be the solution for all organizations and department which have to work together and can be a preferred alternative way with a cheaper cost [3].

This research is aimed to find a room for INMU business processes improvement and information system development of the food analysis services by focusing on a flowing process of information through Web-based technology. A process of nutrition labeling is the aim of the improvement owing to this research aimed to minimize time used for non-value added activity. The process adjusted found from this research is expected to help INMU provide maximized and effective services.

1.2 Objectives

1. To map the business processes which represents the current state of the operation of the case study by using flow charting technique and Integration Definition method.
2. To design a new business process by using Web-based technology.
3. To develop web application for the analytical services according to the designed business process.

1.3 Scope of the Work

The study focuses on INMU's analytical service process in order to link analytical service information among Technical Service Office, Analytical Laboratories and Nutrition Labeling Assessor, under the designed business function as follow:

- Ordering
- Sample Analysis
- Nutrition Labeling Assessment
- Reporting
- Tracking

1.3 Expected Result

A web application for an analytical services system in the Institute of Nutrition, Mahidol University (WAS)

CHAPTER II
LITERATURE REVIEW

2.1 Food Analysis [5]

Investigations in food science and technology, whether by the food industry, governmental agencies, or universities, often require determination of food composition and characteristics. Trends and demands of consumers, the food industry, and national and international regulations challenge food scientists as they work to monitor food composition and to ensure the quality and safety of the food supply. All food products require analysis as part of a quality management program throughout the development process, through production, and after a product is in the market.

Scientists analyze foods for their composition; structure; and chemical, physical, and biological properties. The information obtained may be used for research or for monitoring product quality.

Chemical analysis of foods is an important part of a quality assurance program in food processing, from ingredients and raw materials, through processing, to the finished products. Chemical analysis is also important in formulating and developing new products, and evaluating new processes for making food products, and in identifying the source of problems with unacceptable products. For each type of product to be analyzed, it may be necessary to determine either just one or many components. The nature of the sample and the way in which the information obtained will be used may dictate the specific method of analysis. For example, process control samples are usually analyzed by rapid methods, whereas nutritive value information for nutrition labeling generally requires more time-consuming methods of analysis endorsed by scientific organizations.

2.2 Food Control in Thailand [6]

In Thailand, various food control activities are undertaken by several organizations. However the Minister of Public Health is designated by law to be in charge of the execution of the Food Act B.E.2522, and is empowered to appoint competent officers, promulgate regulations and set other activities in order to carry out the provisions of this act. The Food and Drug Administration of the Ministry of Public Health and the Provincial Offices of Public Health are responsible for legal food control operations with the support of food analytical services of the Department of Medical Sciences.

The Thai Food and Drug Administration of the Ministry of Public Health is an agency whose primary duty by virtue of Food Act B.E.2522 (1979). It's main roles are implementation and enforcement of this law, and is to guarantee the quality and safety of food

Food Control Division of Food and Drug Administration (FDA) is responsible for regulating food control activities as follows:

1) Pre-marketing Control

Activities include issuance of Manufacturing License and Importation License to manufacturer and importer respectively; registration of controlled food products before marketing; approval of food additives to be used in foods, labeling and advertising approvals.

- Manufacturing License

Plant lay-out is to be submitted for approval and plant inspection by food inspector is required before manufacturing license is issued. This license is to be renewed every three years.

- Importation License

A license is required in order to import food into Thailand. A licensed importer may import various kinds of food providing that they are approved by the Thai FDA. The designated storage or warehouse has to be inspected and approved by the Thai FDA before a license is issued. An importation license has to be renewed every three years as well.

- Product Registration

If a food product, either manufactured or imported, is categorized as Specific-Controlled Food, it must be registered. Analyses of the product as well as details of the process and ingredients are required for the registration process and the standard of these food products have to meet the standard specified in the Ministerial Notification.

- Labeling Approval

Some product such as dietary supplement are required to bear labels containing Thai language and subjected to be approved by Thai FDA prior selling in the market. For food products, in general, labeling must follow the Notifications of the Ministry of Public Health No.194 (B.E.2544).

- Advertising Approval

Any form of advertisement for food through any media is subjected to be approved by Thai FDA. False or deceptive advertisement on quality or benefit of food is prohibited.

2) Post-marketing Control

The purpose of Post-marketing Control is to ensure that food distributes to consumers are wholesome and have quality that complies with the national food standard. As a result, this measure deals primarily with the activities of enforcement. Inspection of all food factories and premises throughout the country is conducted regularly, together with sampling of food products for analysis and assaying to ensure compliance with legal requirements. In case of violations, actions like seizure, recall, and prosecution will be executed. In general, there are two types of inspections:

- Regular Inspection. This is planned inspection to ensure that the FDA annual plan on food has been done successfully.

- Routine Inspection. This is a periodic inspection particularly to the premise received licenses.

- Surveillance Inspection: to inspect manufacturing premises, warehouse for importer, sellers to comply with the regulation concerned.

- Point of Entry Inspection. This is done by food inspectors stationed at the ports to ensure the safety of food products entering into the country comply with the regulations concerned.

- Suspected or Petitioned Inspection

- This is a particular type of inspection with specific aim to investigate and gather necessary evidence for taking legal action.

- This includes an inspection to find out the cause of the complaint or rejected food from the importing country, as to solve the problems of food manufacturers and food products.

3) Food Surveillance

The aim of food surveillance is to assure the safety and quality of food items distributed in market place. Food surveillance is conducted by several ministerial organizations and TFDA also plays a main role in this activity. Food are taken from market place and then analyzed to ensure the conformity to the standards.

2.3 Thailand Agency for Food Analysis Services [7]

Thailand agency serving food analysis for product registration, food label registration and nutrition label registration in the notification of Food Control Division, Food and Drug Administration shows governmental agencies list as the following;

1) Department of Medical Sciences, Ministry of Public Health
2) Department of Science Service, Ministry of Science and Technology
3) Nutrition Division, Department of Health, Ministry of Public Health
4) Regional Medical Sciences Center
5) Institute of Food Research and Product Development, Kasetsart University
6) Institute of Nutrition, Mahidol University
7) Thailand Institute of Scientific and Technological Research
8) Division of Agricultural Chemicals, Department of Agriculture
9) Faculty of Science, Burapha University

Private agencies list as the following;

1) Analytical Laboratory Service Co., Ltd.
2) SGS (Thailand) Ltd.
3) South East Asian Laboratory Ltd.
4) IQA Laboratory Co., Ltd.
5) National Food Institute
6) Nestle (Thaiand) Ltd.
7) Chemlab Services (Thailand) Ltd.
8) Central Laboratory (Thailand) Co., Ltd.
9) Thai Agri Foods Public Co., Ltd.
10) Asia Medical and Agricultural Laboratory and Research Center

2.4 Business Process Mapping and Reengineering [8,9]

A process is a series of activities (tasks, steps, events, operations) that takes an output, adds value to it, and produces an output (product, service, or information) for a customer. Customers are all those who receive that process output. All/any processes within any operation or a department, including facilities management, can be and should be evaluated for effectiveness.

Processes produce an organization's products and/or services. Processes are critical to seizing and maintaining a competitive advantage. Processes are the vehicles for exceeding customer expectations and achieving organizational goals. The performance of individuals is only as good as the process will allow it to be. Processes, especially cross-functional business practices, are usually not documented, not standardized, not measured, not systematically and continually improved and not managed by the micro-process doer or owner.

Then process mapping is identifying, documenting, analysing and developing an improved process. To use process mapping methodology, a completely new different thought pattern occurs when the process is focused on management's obsession with the outcomes must be abandoned and replaced with a focus on the process. A process map is used to understand your business and improve the performance of your processes.

A process map is a visual aid for picturing work processes which shows how inputs, outputs and tasks are linked. A process map prompts new thinking about how work is done. It highlights major steps taken to produce an output, who performs the steps, and where these (major) problems consistently occur. Process mapping alerts to areas in which a change in processes will have the greatest impact on improving quality. An excellent analogy of a process map is a "road map". Teams become an important aspect of developing and using process maps. Very often, several functions, working separately and independently, are involved in a successful process

Process maps – to most professionals – are a new tool. They are used by more modern and knowledgeable firms. Process maps are excellent for evaluating continuous as well as nonlinear improvement potentials for all departments and operations including facilities management.

At the level of the process design structure, however, the most widely used technique is observational analysis (OA). The OA technique, which primarily entails altering the process structure via inspection, is normally used after mapping the current process with a graphical representation tool; e.g. the structured analysis and design technique (SADT) and the SADT-based functional and process techniques of integrated computer-aided manufacturing.

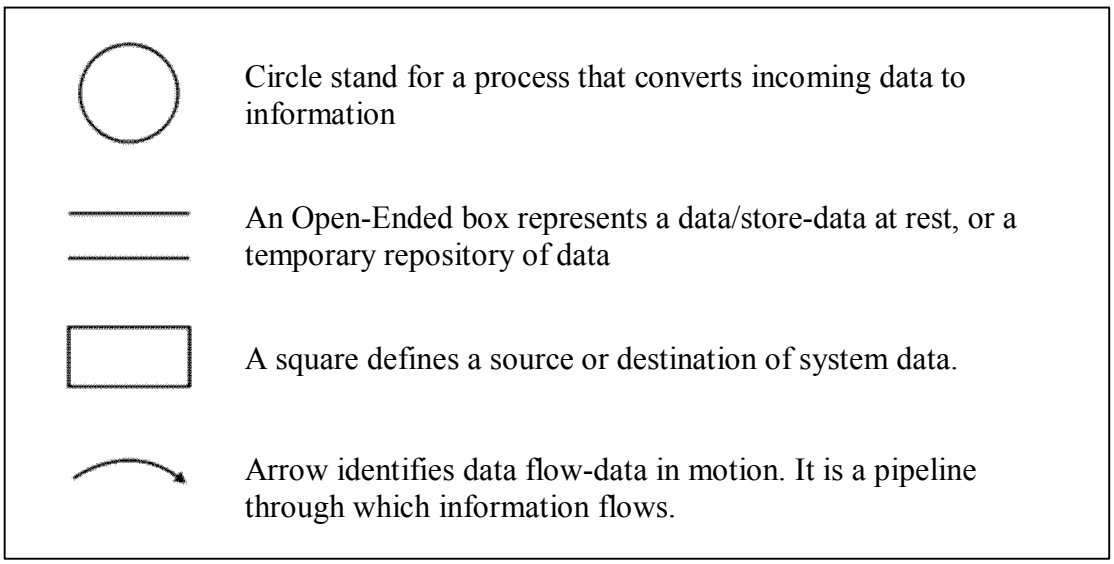
Notable examples of SADT-based techniques are IDEF0 (Function Modeling Method) and IDEF3 (Process Description Capture Method). The OA technique has a set of options to redesign a process that includes eliminating non-value-added activities (e.g. redundant, rework and supervisory activities), simplifying activities, combining activities, increasing the concurrency of activities and automating activities. Value analysis (VA) is sometimes used with OA to numerically assess the relative utility of each activity using a time, cost and value criteria. In addition, simulation techniques are frequently used to evaluate the dynamic behavior of alternative designs.

2.5 Modeling Tools

2.5.1 Data Flow Diagram [10,11]

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system. Dataflow diagrams can be used to provide the end user with a physical idea of where the data they input ultimately has an effect upon the structure of the whole system from order to dispatch to report. How any system is developed can be determined through a dataflow diagram.

Developing a data flow diagram helps in identifying the transaction data in the data model. There are different notations to draw data flow diagrams, defining different visual representations for processes, datastores, dataflow, and external entities. To Construct a Data Flow Diagrams, we use;



Data flow diagram levels

- **Context Level Diagram**

This level shows the overall context of the system and its operating environment and shows the whole system as just one process. It does not usually show data stores, unless they are "owned" by external systems, e.g. are accessed by but not maintained by this system, however, these are often shown as external entities.

- **Level 1 (High Level Diagram)**

This level (level 1) shows all processes at the first level of numbering, data stores, external entities and the data flows between them. The purpose of this level is to show the major high level processes of the system and their interrelation. A process model will have one, and only one, level 1 diagram. A level 1 diagram must be balanced with its parent context level diagram, i.e. there must be the same external entities and the same data flows, these can be broken down to more detail in the level 1.

- **Level 2 (Low Level Diagram)**

This level is a decomposition of a process shown in a level 1 diagram, as such there should be a level 2 diagram for each and every process shown in a level 1 diagram. As before, a level 2 diagram must be balanced with its parent level 1 diagram.

2.5.2 IDEF Modeling [12,13]

IDEF (Integration DEFinition) is a group of modeling methods that can be used to describe operations in an enterprise. IDEF was created by the United States Air Force and is now being developed by Knowledge Based Systems. Originally developed for the manufacturing environment, IDEF methods have been adapted for wider use and for software development in general.

Sixteen methods, from IDEF0 to IDEF14 (and including IDEF1X), are each designed to capture a particular type of information through modeling processes. IDEF methods are used to create graphical representations of various systems, analyze the model, create a model of a desired version of the system, and to aid in the transition from one to the other. IDEF is sometimes used along with gap analysis.

The following table lists the IDEF methods either current or in development. IDEF0 through IDEF4 are the methods most commonly used.

IDEF Methods	
IDEF0	Function Modeling
IDEF1	Information Modeling
IDEF1X	Data Modeling
IDEF2	Simulation Model Design
IDEF3	Process Description Capture
IDEF4	Object-Oriented Design
IDEF5	Ontology Description Capture
IDEF6	Design Rationale Capture
IDEF7	Information System Auditing
IDEF8	User Interface Modeling
IDEF9	Scenario-Driven IS Design
IDEF10	Implementation Architecture Modeling
IDEF11	Information Artifact Modeling
IDEF12	Organization Modeling
IDEF13	Three Schema Mapping Design
IDEF14	Network Design

Figure 2.1 The IDEF Family of Methods

IDEF0 (Integration Definition for Function Modeling) is based on SADT™ (Structured Analysis and Design Technique™), developed by Douglas T. Ross and SofTech, Inc. In its original form, IDEF0 includes both a definition of a graphical modeling language (syntax and semantics) and a description of a comprehensive methodology for developing models. IDEF0 may be used to model a wide variety of automated and non-automated systems. For new systems, IDEF0 may be used first to define the requirements and specify the functions, and then to design an implementation that meets the requirements and performs the functions. For existing systems, IDEF0 can be used to analyze the functions the system performs and to record the mechanisms (means) by which these are done.

The result of applying IDEF0 to a system is a model that consists of a hierarchical series of diagrams, text, and glossary cross-referenced to each other. The

two primary modeling components are functions (represented on a diagram by boxes) and the data and objects that inter-relate those functions (represented by arrows).

As a function modeling language, IDEF0 has the following characteristics:

1. It is comprehensive and expressive, capable of graphically representing a wide variety of business, manufacturing and other types of enterprise operations to any level of detail.
2. It is a coherent and simple language, providing for rigorous and precise expression, and promoting consistency of usage and interpretation.
3. It enhances communication between systems analysts, developers and users through ease of learning and its emphasis on hierarchical exposition of detail.
4. It is well-tested and proven, through many years of use in Air Force and other government development projects, and by private industry.
5. It can be generated by a variety of computer graphics tools; numerous commercial products specifically support development and analysis of IDEF0 diagrams and models.

In addition to definition of the IDEF0 language, the IDEF0 methodology also prescribes procedures and techniques for developing and interpreting models, including ones for data gathering, diagram construction, review cycles and documentation. Materials related solely to modeling procedures are presented in the informative annexes of this document.

IDEF0 Concepts

A model is a representation of a set of components of a system or subject area. The model is developed for understanding, analysis, improvement or replacement of the system. Systems are composed of interfacing or interdependent parts that work together to perform a useful function.

System parts can be any combination of things, including people, information, software, processes, equipment, products, or raw materials. The model describes what a system does, what controls it, what things it works on, what means it uses to perform its functions, and what it produces.

IDEF0 is a modeling technique based on combined graphics and text that are presented in an organized and systematic way to gain understanding, support analysis, provide logic for potential changes, specify requirements, or support systems level design and integration activities. An IDEF0 model is composed of a hierarchical series of diagrams that gradually display increasing levels of detail describing functions and their interfaces within the context of a system. There are three types of diagrams: graphic, text, and glossary. The graphic diagrams define functions and functional relationships via box and arrow syntax and semantics. The text and glossary diagrams provide additional information in support of graphic diagrams.

IDEF0 is an engineering technique for performing and managing needs analysis, benefits analysis, requirements definition, functional analysis, systems design, maintenance, and baselines for continuous improvement. IDEF0 models provide a "blueprint" of functions and their interfaces that must be captured and understood in order to make systems engineering decisions that are logical, affordable, integratable and achievable. The IDEF0 model reflects how system functions interrelate and operate just as the blueprint of a product reflects how the different pieces of a product fit together. When used in a systematic way, IDEF0 provides a systems engineering approach to:

1. Performing systems analysis and design at all levels, for systems composed of people, machines, materials, computers and information of all varieties - the entire enterprise, a system, or a subject area;
2. Producing reference documentation concurrent with development to serve as a basis for integrating new systems or improving existing systems;8
3. Communicating among analysts, designers, users, and managers;
4. Allowing coalition team consensus to be achieved by shared understanding;
5. Managing large and complex projects using qualitative measures of progress;
6. Providing a reference architecture for enterprise analysis, information engineering and resource management.

2.6 Technical Review

2.6.1 Three Tier Software Architecture [14]

The three tier software architecture (a.k.a. three layer architectures) emerged in the 1990s to overcome the limitations of the two tier architecture. The third tier (middle tier server) is between the user interface (client) and the data management (server) components. This middle tier provides process management where business logic and rules are executed and can accommodate hundreds of users (as compared to only 100 users with the two tier architecture) by providing functions such as queuing, application execution, and database staging.

The three tier architecture is used when an effective distributed client/server design is needed that provides (when compared to the two tier) increased performance, flexibility, maintainability, reusability, and scalability, while hiding the complexity of distributed processing from the user. These characteristics have made three layer architectures a popular choice for Internet applications and net-centric information systems.

A three tier distributed client/server architecture as shown in Figure 2.7 includes a user system interface top tier where user services reside such as session, text input, dialog, and display management.

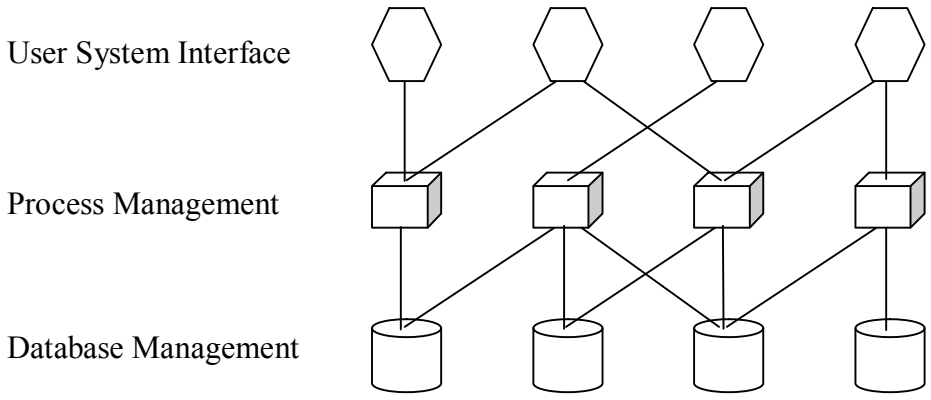


Figure 2.2 Three tier distributed client/server architecture depiction [Louis 95]

The third tier provides database management functionality and is dedicated to data and file services that can be optimized without using any proprietary database management system languages. The data management component ensures that the data is consistent throughout the distributed environment through the use of features such as data locking, consistency, and replication. It should be noted that connectivity between tiers can be dynamically changed depending upon the user's request for data and services.

The middle tier provides process management services (such as process development, process enactment, process monitoring, and process resourcing) that are shared by multiple applications.

The middle tier server (also referred to as the application server) improves performance, flexibility, maintainability, reusability, and scalability by centralizing process logic. Centralized process logic makes administration and change management easier by localizing system functionality so that changes must only be written once and placed on the middle tier server to be available throughout the systems. With other architectural designs, a change to a function (service) would need to be written into every application.

In addition, the middle process management tier controls transactions and asynchronous queuing to ensure reliable completion of transactions. The middle tier manages distributed database integrity by the two phase commit process. It provides access to resources based on names instead of locations, and thereby improves scalability and flexibility as system components are added or moved.

Sometimes, the middle tier is divided in two or more unit with different functions, in these cases the architecture is often referred as multi layer. This is the case, for example, of some Internet applications. These applications typically have light clients written in HTML and application servers written in C++ or Java, the gap between these two layers is too big to link them together. Instead, there is an intermediate layer (web server) implemented in a scripting language. This layer receives requests from the Internet clients and generates html using the services provided by the business layer. This additional layer provides further isolation between the application layout and the application logic.

It should be noted that recently, mainframes have been combined as servers in distributed architectures to provide massive storage and improve security.

Three tier architectures are used in commercial and military distributed client/server environments in which shared resources, such as heterogeneous databases and processing rules, are required. The three tier architecture will support hundreds of users, making it more scalable than the two tier architecture.

Three tier architectures facilitate software development because each tier can be built and executed on a separate platform, thus making it easier to organize the implementation. Also, three tier architectures readily allow different tiers to be developed in different languages, such as a graphical user interface language or light internet clients (HTML, applets) for the top tier; and SQL for much of the database tier.

Building three tier architectures is complex work. Programming tools that support the design and deployment of three tier architectures do not yet provide all of the desired services needed to support a distributed computing environment.

A potential problem in designing three tier architectures is that separation of user interface logic, process management logic, and data logic is not always obvious. Some process management logic may appear on all three tiers. The placement of a particular function on a tier should be based on criteria such as the following:

- ease of development and testing
- ease of administration
- scalability of servers
- performance (including both processing and network load)

Two tier client server architectures are appropriate alternatives to the three tier architectures under the following circumstances:

- when the number of users is expect to be less than 100
- for non-real-time information processing in non-complex systems that requires minimal operator intervention

Distributed/collaborative enterprise computing is seen as a viable alternative, particularly if object-oriented technology on an enterprise-wide scale is desired. An enterprise-wide design is comprised of numerous smaller systems or subsystems.

Although three tier architecture has proven sound, the supporting products implementing the architecture are not as mature as other competing technologies. Transaction Monitors (TM) are a valid alternative when reliability and scalability requirements can not be fulfilled with existing multi layer technology. Although TMs don't support modern development paradigms like Object Orientation (OO) they are still quite useful when massive scalability and robustness is needed.

2.6.2 ASP.NET [15,16]

Active Server Pages (ASP), also known as Classic ASP, was Microsoft's first server-side script engine for dynamically-generated web pages. Initially released as an add-on to Internet Information Services (IIS) via the Windows NT 4.0 Option Pack, it was subsequently included as a free component of Windows Server (since the initial release of Windows 2000 Server).

Developing rich functionality in ASP websites is enabled by the active scripting engine's support of the Component Object Model (COM), with each object providing a related group of frequently-used functions and data attributes. In ASP 2.0 there were six built-in objects: Application, ASPError, Request, Response, Server, and Session. Session, for example, is a cookie-based session object that maintains the state of variables from page to page. Functionality is further extended by objects which, when instantiated, provide access to the environment of the web server; as an example FileSystemObject (FSO) is used to create, read, update and delete files.

Web pages with the .asp file extension use ASP, although some web sites disguise their choice of scripting language for security purposes (e.g. still using the more common .htm or .html extension). Pages with the .aspx extension are ASP.NET (based on Microsoft's .NET Framework) and compiled, which makes them faster and more robust than the than server-side scripting in ASP which is interpreted at run-time; however, many ASP.NET pages still include some ASP scripting.

ASP.NET provides an application program interface (API) for software programmers. The .NET development tools can be used to create applications for both the Windows operating system and the web. Programs like Visual Studio .NET provide a visual interface for developers to create their applications, which

makes .NET a reasonable choice for designing Web-based interfaces as well. It supports executable programs compiled from C#, C++ and other languages and is not backward compatible with regular ASP code.

In order for an ASP.NET website to function correctly, it must be published to a Web server that supports ASP.NET applications. Microsoft's Internet Information Services (IIS) Web server is by far the most common platform for ASP.NET websites. While there are some open-source options available for Linux-based systems, these alternatives often provide less than full support for ASP.NET applications.

2.7 Related Works and Websites

2.7.1 Order Tracking and Web-Based Technology

The samples of the Web-based tracking system in supply chain management. This system will allow customers and suppliers to access current data. Acma Computers uses data sweep Advantage Web-based to track orders on-line to manage product shortages or order changes and to monitor products' quality throughout the product lifecycle. Chrysler Corporation, which allows 12000 suppliers in the Suppliers Partner Information Network (SPIN) to access data via intranet in order to see the design changes, parts shortages, packing information and invoice tracking [4].

In many academic institutions, the tracking system has been widely studied in designing, developing and implementing. For instance, there are students in the faculty of Graduate Studies, Mahidol University, concerning database development on web page for tracking. Webpage of Supreecha Suk-on can achieve the tracking the specification and stock number assignment of Communication Equipment of Technical Affairs Division Signal Department reducing the accessing time and producing consistent data. In the same manner, Weeravut Tongsima represents the Webpage for Tracking Maintenance Status of Communication Equipment, the Communication-Electronics Maintenance Division that recording history of the

repaired equipments as an archive for maintenance tracking. The testing gradations the program efficiency is totally appreciated for officers [17,18].

Another research of the Web-based technology for exchangeable information and support tasks in business processes. For example, an E-procurement web application prototype for automotive industry using the Internet as the channel in communication. The prototype reduces the delay of transfer data and loses of data that occurs from using traditional system such as the Fax or Papers. This prototype works properly for the exchangeable data and all reports that are used in this business and supports tasks from both of OEMs and suppliers. To be exactly the same as the Web-based project monitoring system for the Office of the Royal Development Projects Board (ORDPB) that can support the operation of the ORDPB officials more convenient to track, monitoring of on-going Royal Development Projects, update information, handle real-time projects progress, and analyze the projects efficiently [19,20].

2.7.2 Online Services System for Food Analysis and Testing

About the services system, no research that represent any Thailand Agency to bring information technology and Web-based technology to help support the work in the business process of the food analysis services. Most of Thailand agencies serving the food analysis or food testing only have websites that provide the analytical information, the few agencies that provide online services system to report or review the analysis results as summary in Table 2.1

Table 2.1 The Web Features Comparison

Agencies	Feature *					
	1	2	3	4	5	6
- Department of Medical Sciences, Ministry of Public Health [21]	✓	✓	✓	✓	✓	✓
- Department of Science Service, Ministry of Science and Technology [22]	✓	✓	×	×	×	×
- IQA Laboratory Co., Ltd. [23]	✓	✓	×	×	×	✓
- National Food Institute [24]	✓	✓	×	×	×	×
- Asia Medical and Agricultural Laboratory and Research Center [25]	✓	✓	✓	×	✓	×
- Nutrition Division, Department of Health, Ministry of Public Health [26]	✓	✓	×	×	×	×
- Thailand Institute of Scientific and Technological Research [27]	✓	✓	×	×	×	×
- Institute of Nutrition, Mahidol University [28]	✓	✓	×	×	×	×

* Feature 1 : Represent analysis services information
Feature 2 : Download services request forms / services manual
Feature 3 : Register services on web
Feature 4 : Search analysis results
Feature 5 : Review report
Feature 6 : Administrate data by staff

2.7.3 Conclusion

Information sharing among different utilities is difficult, complex and costly. Technological advances in networking have made it possible to develop a low-cost display system for accessing information. This study presents the Web-based system, made for the analytical services of INMU by select ASP.NET and Microsoft SQL Server database as a development tools. The application is implemented on the basis of three-tier client/server architecture and up-to-date web technologies. The access to data is available from any location 24 hours per day and allowed users to generate specific analysis reports by using web browser instead of expensive third party software.

The new Web-based system will support analytical services of INMU in every process. The new website has the analytical result reporting page and status tracking page for staff. The new website has the registration system that the customers register to request the analysis services via a network of internet services of INMU. Users can view analysis results or review report and track analytic jobs with convenience and quickly more than paper-based.

CHAPTER III
MATERIALS AND METHODS

3.1 Methods

The sequence of the research will be followed in 6 steps starting from Data and Information Gathering, Business Process Mapping by IDEF, Analysis and Design of the Web-Based System, System Development, Conclusion and Recommendation. Consisting of the processes is shown in Figure 3.1

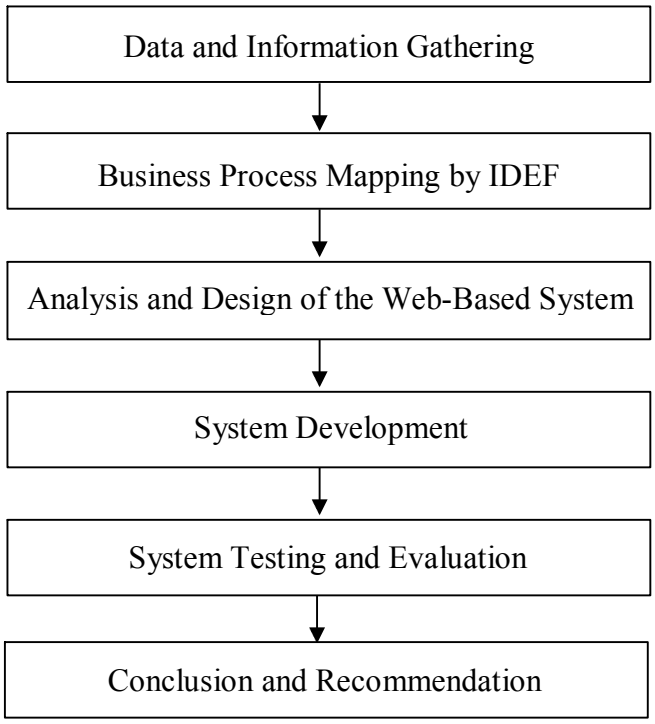


Figure 3.1 Research Steps

3.1.1 Data and Information Gathering

This step is aimed to apply the As-Is system in analyzing the service process especially the nutrition labeling assessment process.

The primary data used in this research come from in-depth interviewing with related officers of the analytical services process. Interviewees are four groups of officer as:

Technical service officer

- Analysts and Laboratory head
- Assessors
- Analytical Services Administrator

The secondary data come from related documents which are the guideline of business process mapping for As-Is model.

3.1.2 Business Process Mapping by IDEF

Integration Definition (IDEF) methods provide easy-to-use techniques and standard languages of communication that promote good engineering discipline.
The fundamental concepts of IDEF process mapping are based on the ideas of structured analysis that have produced significant payoffs in diverse business application. Such benefits include reductions in development costs, fewer system integration failures, and uniformly better communication.

3.1.3 Analysis and Design of the Web-Based System

While As-Is model in the previous step can identify problems in service tracking of analytical services, this step will be finding the solution to solve the identified problems by using Web-based technology (To-Be Model). To-Be model shows the results of current process applying to reduce redundant process and to improve process operation.

The system analysis is the next step for identifying new system. A Data Flow Diagram (DFD) is used to represent all system requirements, hardware and software specifications. It will be designed by using a Top-Down method and Microsoft Visio 2003 as a tool.

The new system consists of the database management and an analytical services web application design as shown in Figure 3.2. The database design is based on Relational Database Management System (RDBMS). The new database system is produced by using the normalization theory. An Entity-Relationship Diagram (ERD) is used to represent the design of the new system.

A stored procedure is a saved collection of Transact-SQL statements in Microsoft SQL Server 2005. A stored procedure is called by web browser, which consists of Forms and Reports. The advantages of stored procedure are reducing data size between client and server communication, preventing directly access table in database and decreasing processor and memory size of client (Figure 3.3-3.4). The stored procedure design is to define module of each stored procedure and relationship between stored procedure and form or report of an analytical services web application (WAS).

Network architecture is Internet for customer and Intranet or Internet for staff, this network architecture will be designed by Web-Based technology. Customers can track services status by using internet to connect and to get services information. Then, data are stored into database. Finally, users can login and use the information from the database server as shown in Figure 3.5. Regarding the data security, WAS application provides various user groups. All users in each level are gained permission on input, output and reports.

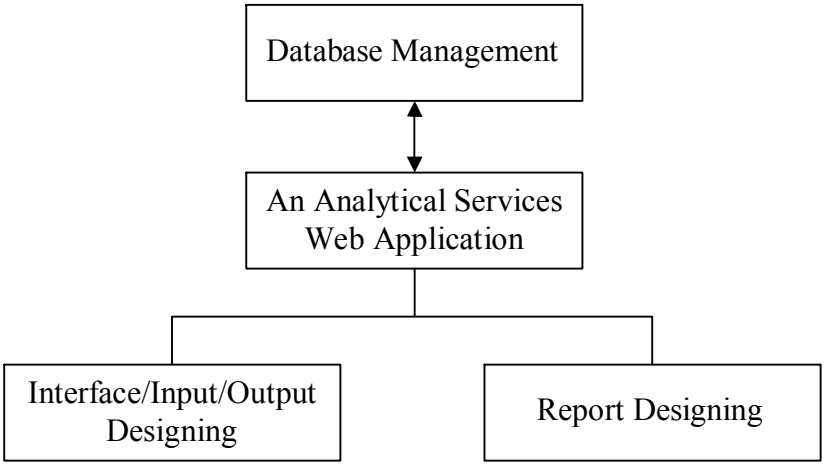


Figure 3.2 Design and Development of the New System

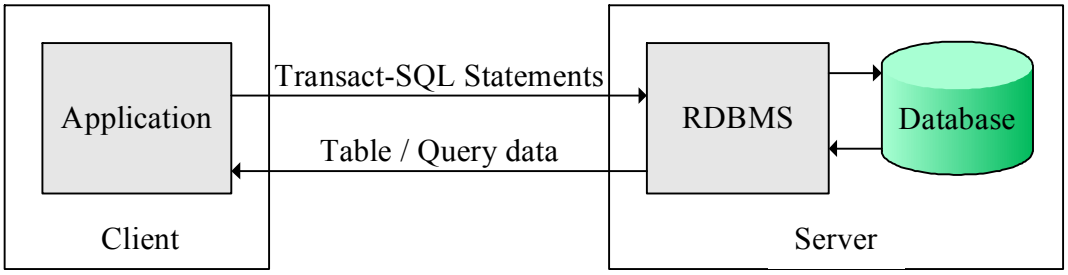


Figure 3.3 Traditional Database Connection

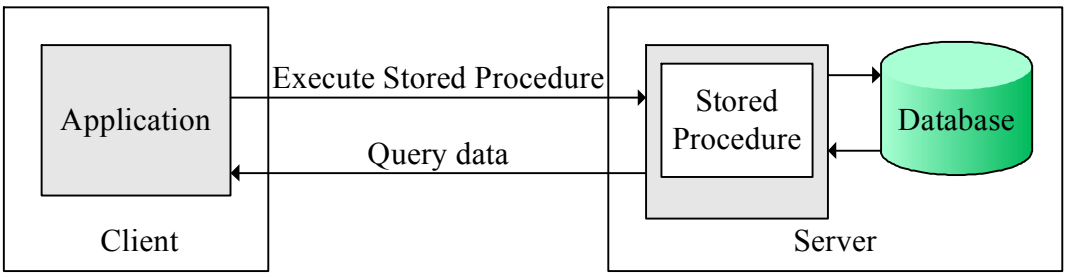


Figure 3.4 Stored Procedure-Database Connection

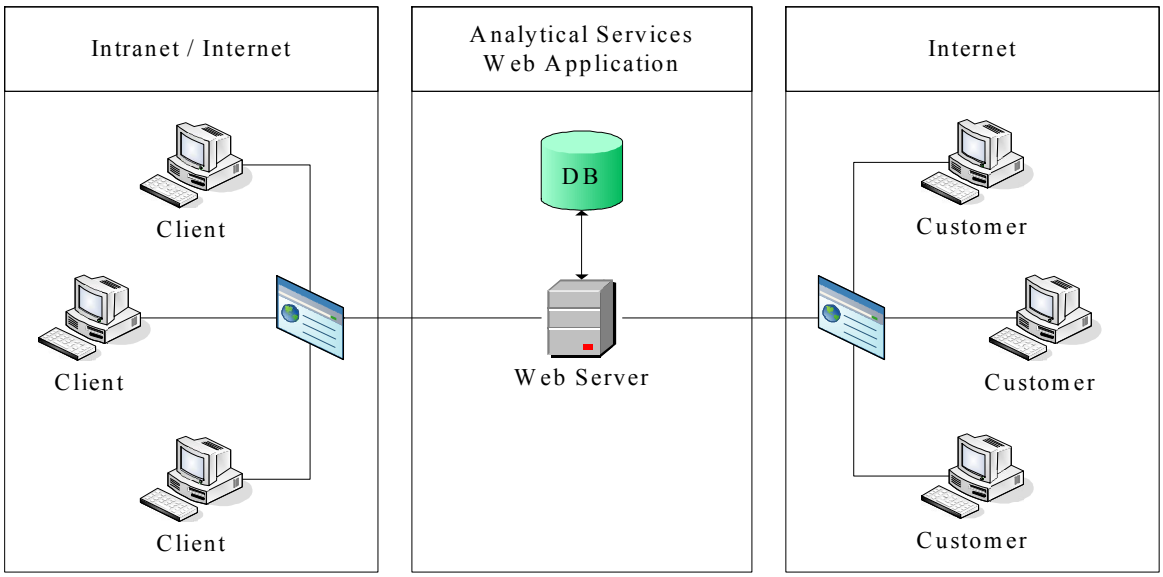


Figure 3.5 Architecture Design

3.1.4 System Development

In this step, the To-Be model in previous step will be developed to be web application for the analytical services as shown in Figure 3.2 by using Microsoft Visual Studio.NET environment (ASP.NET). Finally, the final database management system and WAS will be installed in database server and web server.

3.1.5 System Testing and Evaluation

After the system is developed, it will be tested using functional and performance testing. This step involves verification and validation testing. Verification is the process of ensuring the accuracy for the acquired data, while validation is used to check the accuracy of process of each module, including information flow testing and detecting the bug from application.

The functional testing examines a module within the system; test case comes from function specifications. For system evaluation, it is acceptance testing of system about response time by comparison with an old system.

3.1.6 Conclusion and Recommendation

Results and limitation of the study as well as recommendation and other details are provided to improve the appropriate application for the analytical services and give suggestions for further studies.

3.2 Materials

3.2.1 Hardware

Database and Web Server :

- CPU : Pentium 4 1.50 MHz.
- Ram : 256 MB.
- HDD : 20 GB.
- Peripheral : Keyboard, Mouse
- CD-ROM
- Color Monitor

Client Development :

- CPU : Pentium III 450 MHz.
- Ram :128 MB.
- HDD : 10 GB.
- Peripheral : Keyboard, Mouse
- Color Monitor

3.2.2 Software

Operating System : Microsoft Windows Server 2003

Application Tools :

- Code Editor : Microsoft Visual Studio.NET
- DBMS : Microsoft SQL Server 2005
- Web Server : Internet Information Services
- Web Browser : Internet Explorer or Mozilla Firefox
- Document Tools : Microsoft Office Word
- Document Tools : Microsoft Office Visio

3.3 Research Schedule

Activities	Month							
	1	2	3	4	5	6	7	8
Data and Information Gathering	←	—	→					
Business Process Mapping by IDEF		←	—	→				
Analysis and Design of the Web-Based System			←	—	→			
System Development				←	—	→		
System Testing and Evaluation				←	—	→		
Conclusion and Recommendation					←	—	→	
Generate Research Document						←	—	→

CHAPTER IV
CASE STUDY ON INFORMATION GATHERING

4.1 Organization of Case Study

4.1.1 Overview

The Institute of Nutrition, Mahidol University (INMU) was established in 1977 as a national planning and implementation body of the Thai government, with the mission of strengthening the National Food and Nutrition Plan. Mahidol University was selected among other nutrition and nutrition-related institutions due to its dedication to health and medical sciences, advanced facilities and technologies, and the high level of expertise shown by its faculty in food and nutrition. Since its founding, INMU has fulfilled this mission by conducting research at community and laboratory levels, by providing national and international training and education programs, and by providing technical services in food and nutrition development. The goal has been, and continues to be, the attainment of the highest possible quality of life for individuals, communities, Thai society, and for people living in other countries within and outside the Southeast Asian Region.

Institute Objectives

- To secure and promote better nutrition for all in terms of quality and safety, including the prevention of harmful effects on the food and nutrition system;
- To promote and protect public benefits generated from advances in technological research and development in the area of food and nutrition;
- To strategically create interdisciplinary research, provide education and training, and furnish technical services, with priority being given to the systematic development of Thai foods; the strategic dissemination of food and nutrition information to related organizations and to the public; as well as preventing and

solving malnutrition systematically, particularly those forms that are linked to chronic diseases; and,

- To serve as a quality resource center with a dynamic information system on food, nutrition and allied areas.

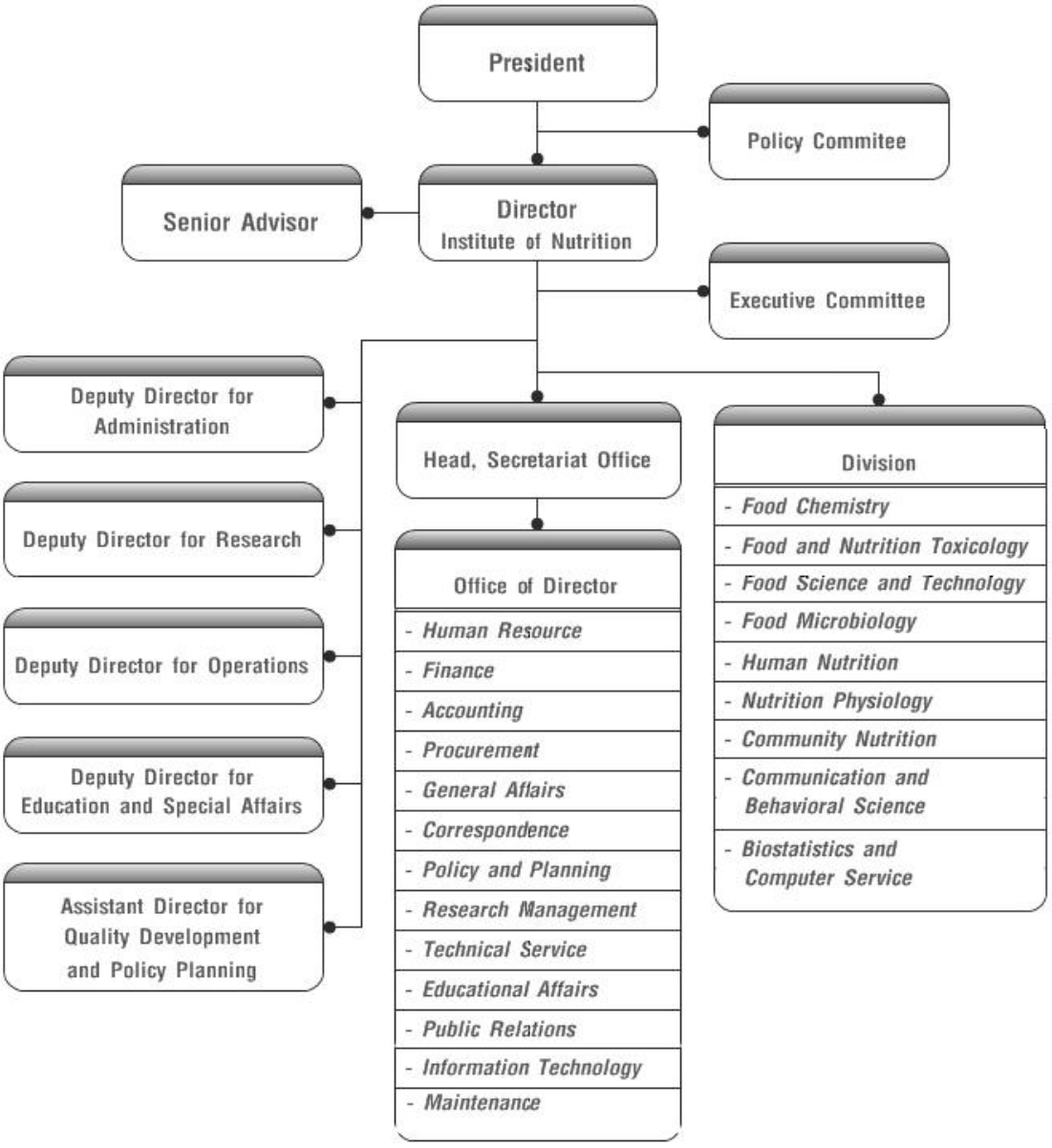


Figure 4.1 Organization Chart of Institute of Nutrition, Mahidol University

4.1.2 INMU Services

Academics

One of INMU's core aims is to enhance the quality of human life by educating postgraduates in the critical application of science; by facilitating training for scientific professions; by raising the standard of governmental and non-governmental personnel, especially health care professionals; and by contributing to knowledge through excellence in consumer protection. Towards this end, INMU provides comprehensive formal and non-formal education and training programs to fulfill the needs of governments, international development agencies, international non-government organizations and private enterprise as they aim to significantly improve nutritional well-being at national, community, household and individual levels. Graduate degree program that INMU provided are;

- Doctoral of Philosophy in Nutrition
- Master of Science Program in Nutrition
- Master of Science Program in Food and Nutrition Toxicology
- Master of Science Program in Food and Nutrition for Development

Training Service

In addition to graduate education, INMU provides formal and non-formal training on relevant food and nutrition issues for professionals working in Thailand and other countries. These training are in the form of short-course training programs as well as attachment programs. Oftentimes, these training programs are specifically requested by governments, non-governmental organizations as well as international development agencies. They vary in duration from, for example, one week to four months, depending upon the topic being studied and the time limitation involved in completing a training program to meet the requirements of funding organizations.

Information Service

The Institute of Nutrition provides information services to share knowledge about food and nutrition to the general public through radio, television, newspaper, magazines, and the Internet.

Counseling Service

The Institute of Nutrition offers an academic counseling service on food and nutrition. Counseling can be related to the development of good nutrition of quality in food products, food quality guarantee system, sensory testing of food products, and nutrition labeling. The counseling service is valuable for developing new products and for the production process, the production of nutrition labeling and nutrition information, as well as identifying solutions to technical problems and conducting reliable analyses. In addition, this service can helps in testing, developing measurements, nutritional counseling and service referral.

Research Service

The Institute of Nutrition has a research service for developing products and production processes, especially food product for nutrition. The service ranges from the laboratory level to the prototype factory level in order to develop food products that are accepted by consumers and are safe, high quality and high in nutritive value.

Moreover, the Institute of Nutrition has developed reference materials to control the quality of nutritional analysis in the laboratory.

Analytical Services

The Institute of Nutrition has conducted academic services since 1978 in order to support nutritional status, food and food safety research, as well as to develop nutritional information for Thai foods. The service is conducted by scientists who have been trained on food analysis from famous institutes in Europe, such as the CIVO (Toxicology and Nutrition Institute), TNO, Zeist in the Netherlands, and the Institute of Food Research in Norwich, England. The Institute of Nutrition provides analytical services for public and private agencies according to the Food Act of the Ministry of Public Health. The service is accepted by the Food and Drug Administration of the Ministry of Public Health as a laboratory that can analyze food samples for registration. At present, the laboratory can analyze more than 25 different types of foods.

- INMU is the first agency in Thailand who offers analytical services and full nutrition labeling for the USA and Thailand.
- INMU regularly organizes a training workshop on developing analysis quality. The Institute is keen on potential development and high quality laboratory analysis. Hence, it conducts research and develops food reference samples for use in laboratory studies or in regular proficiency testing.

4.2 Business Process of Analytical Services (As-Is System)

4.2.1 Service

The Institute of Nutrition provides the analytical service classified into 6 items as the following;

1) Nutritive Values
2) Nutrition Labeling
3) Additives and Chemical Contaminants
4) Physical Properties
5) Microbial Quality
6) Biochemical Assessment

Table of the analytical services, analytical methods and period time for analysis show in Appendix

In the six of analytical services, there are three main service processes; service request (ordering), sampling analysis in the laboratory and analytical report while in the part of Nutrition Labeling, it would be added with the nutritional assessment for making the nutritional information.

Thus, for this study, the researcher chooses the analytical service in the nutrition labeling as the representative of the business process study. This is because it covers all of the analytical service processes making us understand the business process of analytical services at Institute of Nutrition.

4.2.2 Information Technology in the Analytical Services

At present, the analytical service has software program supporting the service tasks developed from Coldfusion language via Web Browser with the database of Microsoft Access

The users of analytical Services System can be classified into 5 levels;

1) Technical Service Officer
2) Analyst
3) Head of Laboratory and Head of Division
4) Nutrition Labeling Assessor
5) Administrator

The laboratories concerning with the analysis can be classified into 6 laboratories;

1) Food Chemical Composition under the responsibility of Food Chemistry Division
2) Food Physical Properties under the responsibility of Food Science and Technology Division, Food and Nutrition Toxicology
3) Food Toxicology under the responsibility of Food and Nutrition Toxicology Division
4) Food Microbiology under the responsibility of Food Microbiology Division
5) Human Nutrition under the responsibility of Human Nutrition Division
6) Nutrition Labeling Assessor receiving the results from the other laboratories

4.3 Nutrition Labeling Processing

The first step of interviews conducted during the course of performing the process mapping is a fact finding for understanding the current process operations. This type of interview is used for establishing the scope and basic elements of a process and to make the better understanding on the existing process environment.

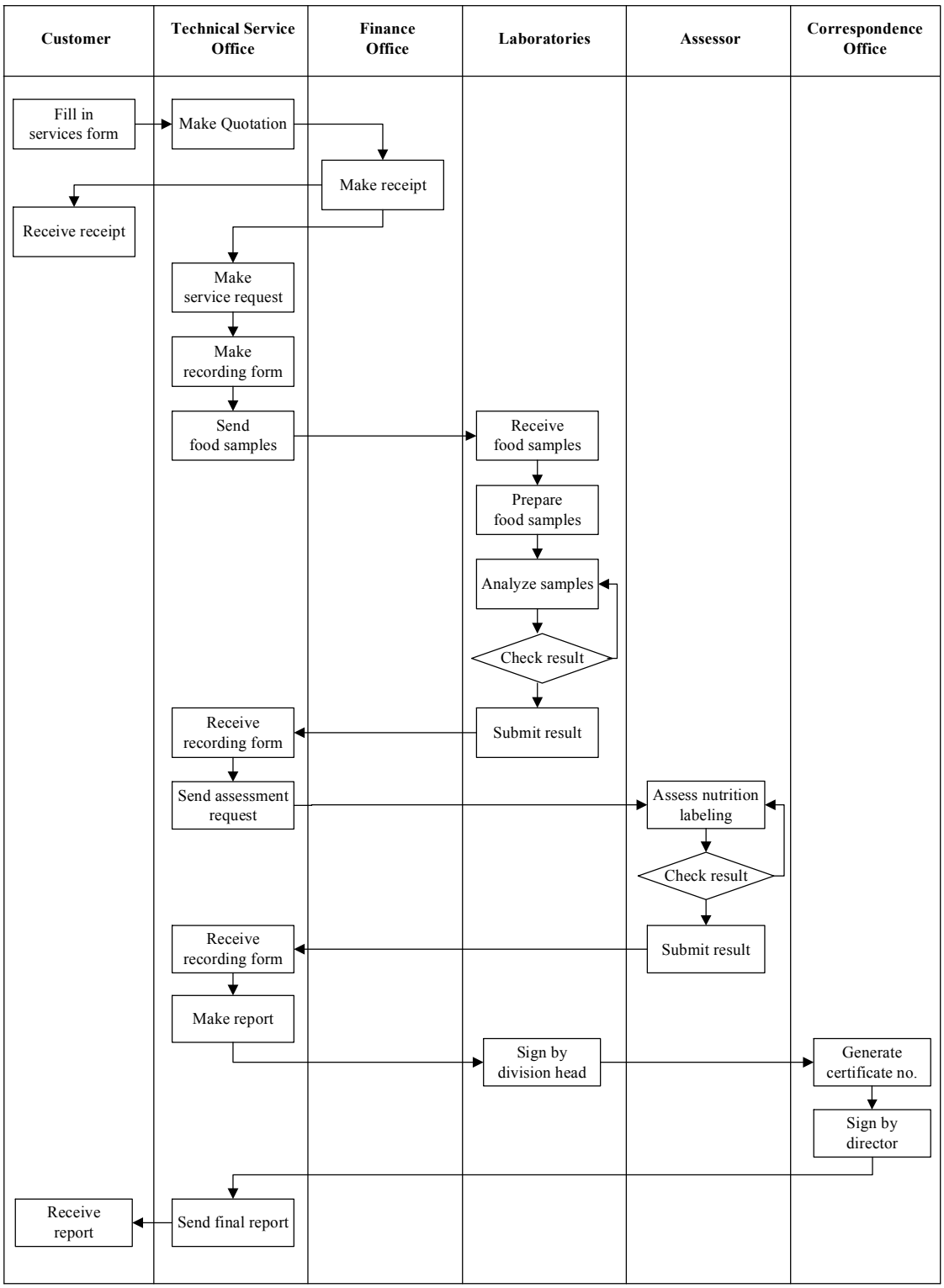


Figure 4.2 Functional Flow Chart of Nutrition Labeling

The business process would be described step by steps from Ordering process, Samples analysis process, Nutrition labeling assessment process and Reporting process as the following

4.3.1 Ordering Process

When customers want to attend the service they have to fill in the services request form at Technical Service Office Institute of Nutrition with the officer providing the information and also giving the advice in case of the new food products under the Food Act Ministry of public health.

After receiving the form, the officer input the data in the MS Excel program to calculate the fee and make the quotation. At this process, the officer will estimated the date to receiving the analysis report to customers by calculating from period used as shown in Appendix A. The officer will send orders to finance office to issue a receipt.

After that, the officer login the analytical system software and input the data from the services request form. When clicking the “Confirm” button, the data will be sent to the laboratories to make the analysis for the nutritional labeling while the analytical test will be sent to the Food Chemical Composition laboratories and the Food Microbiology laboratories.

The officer will make the record form for each concerning laboratory together with the food sample to the laboratories.

4.3.2 Samples Analysis Process

The staff receives the food sample and the record form to fill in together with recording in the sample received book in the laboratories. After that, preparer will prepare the food sample in the proper type and quantity then recording the detail of the sample preparation in the sample received book.

Each analyst will follow the sample received book for bringing the food sample to analyze in the laboratories. (The information in the sample received book is priority)

The analyst will analyze nutrients in the laboratory and record result in the book designed specifically for laboratory use only.

The analyst hand the record book to the head of the laboratory, if there is something wrong about the analytical result; the head of the laboratory can request the analyst to re-analyze. On the other hand, if the result is under quality control, the head of the laboratory will login the system to input the result in the system together with recording in the report and sending to the Technical Service Office.

4.3.3 Nutrition Labeling Assessment Process

When the officers of Technical Service Office receive the completed record form, they will record the date and examine whether it was analyzed according to the services request.

The technical service officers login the system and select the list of nutrients to assess. When they clicked the “Calculation” button, it will be sent to the nutrition labeling assessor assessing the nutrition labeling assessment. Moreover, the officer will send the completed record form to the assessor.

The assessor will know the nutrients waiting for the assessment and the analytical result from either the completed record form or logging in the system. After finishing the assessment, the assessor input the assessment result to the system together with filling in the completed record form which received from the Technical Service Office. The assessment result will be sent to the second nutrition labeling assessor.

The second nutrition labeling assessor will re-assess to confirm the result. If the result does not show the accordance, the second nutrition labeling assessor will give “comment” to the assessor to re-assess the assessment. When the assessment is correct, the assessor can click “confirm” button to send the result back to Technical Service Office together with the completed record form.

4.3.4 Reporting Process

When the Technical Service Office receives the completed record form, the officer can make analytical report by copying the screen display to paste in the MS Word to make the report in the formatted styles.

The technical service officer will print the report and send it to the head of the laboratory to sign in. At the same time, the completed record form will be sent back to the laboratory.

After the head of the division sign in the report, it will be sent to Correspondence Office Institute of Nutrition to issue the certificate number. The report registered with the certificate number will be sent to the director of Institute of Nutrition to sign and make it be the completed report.

This completed report will be sent back again to the Technical Service Office waiting for giving to the customer.

4.4 IDEFF Diagram of Nutrition Labeling Process

Process mapping chart will be represented by a set of analytical services function processes. Here is node tree and IDEF0 of Nutrition labeling

Figure 4.3 - 4.10 shown IDEF0 of Nutrition Labeling Business Process including the Ordering, Analyze Sample, Assess Nutrition Label and Reporting Process.

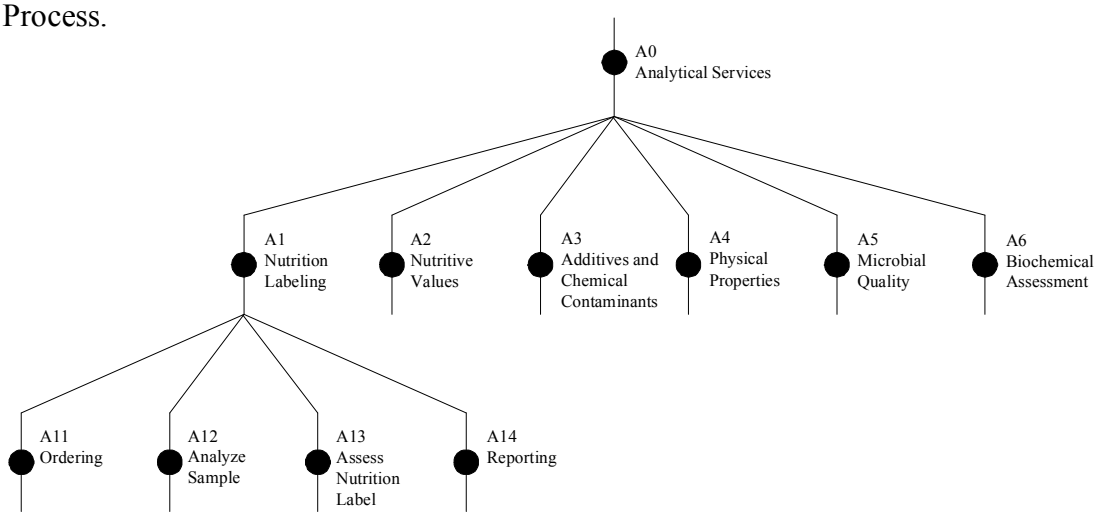


Figure 4.3 Nutrition Labeling IDEF0 node tree

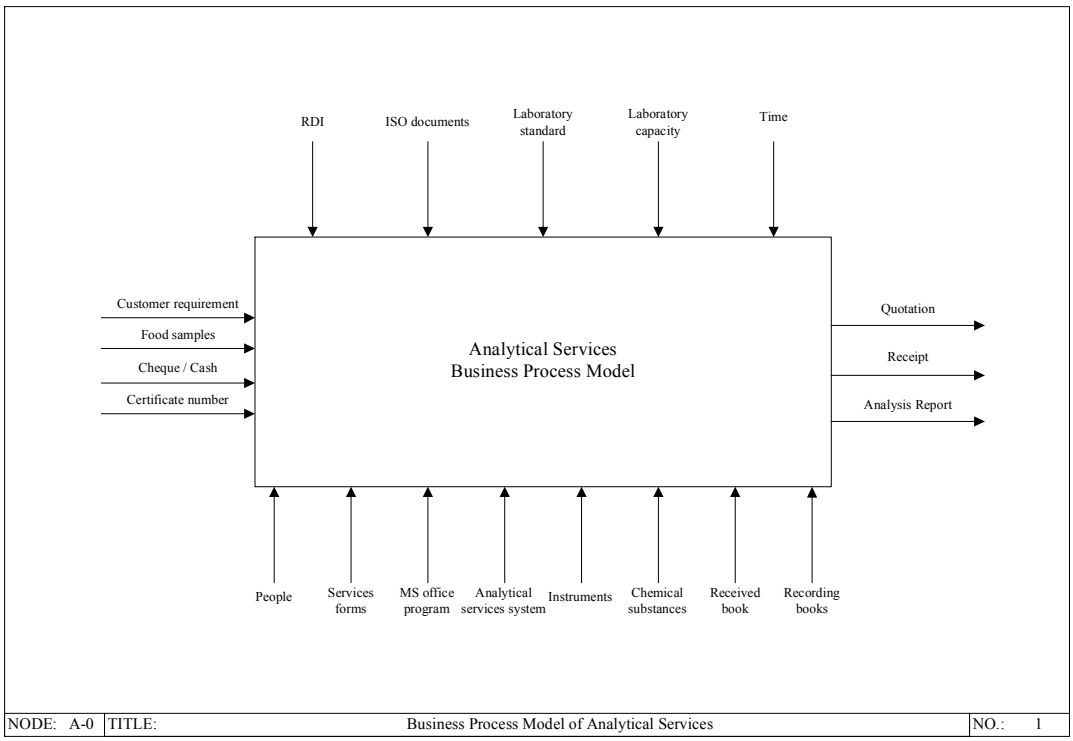


Figure 4.4 As-Is Analytical Services Business Process Model IDEF0

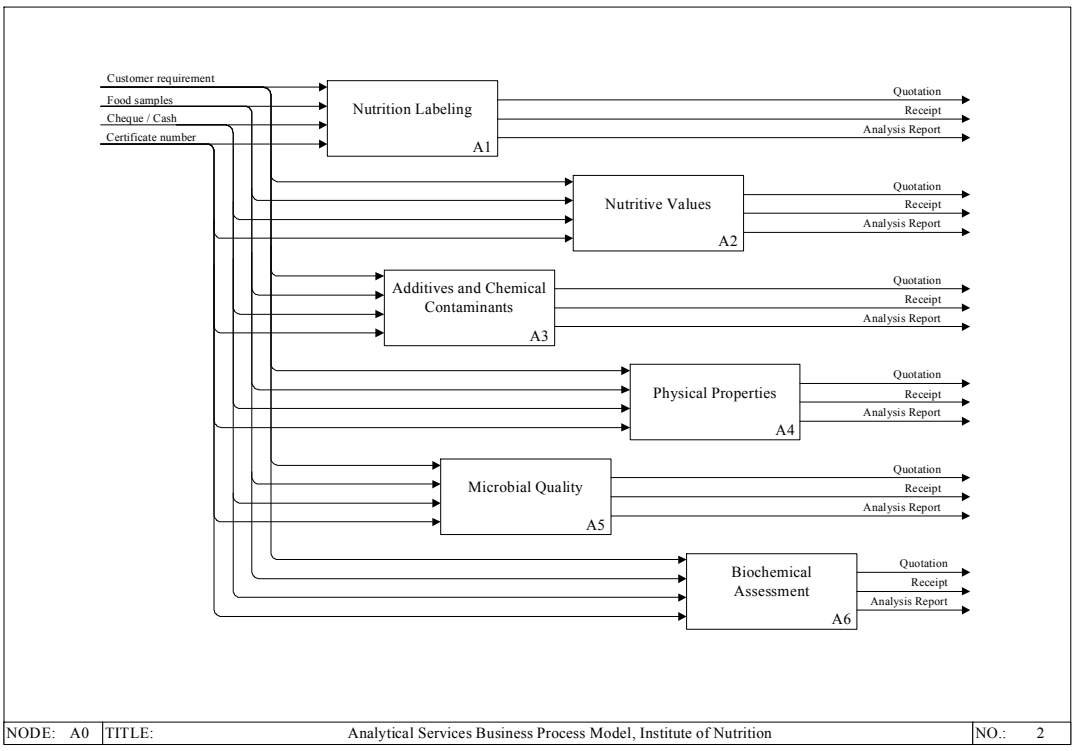


Figure 4.5 As-Is A0 Analytical Services Business Process Model

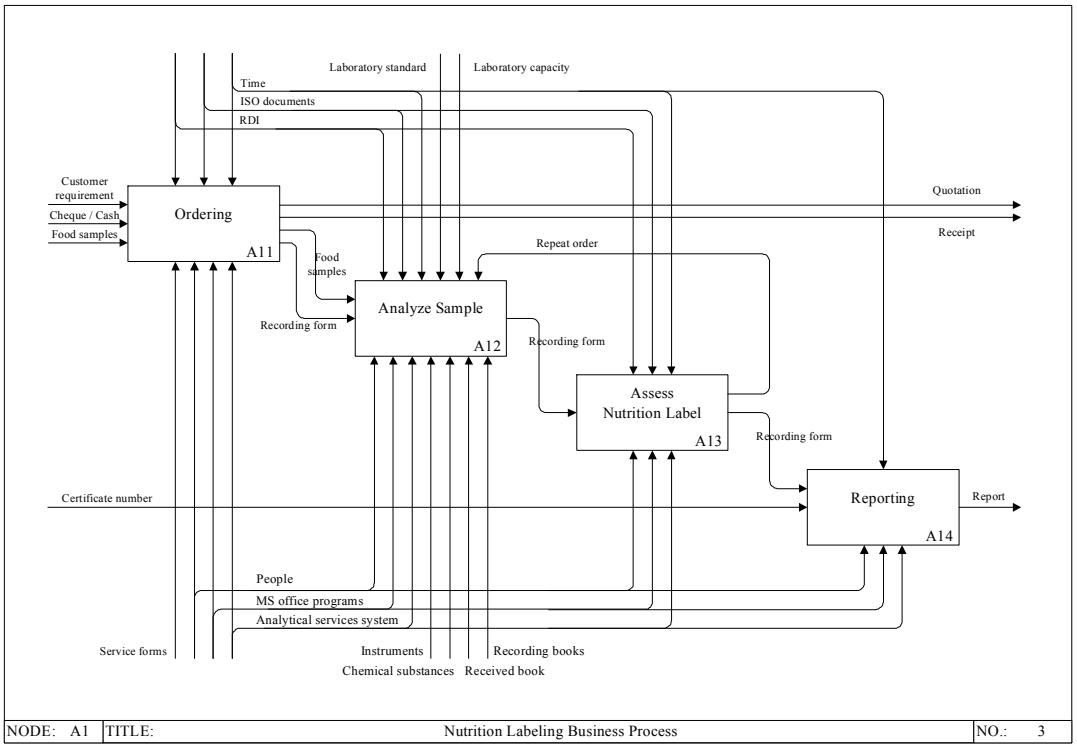


Figure 4.6 As-Is A1 Nutrition Labeling Business Process

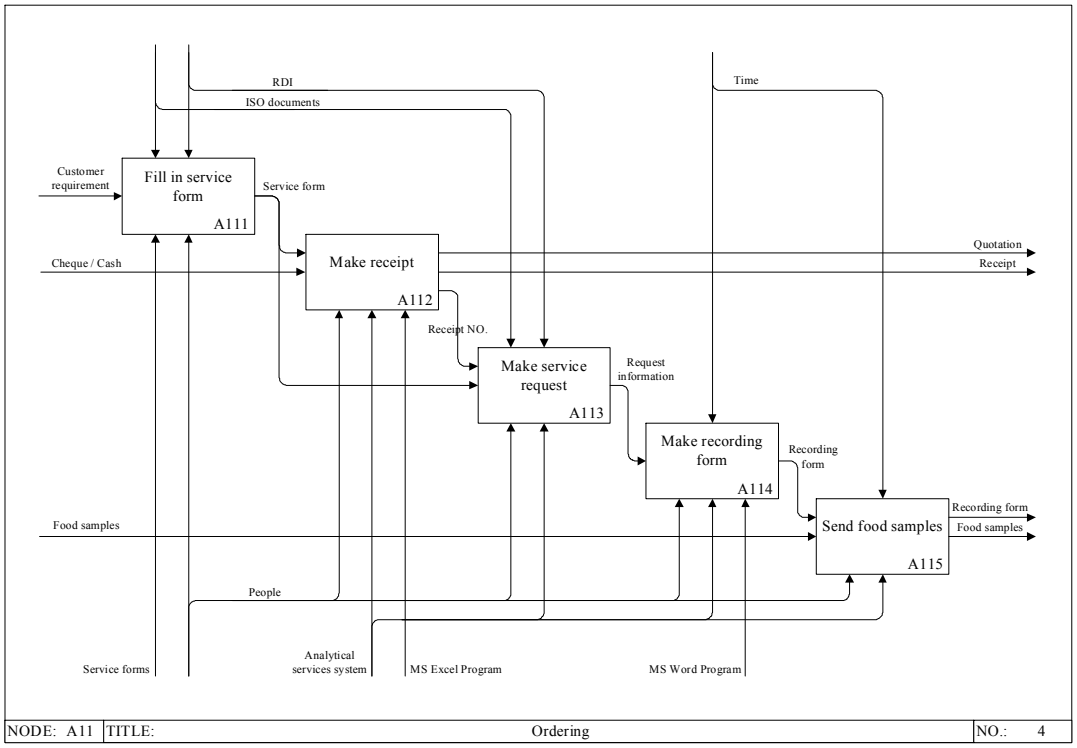


Figure 4.7 As-Is A11 Ordering IDEF0

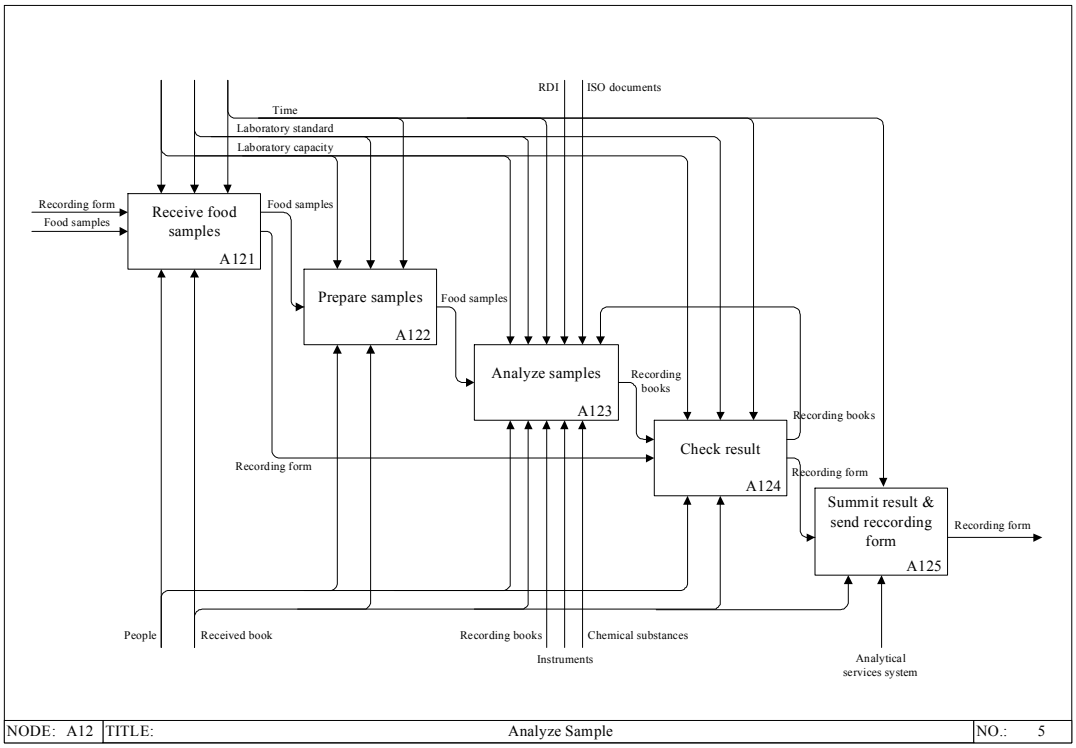


Figure 4.8 As-Is A12 Analyze Sample IDEF0

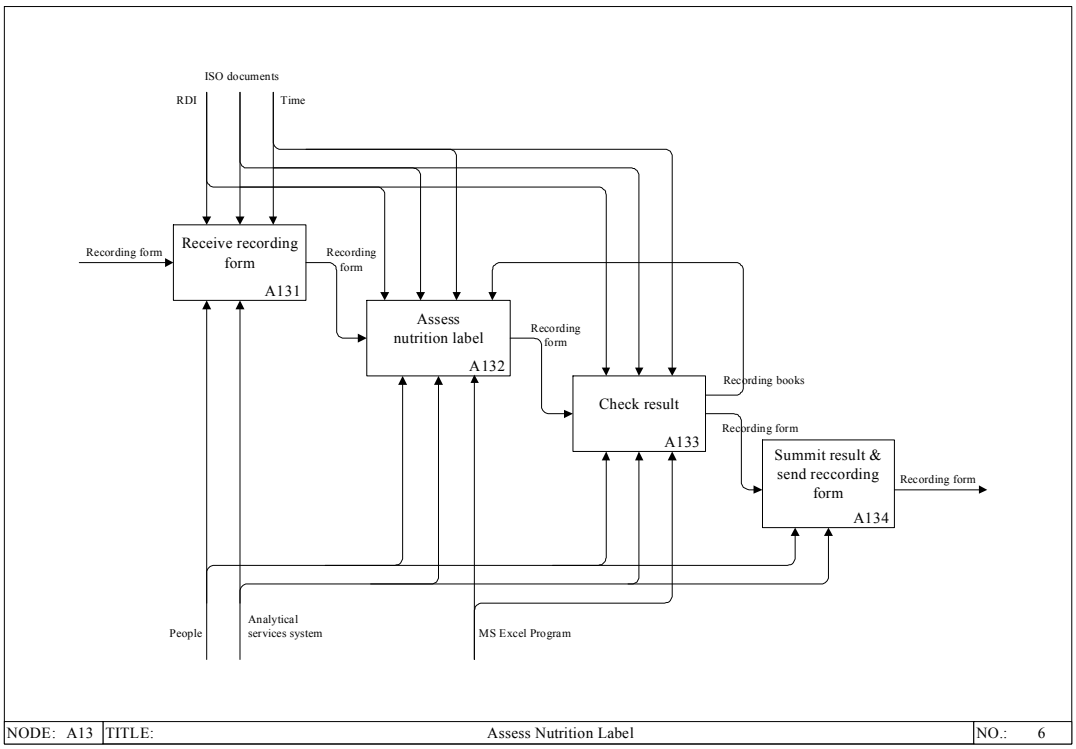


Figure 4.9 As-Is A13 Assess Nutrition Label IDEF0

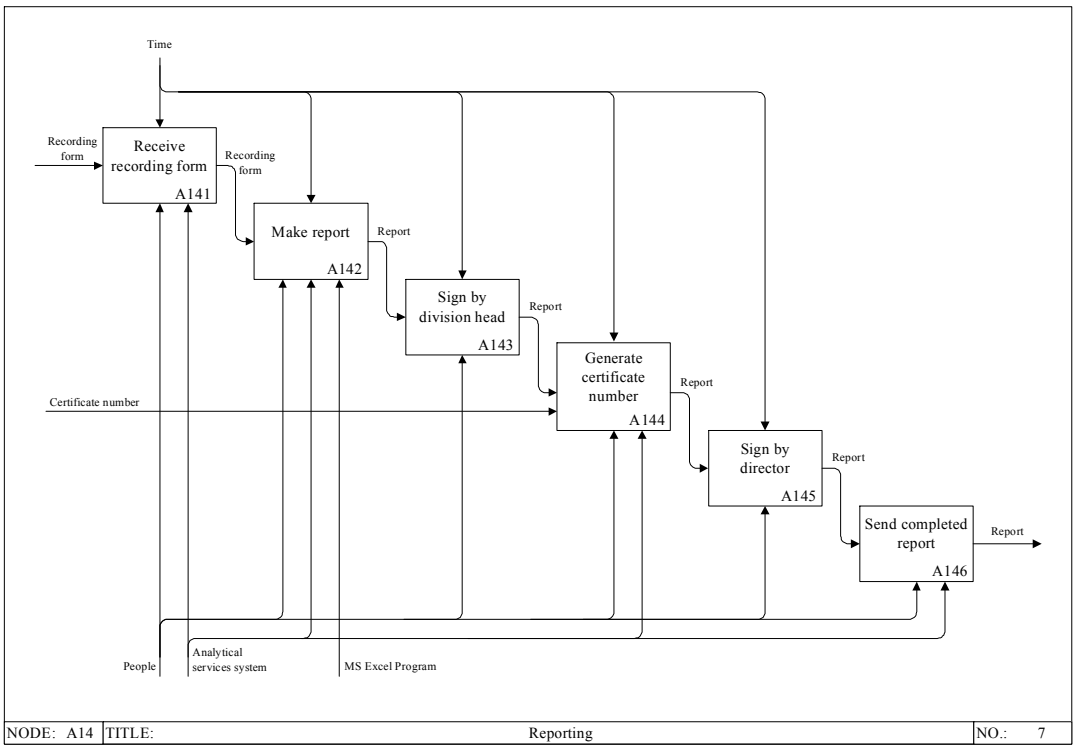


Figure 4.10 As-Is A14 Reporting IDEF0

4.5 Value Stream Mapping of Nutrition Labeling Process

Value Stream Mapping of Nutrition Labeling is aimed to analyze and depict what Non Value Added (NVA), Necessary but Non Value Added (NNVA) and Value Added (VA) activities are. Also, the value stream mapping can identify time spent for each process. Details are shown in Table 4.1-4.2 below.

Table 4.1 Value Stream Mapping of Nutrition Labeling Process

Activity	Time (hrs.)	Value
1. Ordering		
1.1. Fill in service form	0.25	VA
1.2. Make quotation	0.3	NVA
1.3. Make receipt	0.1	NNVA
1.4. Make service request	0.1	NNVA
1.5. Make recording form	0.1	NNVA
2. Analyze sample		
2.1. Send and receive food samples	0.25	VA
2.2. Prepare samples	4	VA
2.3. Queue for analysis	112	NVA
2.4. Analyze samples	112	VA
2.5. Check and submit result	8	VA
3. Assess nutrition label		
3.1. Send and receive recording form	0.2	NNVA
3.2. Send recording form to assessor	0.2	NNVA
3.3. Assess nutrition labeling	0.5	VA
3.4. Check and submit result	0.5	VA
4. Reporting		
4.1. Send and receive recording form	0.25	NNVA
4.2. Make report	0.5	NNVA
4.3. Sign by laboratory head	8	NNVA
4.4. Generate certificate number	2	NNVA
4.5. Sign by director	4	NNVA
4.6. Send final report	8	VA
Total	261.25	

Table 4.2 Duration of Nutrition Labeling Process

Activity	Time (hrs.)	Percent (%)
Non Value Added: NVA	112.3	42.99
Necessary but Non Value Added: NNVA	15.45	5.91
Value Added: VA	133.5	51.10
Total	261.25	100.00

CHAPTER V
RESULTS

This chapter describes system analysis and design, database design, interface design and the result of testing.

5.1 Analysis of Current System

At the present, the analytical service office has software supporting the task. The software had been developed from Coldfusion language via Web browser. Since the software had been used for more than 10 years, there are many problems about the program itself and/or the software cannot support the new work process, there are many new duties and analytical lists for the laboratories, while the software cannot be adjusted to the new process causing the mistakes in the data record. If there is an error to re-correct, the officer has to inform the administrative officer to make it at the database which causes the dragging and waste of time.

From IDEF0 A11

The system can not make the quotation/receipt in the formatted forms making the staff re-input the data in the Excel program even that data were input before in the system. This is the double-task and time consuming.

The technical service officer estimates received date of the analysis report from period used (Appendix A) regardless the former task in the laboratories. This causes the mistake in making the appointment to the customers and delay task sending.

The officer has to record the service number and the information both in the software program and in the record book. If there is any re-correction, the officer has to change both in the record book and the software program. This causes the time consuming and double task for the officer.

From IDEF0 A12 and A13

The software can not track the analytical result in each item from the list, but can follow up only the task status by searching from the service number. The software does not allow searching the task status in the small detail until the task is finished. While the work process in the laboratories is divided by the analysts themselves and the analytical results from the laboratories will be filled in the form and record in the system after the auditor had confirmed the results already.

This situation causes the problems as the following:

- The head of the laboratories cannot realize the work status in the process, when there is the dragging problem, the head cannot detect the in charge person and solve the problem as fast as possible until open the record book.
- The Technical Service Office cannot detect the current work status in the process causing the officer unable to use the current status data to make the consideration for administration and answer the questions from the customers.

In case of the laboratories, they spent more time than the institute's standard (Appendix A) this is because there is no plan for conducting the analysis within the laboratories and the analytical styles will be depended on the work process in each laboratory as the following:

The Food Chemical Composition Laboratory: There are analysts who are responsible to conduct the analysis of the specific properties. When the staff receives the food sample, the staff will record the information in the record book.

Every analyst will follow the record book in conducting the property analysis by ordering in the service number of the book. Each analyst has his/her own book for record the result classified in one property per book.

In some cases, there is too small number of samples to do the analysis so the analyst will wait until there are enough samples at the break-even point. This makes only the analyst realizes the work status while the others never know.

The Food Microbiology Laboratory: There is no specific duty for the analysts to conduct the analysis. When the food sample comes to the laboratory, the analysts will help each others for analyzing as the record book and the record form assigned.

From IDEF0 A14

The software can not make the report in the formatted form so the technical service officer has to copy the screen result display and make the report in the right form, after that, sending to the head of the laboratories to approve. This increases task and spends more time to complete the job for the officer while the time to make the completed report is more than 3 days.

5.2 Problems of As-Is Processes

After conducting the interview with the technical service officer, analyst and staff at the laboratories and the related department, the researcher can analyze the current problems from the As-Is IDEF0 diagram in Chapter IV. The problems can conclude in 4 problems;

1. Loss of appropriate information storage system

Main problem of the current process is unsuitable information storage. This is the causes that can not share and search information between co-operations and can not track the status of services. Table 5.1 shows the information storage of current process in separated divisions.

2. Loss of estimation for reported date (Process A11)

The Value Stream Mapping (Table 4.1) shows the time to be used in queue for analysis process while the estimate reported date does not include times for queue. This causes the mistake in making the appointment to the customers and delay task sending.

3. Lack of service status tracking (Process A11-A13)

The samples analysis process is a practical task within the laboratory which the technical services officer can not track the analytical services status. To obtain the status of analytical task during in the laboratory, the services tracking are extremely essential.

4. Lack of reporting and document entry (Process A14)

In the reporting, the technical services officer copies the screen result display and makes the report in the right form as to the reports in various formats. This increases task and spends more time.

Table 5.1 Information Storage of As-Is Model

Division	Process	Information	As-Is (Storage in)
Technical service	Ordering	- Customer requirements - Analytical service items - Invoice/Receipt information - Analytical request items - Food samples information	- Services request form - Access database, Document - Access database, Excel file - Access database, Recording form - Access database, Recording form
	Reporting	- Analytical information and results	- Access database, Analytical report, Word file
Laboratories	Samples analysis	- Received information - Samples preparing information - Analysis status - Analytical results	- Access database, Received book - Excel file, Received book - Recording form - Access database, Recording form
Assessor	Nutrition labeling assessing	- Received information - Assessment status - Assessment results	- Access database, Received book - Recording form - Access database, Recording form
Correspondence	Reporting	- Analytical information and results - Certificate number	- Access database, Analytical report, Word file - LotusNote System

5.3 Design of the New Processes

To solve the problems in the current status, the researcher would propose the following solution;

- Conducting the analysis and design for the new business process which is in accordance to the current needs by reducing the non-value added activity or the double tasks.
- Bringing the information technology to help the work process and design as well as develop web application for the new analytical service system with the information sharing between the technical service office, the analysts in the laboratories or nutrition labeling assessors.
- Filing and storing all data transactions aimed for convenient searching results. Furthermore, good filing and storing can monitor work status, nutrition evaluation and performance of concerned staffs.

This study suggests the web-based technology to store data in the need form. The new system analyzed and designed can track for the status of the analytical service items and the required information of customer and officer.

Table 5.2 Function Requirements of To-Be Model

As-Is	To-Be (By Web-based)
- Can not estimate period used for the analysis	- Estimate received date for the analysis result
- Input data into Access database, Excel files, Word files, paper forms	- Input data into database
- Can not share information with co-operation or customer, except calling to ask	- Can share some information with co-operation or customer
- Search data from paper forms or excel files in each responsibility of division	- Search information every division from database via web-based
- Phone to ask and get the analytical service status from laboratories	- Can track analytical service items every time, every where

The key element of the business processes re-engineering is the development the application using web-based technology which enables to improve four identified problems within the new business functions below;

- Ordering
- Sample Analysis
- Nutrition Labeling Assessment
- Reporting
- Tracking

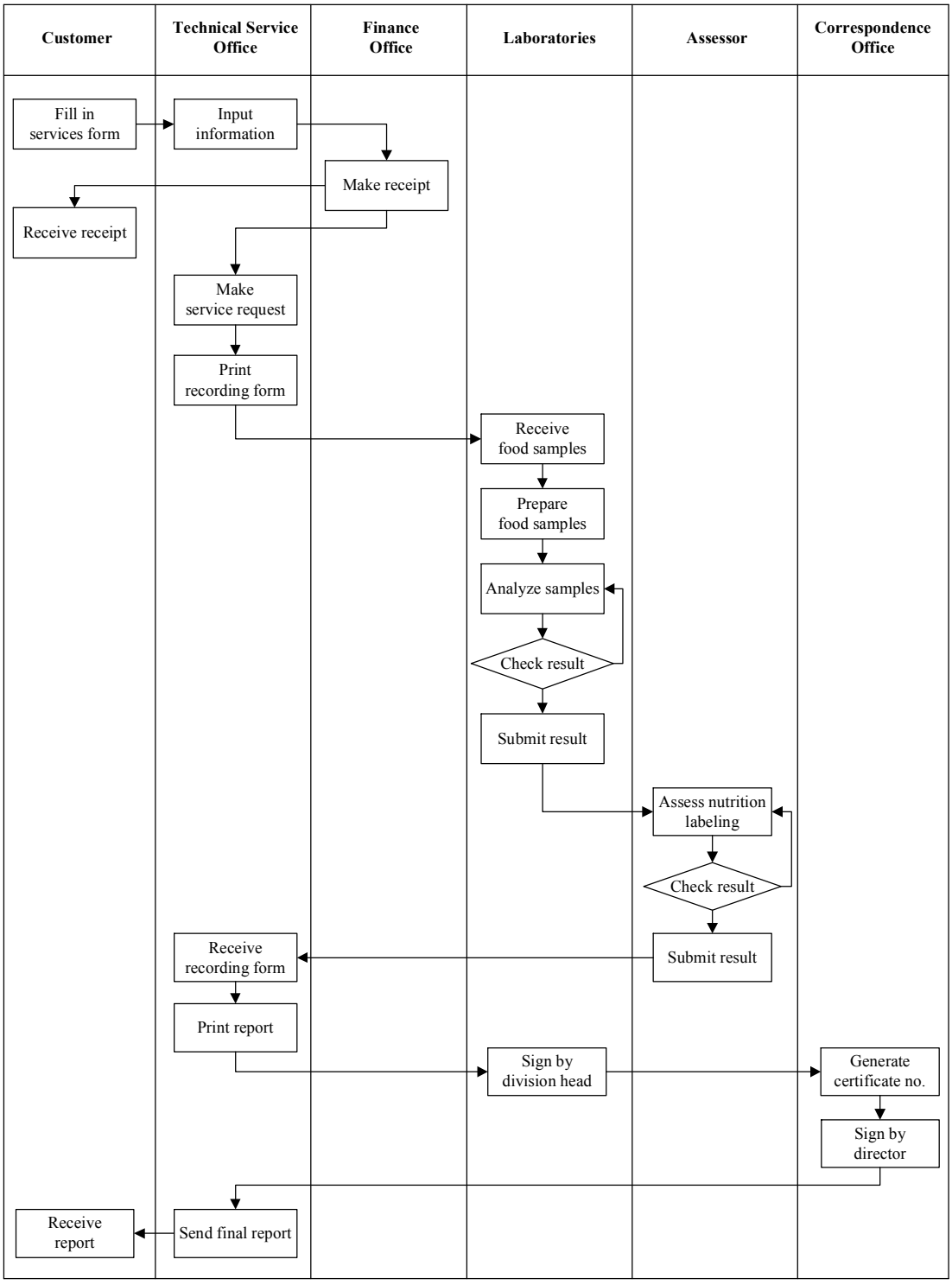
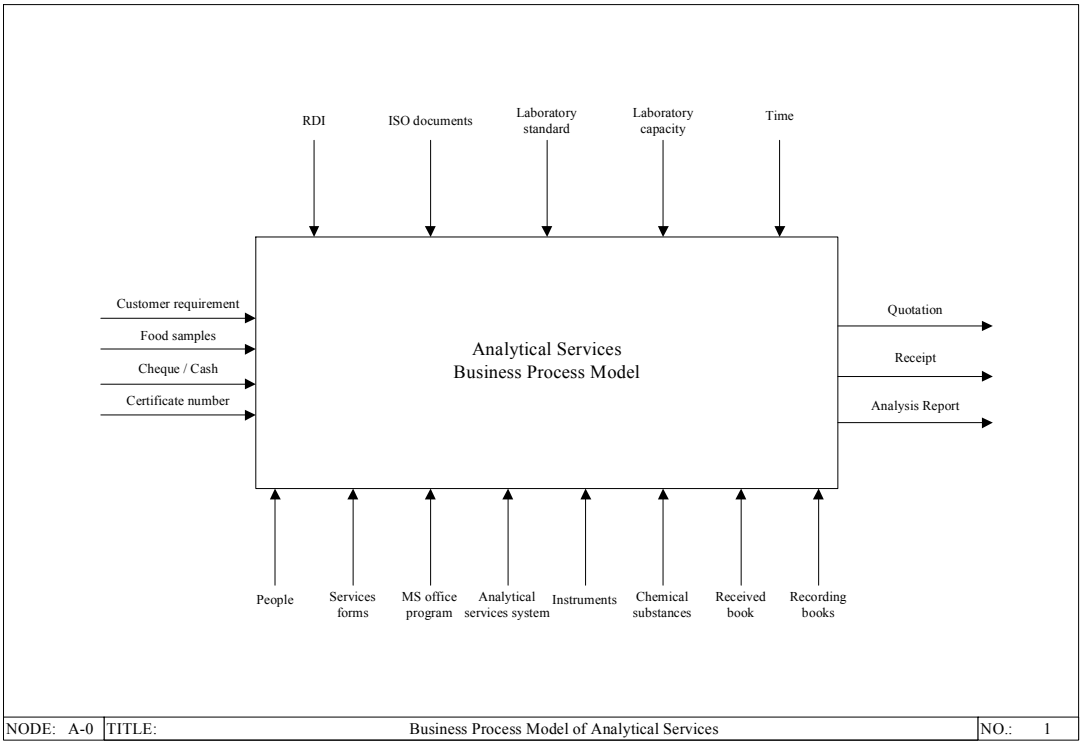


Figure 5.1 Functional Flow Chart of To-Be Model

5.3.1 Design of IDEF0 Diagram



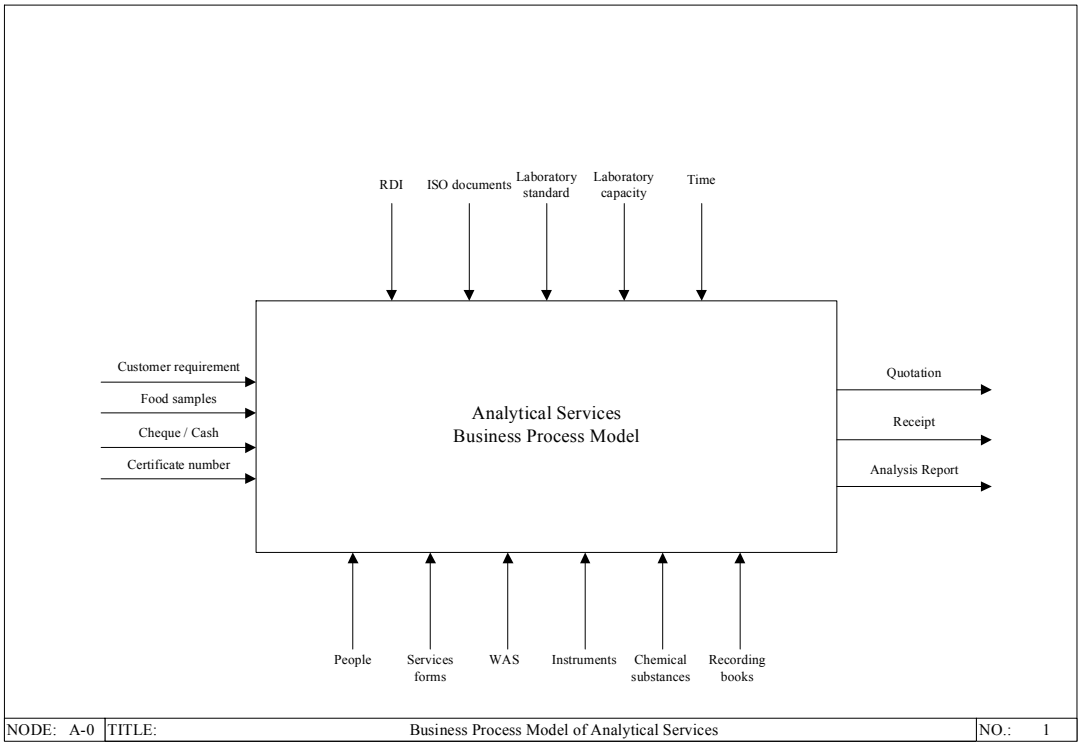
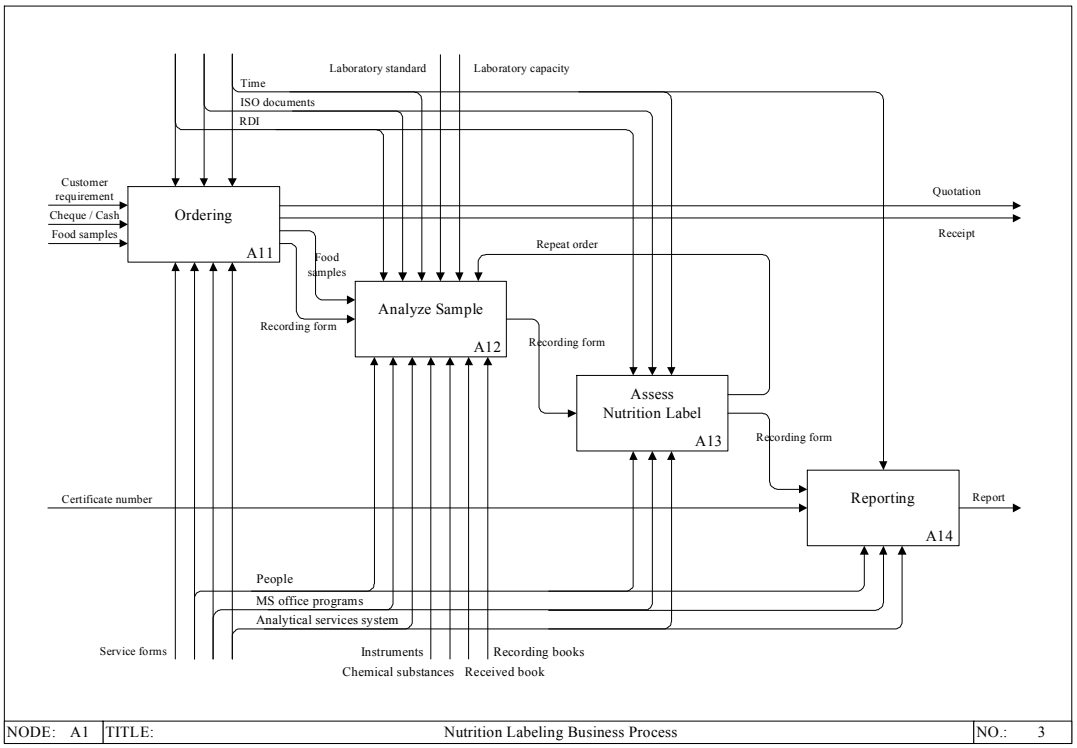


Figure 5.2 Compare between As-Is and To-Be

Analytical Services Business Process Model IDEF0



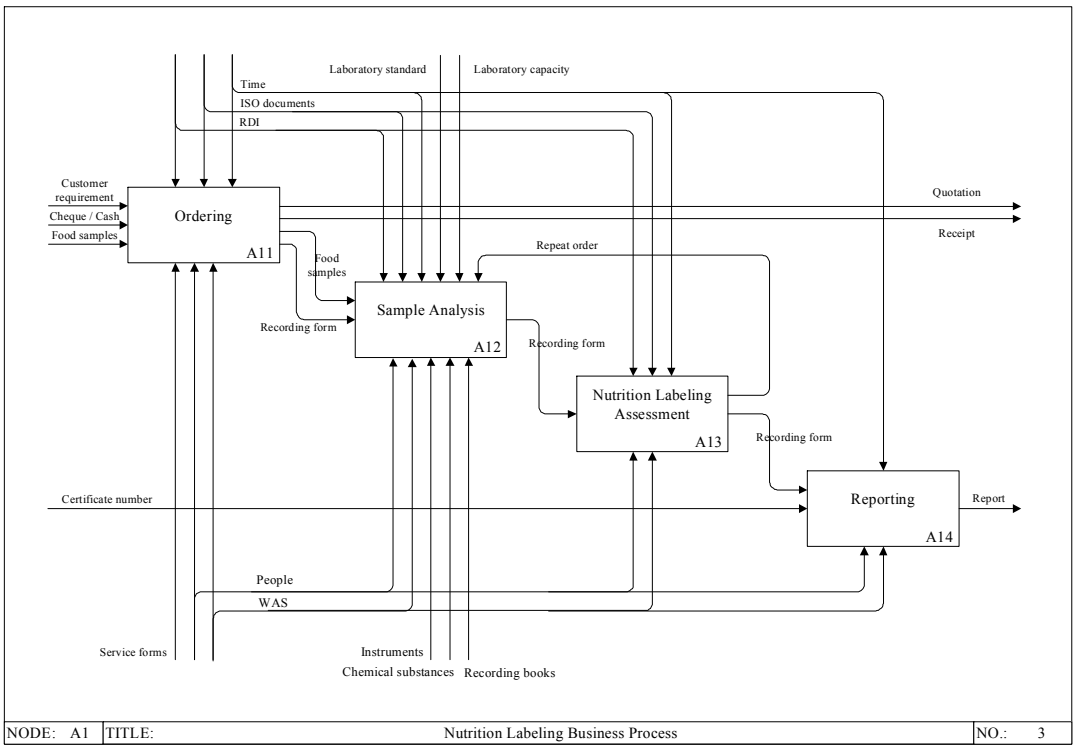


Figure 5.3 Compare between As-Is and To-Be Nutrition Labeling Process Model IDEF0

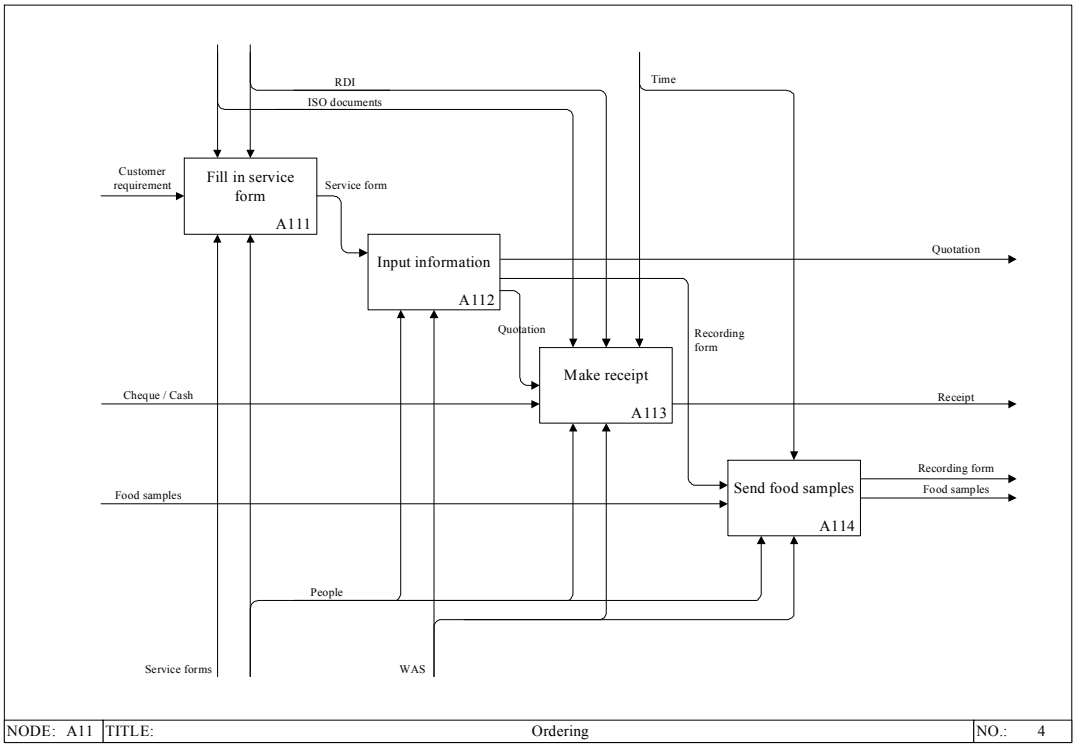


Figure 5.4 To-Be A11 Ordering IDEF0

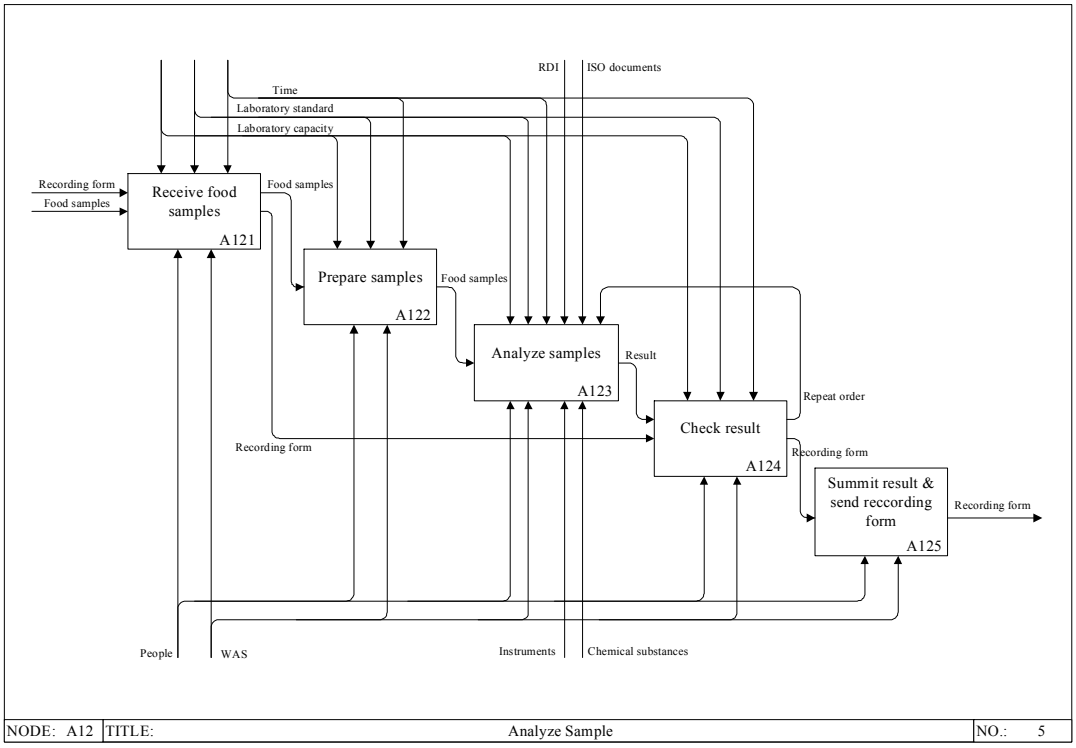


Figure 5.5 To-Be A12 Analyze Sample IDEF0

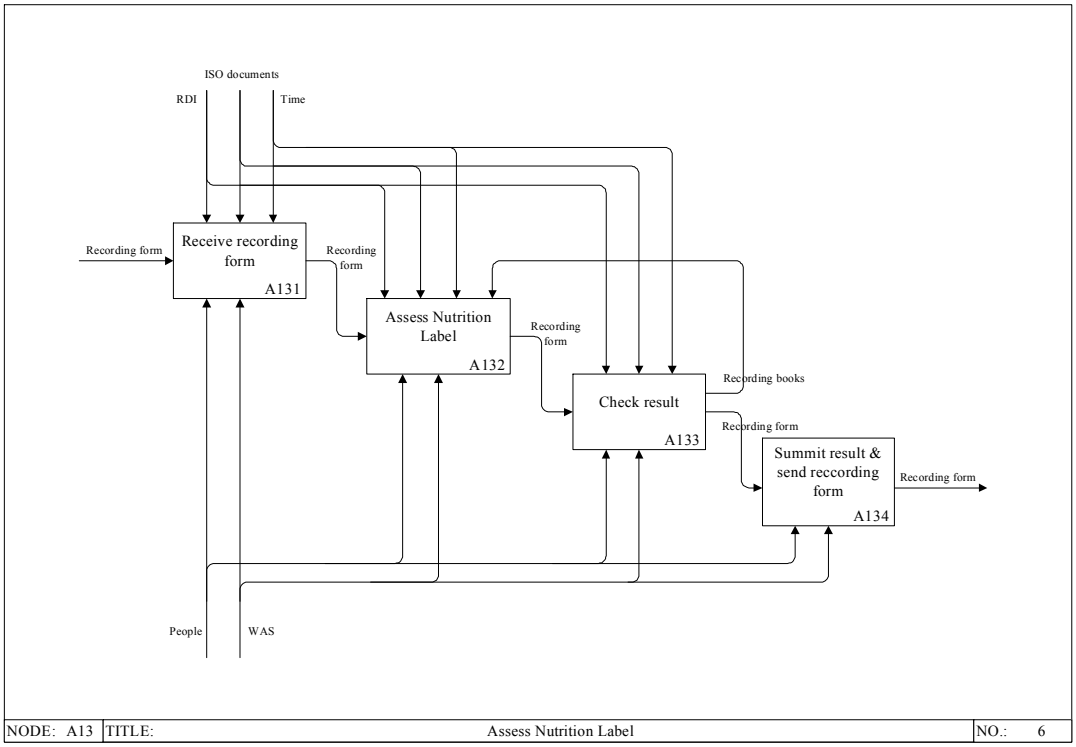


Figure 5.6 To-Be A13 Assess Nutrition Label IDEF0

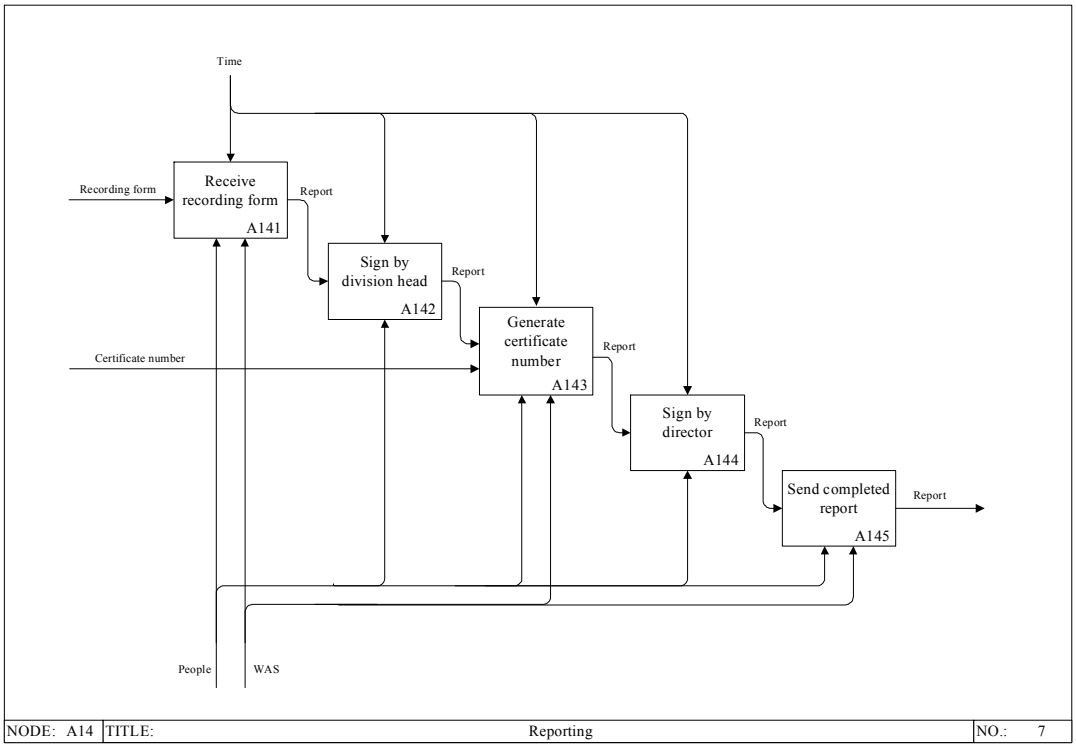


Figure 5.7 To-Be A14 Reporting IDEF0

5.3.2 Data Flow Diagram

A context diagram and Data Flow Diagram (DFD) are used to identify the transaction data of the new system as shown in Figure 5.8 – 5.13

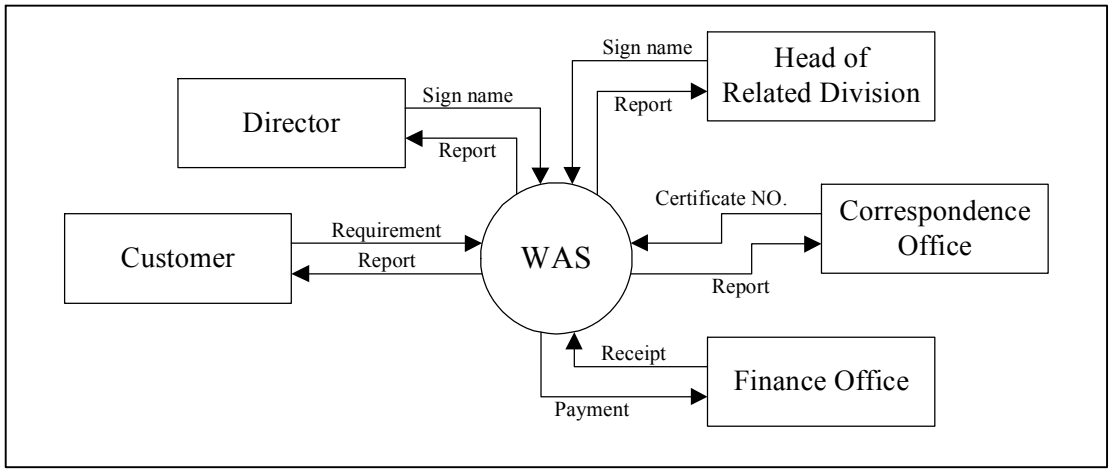


Figure 5.8 Context Level Data Flow Diagram

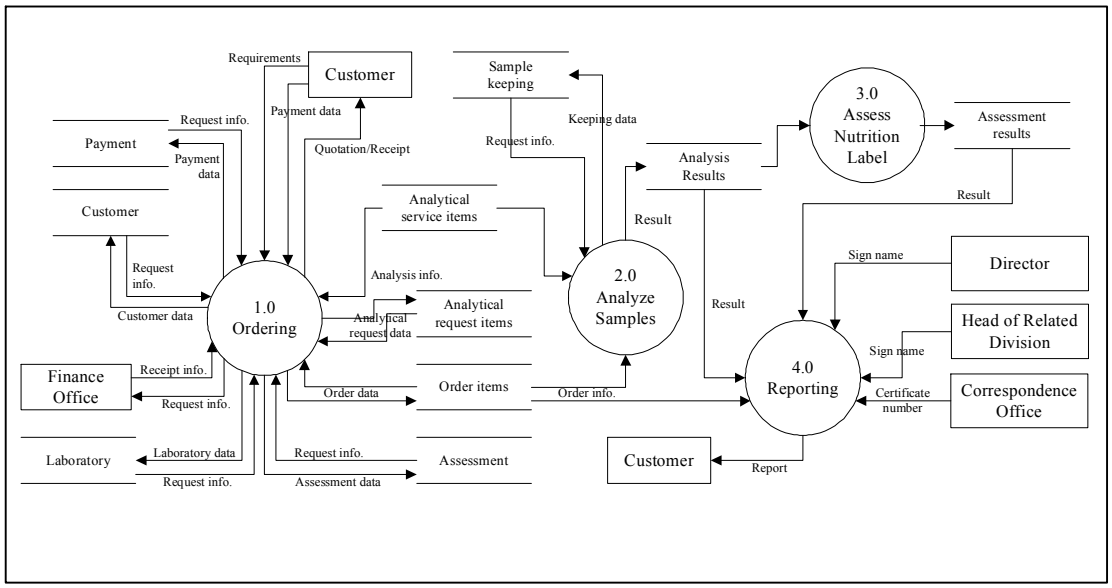


Figure 5.9 Level 0 Data Flow Diagram

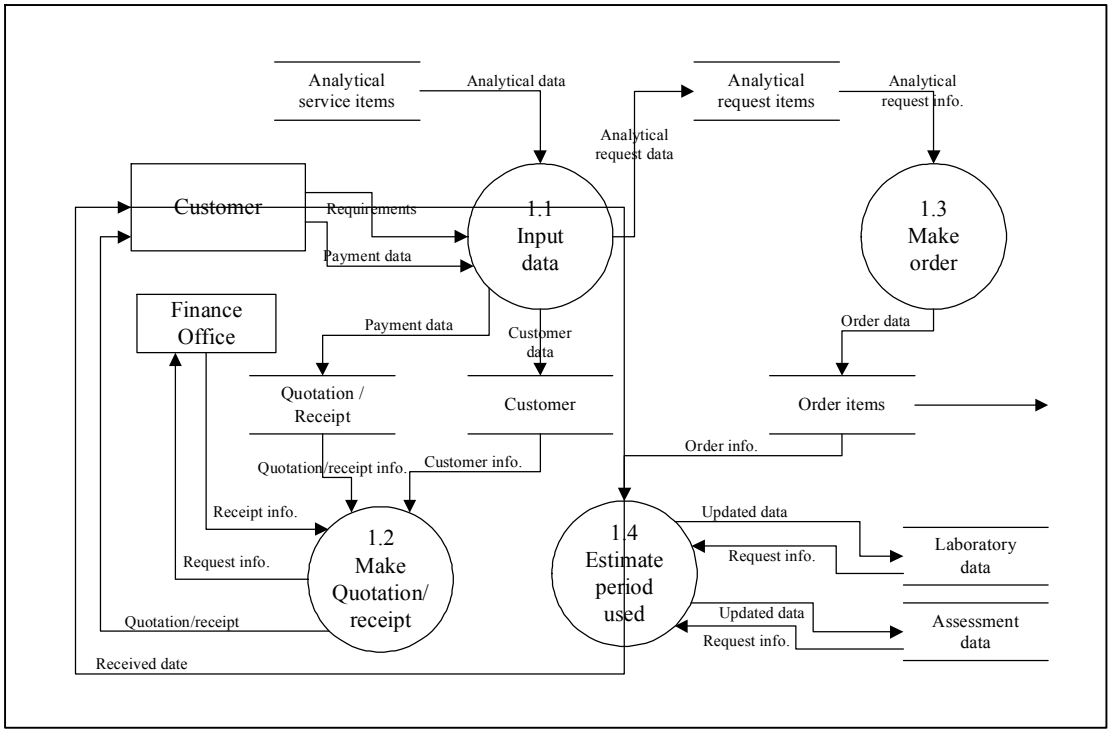


Figure 5.10 Data Flow Ordering Diagram Level 1

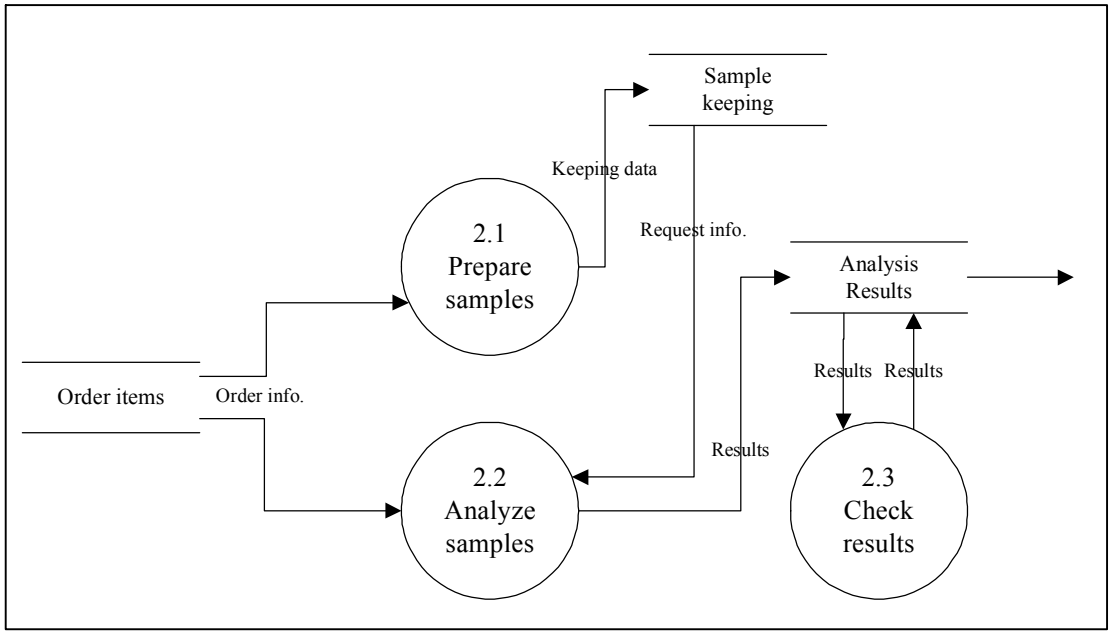


Figure 5.11 Data Flow Analyze Samples Diagram Level 1

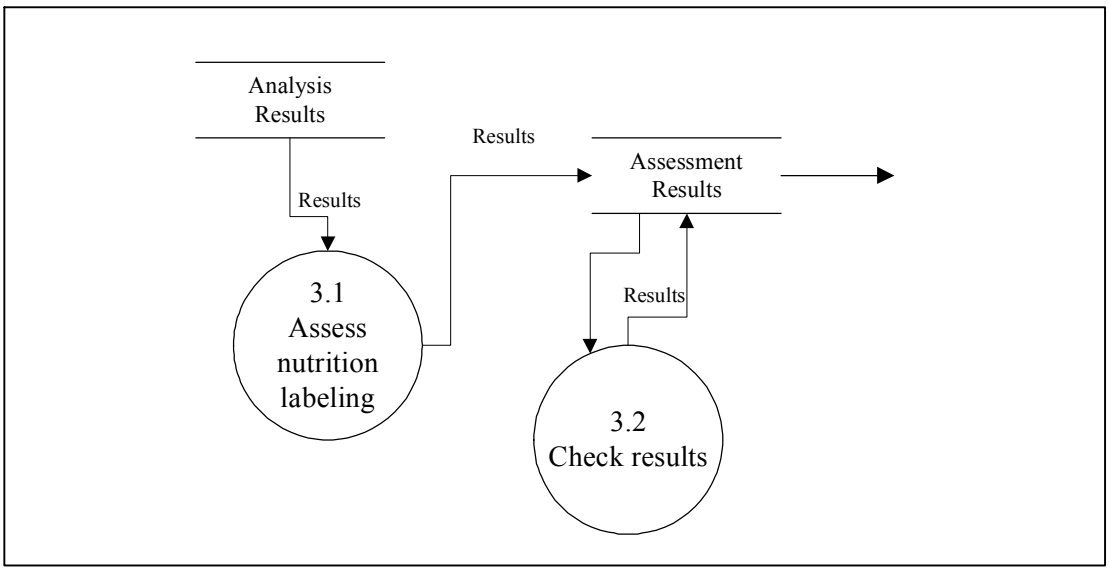


Figure 5.12 Data Flow Assess Nutrition Label Diagram Level 1

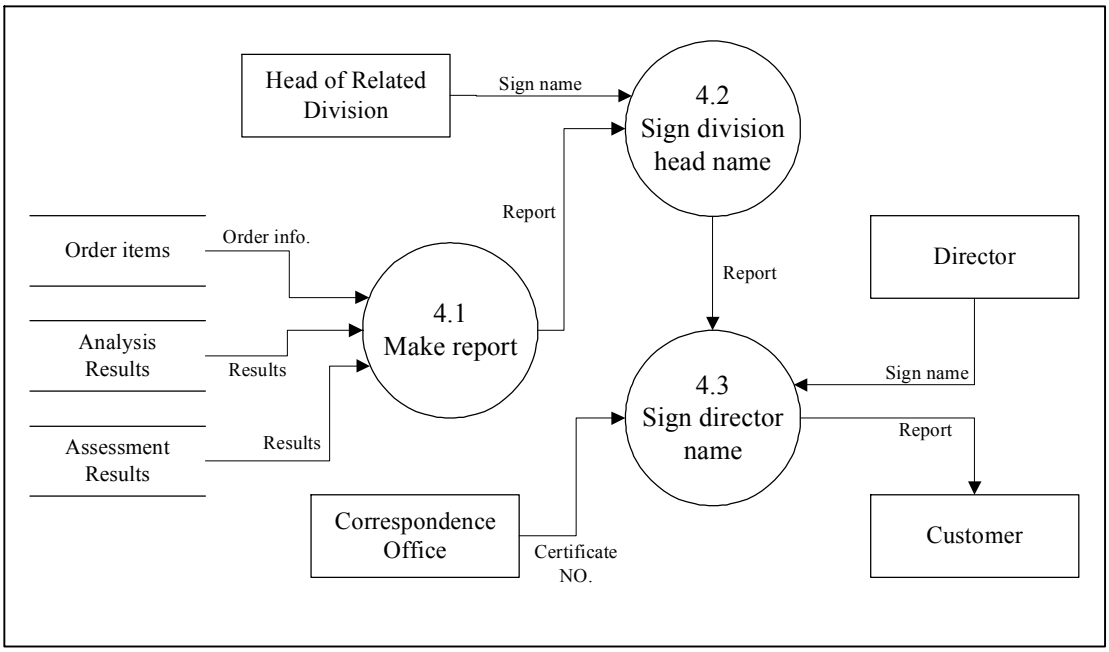


Figure 5.13 Data Flow Reporting Diagram Level 1

5.3.3 Database Design

An Entity-Relationship diagram is used to represent the design of the new system. The relational database is produced by using the normalization. The complete normalized E-R diagram is shown as Figure 5.14 and data dictionary is shown as Appendix B.

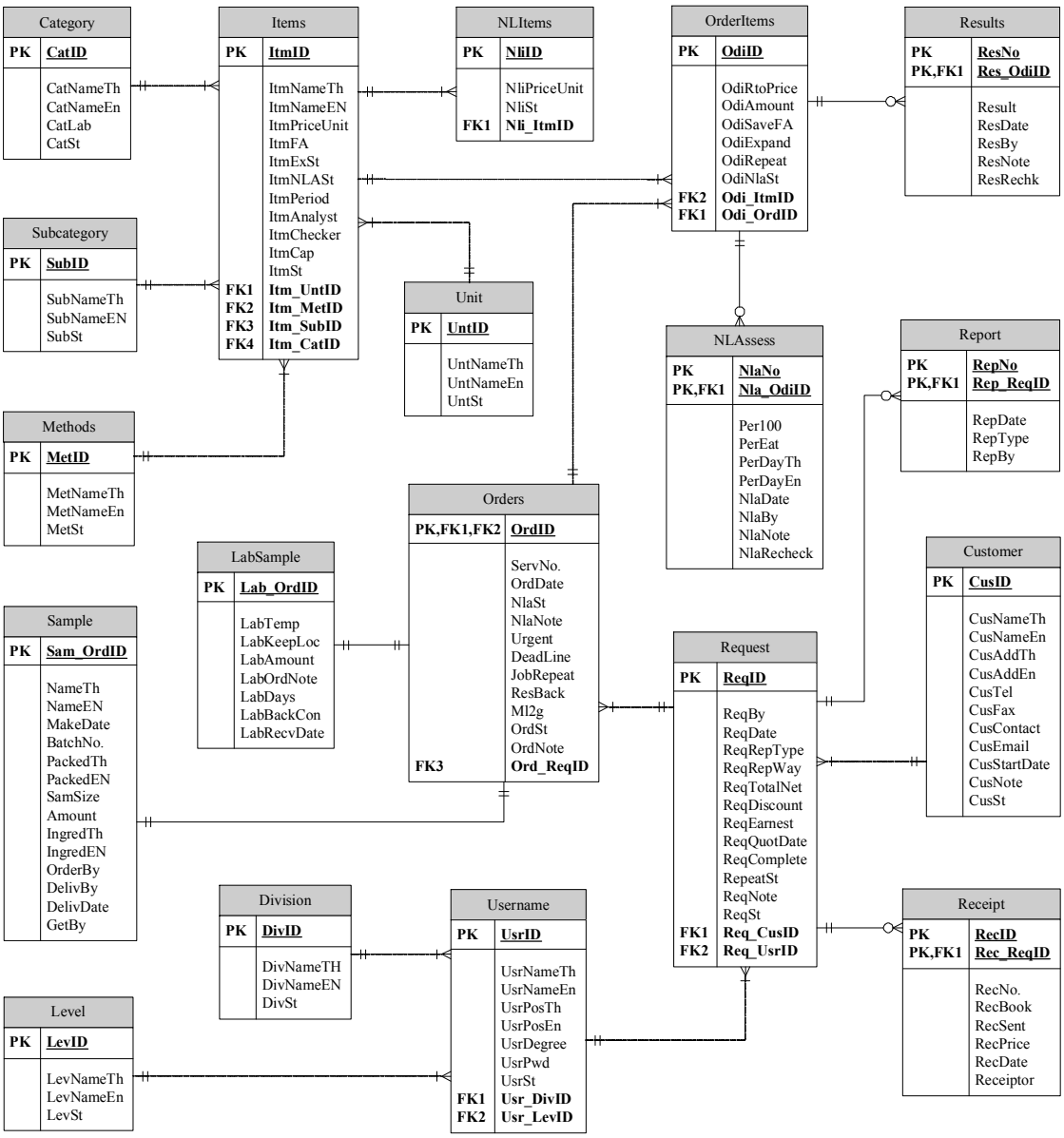


Figure 5.14 Entity-Relationship Diagram

5.3.4 Interface Design

The graphic user interface (GUI) input control is used for helping user to use this web database easier. The input controls that are used in this web application are text box, check box, radio button and drop down list.

The structure of this web can be broken down into 6 levels of users as the following: Technical Service Officer, Analysts, Head of Laboratory/Division, Nutrition Labeling Assessor, Administrator and Customers.

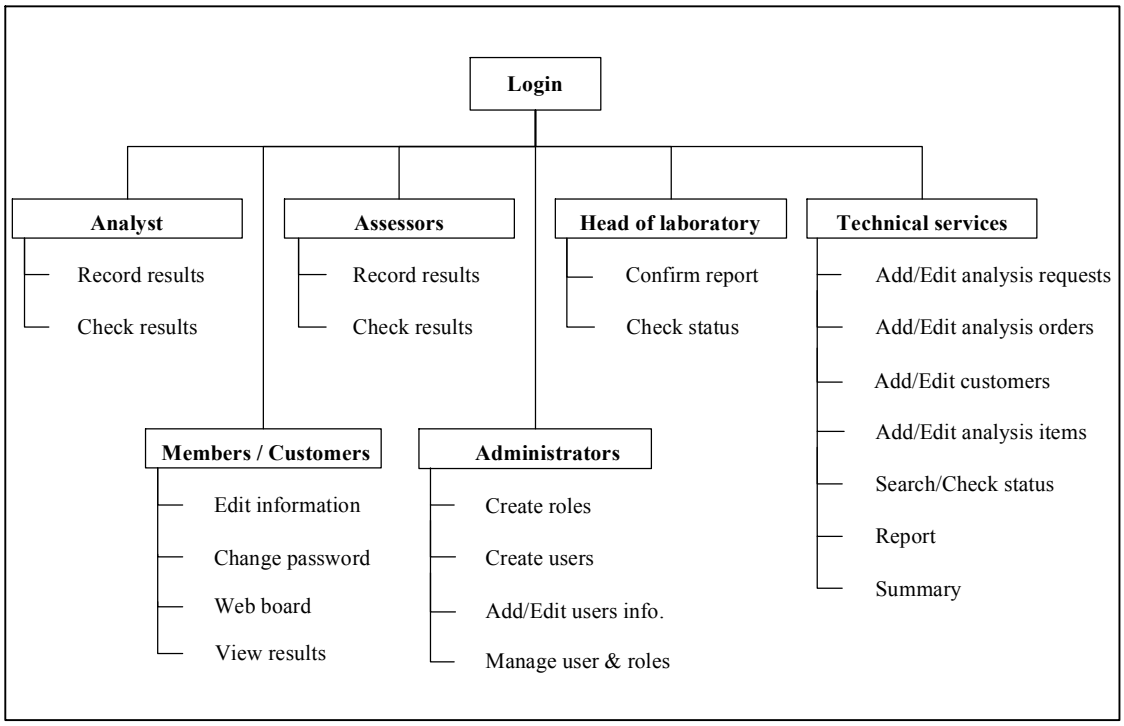


Figure 5.15 Structure Chart of Web Application

5.4 Implementation

5.4.1 Hardware and Software Requirements

Web application is installed on the server and web application can be done through INMU network currently provided. Table 5.3 shows the specification requirements in detail.

Table 5.3 The Specification Requirements

List	Buy	In house
Web server / Database server	-	1
Computer client	-	17
Operation system for server *	-	1
Data base management system *	-	1
Development tool programs *	-	1

* Mahidol University License

5.4.2 Installation

For the system implementation, it is not possible for changing into the new system immediately. Thus, the current and the new systems must be run altogether at the same time in order to record the compared time spent between the two. After that, the current system is closed and the new one will be applied. The parallel installation is shown in Figure 5.16

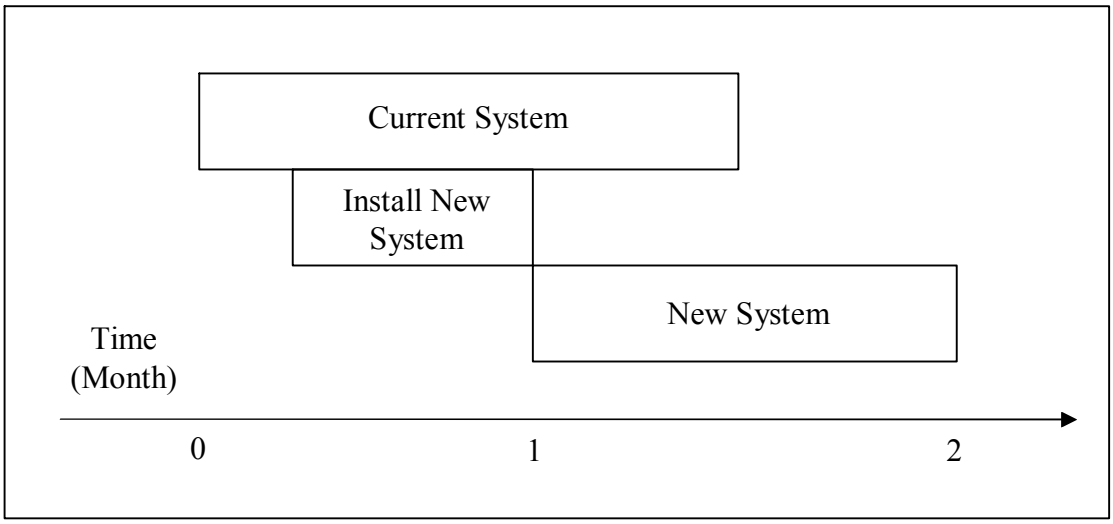


Figure 5.16 Parallel Installation

5.4.3 Person

There are 31 authorized staffs who can officially access/log in to use WAS. Data allowed for accessing for each staff are depended on his/her level of permission as detail shown in the Table below.

Table 5.4 The Number of Related Staff

Level	Person
Administrator	1
Technical services officers	3
Analysts	21
Checkers / Head of laboratory	13
Assessors	3
Total	31

Among 31, there are 21 staffs whose have good computer and internet usage skill since they are used to work with Coldfusion system. Thus, it means that there are 10 left of less skill due to they did not get permission to log in for data recording before since the data recording process must be completed only by the lab head.

5.5 System Testing and Evaluation

A functional testing examines a module within the Web Application for an Analytical Services System (WAS) as following:

5.5.1 Functional Testing

Table 5.5 Test Case for System Access

Test Case	Result
Open web application to system access	Web application availably displays main page times <15 sec.
Access without username and password	System access denied
Access with username and password	System accepts username and password

Table 5.6 Comparing Function of the New System

Function	As-Is	WAS
Make quotation	×	✓
Estimate period used	×	✓
Record service request	✓	✓
Make record form	×	✓
Record analysis result	✓	✓
Record assessment	✓	✓
Make analysis report	×	✓
Make summary report	×	✓
Search information	×	✓
Track status of order	×	✓
Track status of analysis items	×	✓

5.5.2 Response Time Testing

Response Time Testing is a process aimed to analyze Value Stream Mapping and delete Non-value Added Activity: NVA.

Table 5.7 Value Stream Mapping of the New System

Activity	Time (hrs.)	Value
1. Ordering		
1.1 Fill in service form	0.25	VA
1.2 Input information	0.1	NNVA
1.3 Make receipt	0.1	NNVA
2. Analyze sample		
2.1 Send and receive food samples	0.25	VA
2.2 Prepare samples	4	VA
2.3 Queue for analysis	104	NVA
2.4 Analyze samples	104	VA
2.5 Check and submit result	4	VA
3. Assess nutrition label		
3.1 Send recording form to assessor	0.2	NNVA
3.2 Assess nutrition labeling	0.5	VA
3.3 Check and submit result	0.5	VA
4. Reporting		
4.1 Send and receive recording form	0.25	NNVA
4.2 Sign by laboratory head	8	NNVA
4.3 Generate certificate number	2	NNVA
4.4 Sign by director	4	NNVA
4.5 Send final report	8	VA
Total	240.15	

Table 5.8 Time Spent Before and After the Process Applied

Activity	Time spent before (hrs.)	Time spent after (hrs.)	Time difference (hrs.)
Non Value Added	112.30	104	8.30
Necessary but Non Value Added	15.45	14.65	0.80
Value Added	133.50	121.5	12.00
Total	261.25	240.15	21.10 (reduced by 8.08%)

By comparing the time spent between the current and the new system, it is found that the new system in which web-based technology is applied can minimize time for nutrition labeling by 4 activities, generating time saved by 21.10 hours or 8.08% time saved by comparing with the current one. However, there are some activities having no room for improvement. Details are discussed in the next chapter.

CHAPTER VI
DISCUSSION

The objective of this study is to employ the web application for an analytical services system (WAS) in the Institute of Nutrition, Mahidol University. This system can be accessed by a web browser which specified URL with the IP address of the web server. The following topics are the issues of this system discussion.

6.1 Analysis and Design

The new system designed for deleting non value added activity and necessary but non value added activity has some limitations as follows:

1) The new system can not provide a financial transaction activities such as receipt providing due to the number of receipt, number of receipt book as well as number of reference must be provided only by the financial division.

2) For the analysis lab and nutrition evaluation section, the process of these sections can not be done significantly since all processes provided by labeling is needed to design according to ISO regulation.

3) For traditional transaction documents such as analysis record document, request/invoice form etc., these documents have to be still used in order to serve the inspection purpose of the governmental regulation.

4) Waiting time for lab process is significantly depended on the work load and queuing in the process of the lab.

According to above limitations, the researcher intends to design a process in which the information system can be employed for supporting, rather than making change for the process by:

1) Adding a function relating to request/invoice form, reporting form and analysis report form preparation

2) Enhance the system for estimating the will-be time which is close to the real time spent by calculating work load in the system.

3) Increase the capacity on work status checking and reporting in order to inform all concerned officers the status of current jobs and time spent for the new coming jobs, especially in case of having delayed jobs in the lab.

6.2 Database Management

1) Provide the database in which it can identify period used, number of sample for each time of analyzing, analyzer and inspector. All data are beneficial for estimating duration of analysis as well as being a guideline for reasonable resource allocation.

2) Provide the database owing to the Nutrition Act of the Ministry of Public Health in which food products are categorized. This database would be a guideline for advising customers for ingredient analysis, ingredient registration and legalized labeling.

6.3 Tools in the Development

Windows Server 2003 was chosen as an operating system of server and Microsoft SQL Server 2005 as the database server. These tools and technology were selected because their performance can support the system needed and all of them were existing resources that Mahidol University gets the license. ASP.NET provides an Application Program Interface (API) for software programmers. The .NET development tools, like Microsoft Visual Studio, can be used to create the web application and provided a visual interface for developers to create their applications, which makes .NET a reasonable choice for designing Web-based interfaces as well.

In order to support ASP.NET website functioning correctly, web server such as Microsoft's Internet Information Services (IIS); a common platform for ASP.NET application, is used for serving this purpose.

These tools and technology were selected because their performance can support the system needed and all of them were existing resource for Institute of Nutrition, Mahidol University.

6.4 The Advantages

The analytical service is a special process in which there is no specific software directly supported. Thus, this study is intended to consider the feasibility of using web-based technology to support the business processes by system testing evaluation. The finding of comparison shows that web-based technology in the new system can support the process of reporting and monitoring better than the current one.

The advantages points of using this system can be shown down as the following:

- The system can estimate the analytical period used and report received date.
- The system can make the quotation/record from and analysis report in the formatted forms.
- The head of the laboratories can realize the work status in the process.
- The technical service office can detect the current work status in the process to make the consideration for administration and communicate with the customers.
- The information from tracking status can use to check work status of the analysts.
- The customer can view test results, review or print draft report and track analytic jobs with convenience and quickly by internet access.

CHAPTER VII
CONCLUSION AND RECOMMENDATION

7.1 Conclusion

A web application for an analytical services system (WAS) is business process model applying Web-base technology to manage information in the analytical services for food analysis and testing via internet and intranet. This research uses the IDEF0 methodology to represent the existent business process. From As-Is model, four major problems are identified as loss of appropriate information storage system, loss of estimation for reported date, lack of service status tracking, lack of reporting and document entry. The To-Be processing is applied form IDEF0 and data flow diagram to represent information transaction. The result of development is web database and web application for the analytical services which consists of many functions; Ordering, Sample Analysis, Labeling Assessment, Reporting and Tracking.

For the development phase, the web application is developed on Windows Server 2003 operating system, Internet Information Services (IIS) for web server, Microsoft SQL Server 2005 for database management system and ASP.NET as a server side script language for interface design.

The WAS can manage the analytical services to make data more accurate, prevent losing data, eliminate double-task in processes and reduce the time for work. Also, it can track the status of in process task and report analysis result.

In conclusion, the development covers the objective and scope proposed and completed the expected result of this study.

7.2 Recommendation

Recommendations for the further study are as follows:

1) Motivation system for motivating customers to get services is needed such as;

- The customers can send request form for nutrition analysis to INMU via internet for anytime and place
- INMU should provide a nutrition catalog according to Nutrition Act of Ministry of Public Health. This catalog can give information for the customers on type of food and type of registration needed.

2) The further study should cover purchasing process as well as device, material and chemical substances preparation for laboratory analysis.

3) System improvement on queuing is needed in order to reduce waiting time, total time spent and cost as well as increase work effectiveness.

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APPENDICES

APPENDIX A
ANALYTICAL SERVICES

Table A.1 Nutritive Values

Analysis	Methods	Period used (days)
1. Common nutrients		
Crude protein	Kjeldahl	7
Crude fat	Acid hydrolysis, solvent extraction using oxtec™	7
Ash	Dry ashing	7
Moisture/Total solid	Drying: oven or vacuum	5
Dietary fiber/Insoluble dietary fiber	Enzymatic-gravimetric	10
Soluble dietary fiber		10
Energy/Carbohydrate (includes dietary fiber)	By calculation	14
Energy/Carbohydrate (excludes dietary fiber)	By calculation	14
Total sugar	HPLC	14
Non protein nitrogen	Precipitation and Kjeldahl	7
Milk solid not fat	Acid hydrolysis, solvent extraction using oxtec™	7
2. Vitamins		
Vitamin A	HPLC	14
B-carotene	HPLC	14
Vitamin E	HPLC	14
Vitamin C	HPLC	14
Thiamin (B_1)	HPLC	7
Riboflavin (B_2)	HPLC	7
Niacin	Microbiological assay	12
Vitamin B_6	Microbiological assay	12
Vitamin B_{12}	Microbiological assay	12
Folate	Microbiological assay	12
Pantothenate	Microbiological assay	12
Biotin	Microbiological assay	12

Table A.1 Nutritive Values (cont.)

Analysis	Methods	Period used (days)
3. Minerals		
Calcium[1]	Atomic absorption	14
Magnesium[1]	Atomic absorption	14
Phosphorus[1]	Gravimetric	14
Sodium[1]	Atomic absorption	14
Potassium[1]	Atomic absorption	14
Iron[2]	Atomic absorption	14
Zinc[2]	Atomic absorption	14
Copper[2]	Atomic absorption	14
Chloride[3]	Chloridometer	14
4. Fatty acids		
Fatty acids (profile)	Extraction and GLC	14
Fatty acids (profile and quantitative)	Extraction and GLC, Total fat	14
Trans Fatty acid	Extraction and GLC	14
5. Others		
Cholesterol	GLC	14
Glucose[4]	HPLC	14
Fructose[4]	HPLC	14
Sucrose[4]	HPLC	14
Lactose[4]	HPLC	14
Sorbitol[4]	HPLC	14
Salt (sodium+chloride)	Atomic absorption, Chloridometer	14
Trypsin inhibitor activity	AACC Method 22-40	10
Antioxidant Activity	ORAC	5
Inulin	GC	30
Additional mineral in the same sample costs [1]400 baht, [2] 450 baht, and [3] 500 baht each, [4]Additional sugar in the same sample costs 100 baht each		

Table A.2 Nutrition Labeling

Analysis	Methods	Period used (days)
1. Nutrition labeling (U.S. FDA)*		
Total calories	Calculation	
Calories from fat	Calculation	
Total fat	Acid hydrolysis, solvent extraction using Soxtec™	7
Saturated fat	GLC	14
Cholesterol	GLC	14
Sodium	Atomic absorption	14
Total CHO (includes dietary fiber)	Calculation by subtracting protein, fat, ash, moisture from 100	14
Dietary fiber	Enzymatic-gravimetric (AOAC)	10
Total sugars	HPLC	14
Protein	Kjeldahl	7
Vitamin A	HPLC	14
Vitamin C	HPLC	14
Calcium	Atomic absorption	14
Iron	Atomic absorption	14
Evaluation and presentation of Nutrition Facts Preparation of composite sample and serving size		
* In order to save customers' expenses, only certain nutrients may be selected for analysis by professional staff.		
2. Nutrition labeling (Thai FDA)*		
Total calories	Calculation	
Calories from fat	Calculation	
Total fat	Acid hydrolysis, solvent extraction using Soxtec™	7
Saturated fat	GLC	14
Cholesterol	GLC	14
Protein	Kjeldahl	7
Total CHO (includes dietary fiber)	Calculation by subtracting protein, fat, ash, moisture from 100	14

Table A.2 Nutrition Labeling (cont.)

Analysis	Methods	Period used (days)
Dietary fiber	Enzymatic-gravimetric (AOAC)	10
Total sugars	HPLC	14
Sodium	Atomic absorption	14
Vitamin A	HPLC	14
Vitamin B1	HPLC	7
Vitamin B2	HPLC	7
Vitamin B1+B2	HPLC	7
Calcium	Atomic absorption	14
Iron	Atomic absorption	14
Evaluation and presentation of Nutrition Facts Preparation of composite sample and serving size		
* In order to save customers' expenses, only certain nutrients may be selected for analysis by professional staff.		

Table A.3 Additives and Chemical Contaminants

Analysis	Methods	Period used (days)
1. Preservatives		
Benzoic acid	HPLC	10
Sorbic acid	HPLC	10
Benzoic acid and sorbic acid	HPLC	10
Saccharin	HPLC	10
Sulfur dioxide	Optimized Monier-Williams	10
2. Food additives		
Nitrate and nitrite	ISO 3091: Colorimetric	10
Nitrite	ISO 2918: Colorimetric	10
Borax/boric acid	Qualitative/semi-quantitative: Curcumin indicator	5
Salicylic acid	Qualitative analysis	5
Caffeine	HPLC	10
Free glutamic acid	HPLC	10

Table A.3 Additives and Chemical Contaminants (cont.)

Analysis	Methods	Period used (days)
3. Heavy metal		
Lead	Atomic absorption	10
Cadmium	Atomic absorption	10
Lead and Cadmium	Atomic absorption	10
4. Food color		
Food color	Qualitative: Wool dying	5
Food color	Quantitative: Paper chromatography	10
5. Food contaminant		
Aflatoxin in corn and peanut	HPLC	14
Aflatoxin in general foods	HPLC	14
Total phosphate	Spectrophotometry	5
EDTA	HPLC	10
6. Water		
Hardness	TISI 257: Titration	5
Nitrate and nitrite	ISO 3091: Colorimetry	5
Nitrite	ISO 2918: Colorimetry	5
Chloride	TISI 257: Titration	5
Lead	Atomic absorption	7
Cadmium	Atomic absorption	7
Lead and cadmium	Atomic absorption	7
Color	TISI 257: visual inspection	5

Table A.4 Physical Properties

Analysis	Methods	Period used (days)
Water activity	AOAC: Novasina	3
Net weight	TISI	3
Drain weight	TISI	3
Liquid weight	TISI	3
Oil weight	TISI	3
% Drain wt/Net wt	TISI	3
% Liquid wt/Net wt	TISI	3
% Oil wt/Net wt	TISI	3
Head space	TISI	3
Vacuum	TISI	3
Appearance	TISI	3
Smell	TISI	3
Color	TISI	3
Color	Colorimeter	3
Mesh	TISI	3
Consistncy / Viscosity	TISI	3
Count	TISI	3
% Salt	AOAC: Titration	5
PH	AOAC: pH meter	3
Iodine value	AOAC	5
Unsaponifiable matter	AOAC	5
Peroxide value (Food)	AOAC	5
Peroxide value (Oil)	AOAC	5
Acidity	AOAC	5
TISI: Thai Industrial Standard Institute		

Table A.5 Biochemical Assessment

Analysis	Methods	Period used (days)
Vitamin Status		
Serum vitamin A	HPLC	14
Serum β-Carotene	HPLC	14
Serum vitamin C	HPLC	14
Serum vitamin E	HPLC	14
Serum vitamin A, E	HPLC	14

Table A.6 Microbial Quality

Analysis	Methods	Period used (days)
1. Microbiological safety		
Aerobic plate count	BAM	7
APC – membrane filtration technique	BAM	7
Anaerobic plate count	BAM	7
Yeast and molds	BAM	10
Coliforms	BAM	7
Coliforms – membrane filtration technique	BAM	7
Bacillus cereus	BAM	12
Clostridium perfringens	BAM	12
Escherichia coli	BAM	12
Lactic acid bacteria	BAM	7
Salmonella	BAM	12
Staphylococcus aureus	BAM	12
Vibrio cholerae	BAM	12
Vibrio parahaemolyticus	BAM	12
Gram negative bacilli	BAM	7
MPN Coliforms	BAM	7
MPN E. coli	BAM	12
2. Canned foods		
Low acid: Incubation test at 37°C and 55°C - Total plate count - Flat sour mesophile - Flat sour thermophile - Clostridium botulinum	BAM	27
Acid/Acidified/Low water activity: incubation test at 37°C and 55°C - Total plate count - Acid tolerant mesophile - Acid tolerant thermophile - Yeast and mold	BAM	27
BAM: Bacteriological Analytical Manual, AOAC International		

APPENDIX B
DATA DICTIONARY

Table B.1 Data Dictionary of Database Design

Table Name	Attribute Name	Definition	Type	PK/FK
Category	CatID	Analytical Service Category ID	int (4)	PK
	CatNameTh	Category Name (Thai)	vchar (100)	
	CatNameEn	Category Name (English)	vchar (50)	
	CatLab	Laboratory Name	vchar (20)	
	CatSt	Status	char (1)	
Subcategory	SubID	Analytical Service Subcategory ID	int (4)	PK
	SubNameTh	Subcategory Name (Thai)	vchar (100)	
	SubNameEn	Subcategory Name (English)	vchar (50)	
	SubSt	Status	char (1)	
Method	MetID	Method ID	int (4)	PK
	MetNameTh	Method Name (Thai)	vchar (100)	
	MetNameEn	Method Name (English)	vchar (50)	
	MetSt	Status	char (1)	
Unit	UntID	Unit ID	vchar (10)	PK
	UntNameTh	Unit Name (Thai)	vchar (100)	
	UntNameEn	Unit Name (English)	vchar (50)	
	UntSt	Status	char (1)	
Items	ItmID	Item ID	int (4)	PK
	ItmNameTh	Item Name (Thai)	vchar (100)	
	ItmNameEn	Item Name (English)	vchar (50)	
	ItmPriceUnit	Price/Unit	numeric (9,2)	
	ItmFA	FA Status	vchar (50)	
	ItmExSt	Expand Status	char (1)	

Table B.1 Data Dictionary of Database Design (cont.)

Table Name	Attribute Name	Definition	Type	PK/FK
Items	ItmNLASt	Nutrition Labeling Assessment Status	char (1)	
	ItmPeriod	Period For Analysis	int (4)	
	ItmAnalyst	Analyst ID	int (4)	FK
	ItmChecker	Checker ID	int (4)	FK
	ItmCap	Amount Of Samples For Analysis	int (4)	
	ItmSt	Item Status	char (1)	
	Itm_UntID	Unit ID	vchar (10)	FK
	Itm_MetID	Method ID	int (4)	FK
	Itm_SubID	Analytical Service Subcategory ID	int (4)	FK
	Itm_CatID	Analytical Service Category ID	int (4)	FK
NLItems	NliID	Nutrition Item ID	int (4)	PK
	NliPriceUnit	Price/Unit	numeric (9,2)	
	NliSt	Status	char (1)	
	Nli_ItmID	Item ID	int (4)	FK
Username	UsrID	User ID	int (4)	PK
	UsrNameTh	User Name (Thai)	vchar (100)	
	UsrNameEn	User Name (English)	vchar (100)	
	UsrPosTh	Academic Position (Thai)	vchar (100)	
	UsrPosEN	Academic Position (English)	vchar (100)	
	UsrDegree	Degree	vchar (100)	
	UsrPwd	Password	vchar (50)	
	UsrSt	Status	char (1)	
	Usr_DivID	User	int (4)	FK
	Usr_LevID	User	int (4)	FK
Level	LevID	Level ID	int (4)	PK
	LevNameTh	Level Name (Thai)	vchar (100)	
	LevNameEn	Level Name (English)	vchar (100)	
	LevSt	Status	char (1)	

Table B.1 Data Dictionary of Database Design (cont.)

Table Name	Attribute Name	Definition	Type	PK/FK
Division	DivID	Division ID	int (4)	PK
	DivNameTh	Division Name (Thai)	vchar (100)	
	DivNameEn	Division Name (English)	vchar (100)	
	DivSt	Status		
Request	ReqID	Request ID	int (4)	PK
	ReqBy	Request By	vchar (100)	
	ReqDate	Request Date	datetime	
	ReqRepType	Report Type	char (1)	
	ReqRepWay	Receive Way	char (1)	
	ReqTotalNet	Total Net	numeric (9,2)	
	ReqDiscount	Discount Rate	numeric (9,2)	
	ReqEarnest	Earnest	numeric (9,2)	
	ReqQuotDate	Quotation Date	datetime	
	ReqComplete	Complete Date	datetime	
	ReqNote	Request Note	vchar (255)	
	RepeatSt	Repeat Status	char (1)	
	ReqSt	Status	char (1)	
	Req_CusID	Customer ID	int (4)	FK
	Req_UsrID	User ID	int (4)	FK
Orders	OrdID	Order ID	int (4)	PK
	ServNo.	Service Number	vchar (20)	PK
	OrdDate	Order Date	datetime	
	NlaSt	Nutrition Label Status	char (1)	
	NlaNote	Nutrition Label Note	vchar (255)	
	Urgent	Urgent Status	char (1)	
	Deadline	Deadline	datetime	
	JobRepeat	Job Repeat Status	int (4)	
	ResBack	Result Back	datetime	
	Ml2g	Per g./ ml.	int (4)	
	OrdNote	Order Note	vchar (255)	
	OrdSt	Order Status	char (1)	
	Ord_ReqID	Request ID	int (4)	FK

Table B.1 Data Dictionary of Database Design (cont.)

Table Name	Attribute Name	Definition	Type	PK/FK
Sample	Sam_OrdID	Order ID	int (4)	PK
	NameTh	Sample Name (Thai)	vchar (100)	
	NameEn	Sample Name (English)	vchar (50)	
	MakeDate	Make Date	datetime	
	BatchNo.	Batch Number	vchar (50)	
	PackageTh	Package (Thai)	vchar (255)	
	PackageEn	Package (English)	vchar (255)	
	SamSize	Sample Size	vchar (100)	
	Amount	Amount	numeric (9,2)	
	IngredientTh	Ingredient (Thai)	vchar (255)	
	IngredientEn	Ingredient (English)	vchar (255)	
	OrderBy	Order By	vchar (100)	
	DelivBy	Delivery By	vchar (100)	
	DelivDate	Deliver Date	datetime	
	GetBy	Get Sample By	int (4)	
LabSample	Lab_OrdID	Order ID	int (4)	PK
	LabTemp	Keeping Temperature	int (4)	
	LabKeepLoc	Keeping Location	vchar (255)	
	LabDay	Keeping Days	int (4)	
	LabBackCon	Send Back Status	char(1)	
	LabRecvDate	Receive Date	datetime	
Receipt	Rec_ReqID	Resuest ID	int (4)	PK
	RecID	Receipt ID	int (1)	PK
	RecNo.	Receipt Number	vchar (20)	
	RecBook	Receipt Book	vchar (20)	
	RecSent	Receipt Send Number	vchar (20)	
	RecPrice	Price	numeric (9,2)	
	RecDate	Date Stamp	datetime	
	Receiptor	Receipt By	int (4)	

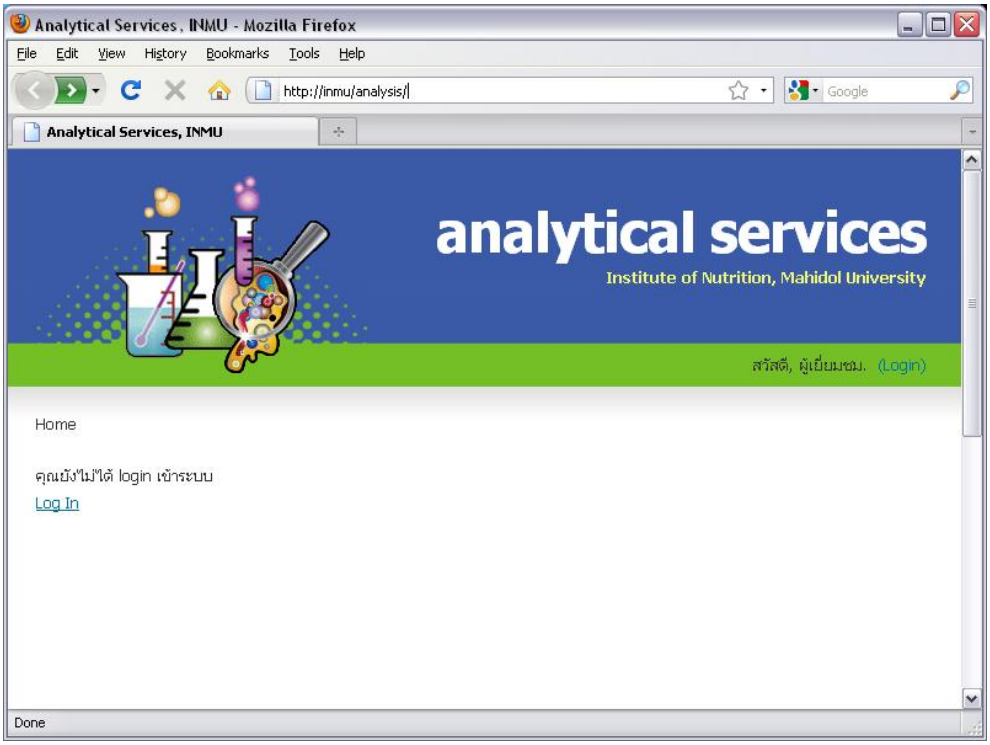
Table B.1 Data Dictionary of Database Design (cont.)

Table Name	Attribute Name	Definition	Type	PK/FK
Report	Rep_ReqID	Request ID	int (4)	PK
	RepNo	Report Number	int (1)	PK
	RepDate	Report Date	datetime	
	RepType	Report Send Number	vchar (20)	
	RepBy	Price	numeric (9,2)	
OderItems	OdiID	Order Item ID	int (4)	PK
	Odi_OrdID	Order ID	int (4)	FK
	Odi_ItmID	Item ID	int (4)	FK
	OdiRtoPrice	Ratio Price	numeric (9,2)	
	OdiAmount	Amount	int (4)	
	OdiSaveFA	Fatty Acid Profile	vchar (50)	
	OdiExpand	Expand Name	vchar (100)	
	OdiRepeat	Repeat Status	int (1)	
	OdiNlaSt	Nutrition Label Status	char (1)	
Result	Res_OdiID	Order Item ID	int (4)	PK
	ResNo	Result Number	int (1)	PK
	Result	Result	vchar (100)	
	ResDate	Record Date	datetime	
	ResBy	Analyst	int (4)	
	ResNote	Result Note	vchar (255)	
	ResRecheck	Recheck By	int (4)	
NLAssess	NLA_OdiID	Order Item ID	int (4)	PK
	NlaNo	Nutrition Item ID	int (1)	PK
	Per100	Per 100 Value	numeric (9,2)	
	PerEat	Per Serving Value	numeric (9,2)	
	PerDayTh	% Daily Value (Thai Report)	numeric (9,2)	
	PerDayEn	% Daily Value (English Report)	numeric (9,2)	
	NLADate	Record Date	datetime	
	NLABy	Record By	int (4)	
	NLANote	Note	vchar (255)	
	NLARecheck	Recheck By	int (4)	

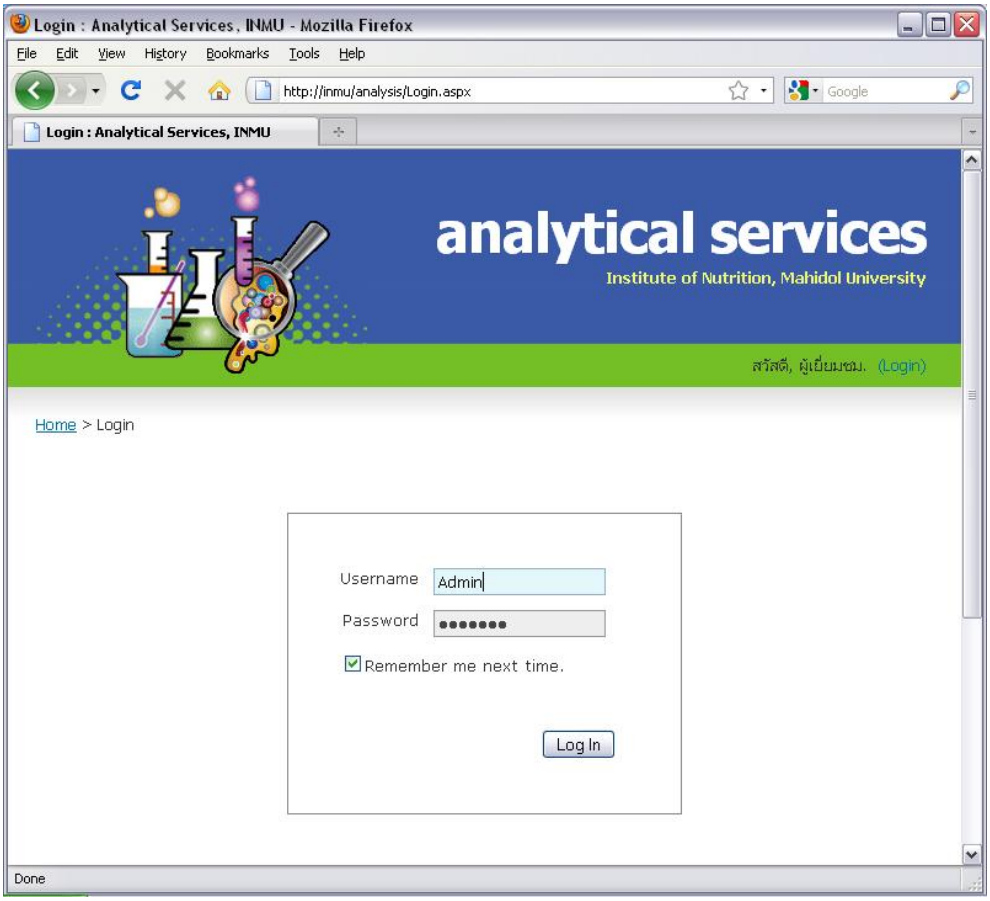
APPENDIX C
USER MANUAL

การเข้าสู่ระบบ สำหรับเจ้าหน้าที่

1. เปิด web browser (Internet explorer/Mozilla Firefox/Google Chorme)
2. พิมพ์ URL สำหรับเข้าใช้งาน คือ http://inmu/intranet/analysis
3. หากเข้าใช้งานครั้งแรกจะปรากฏหน้าจอเพื่อให้ login เข้าระบบ



4. คลิก Login เพื่อเข้าหน้าสำหรับเข้าระบบ
พิมพ์ username และ password ที่ได้รับมา



5. เมื่อผ่านหน้า login เข้ามาแล้วจะปรากฏ เมนู เพื่อใช้งานระบบ ตามสิทธิ์การใช้งาน ของแต่ละ account

A) Administrator (ผู้ดูแลระบบ)

B) Technical Services (เจ้าหน้าที่งานบริการวิเคราะห์)

C) Analyst (ผู้วิเคราะห์)

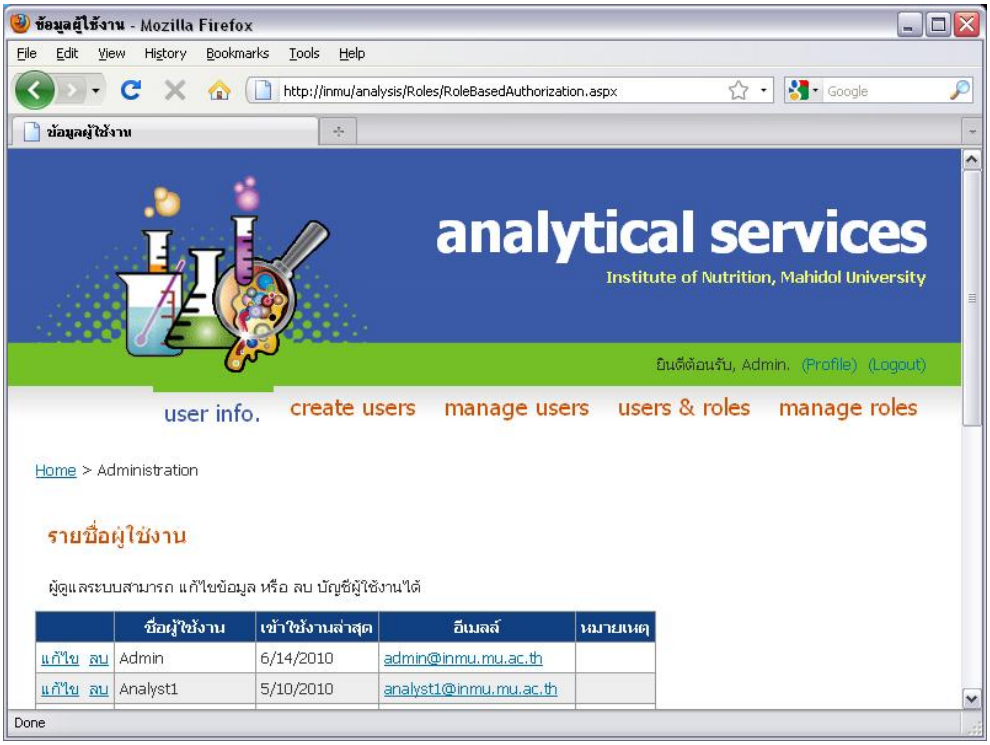
D) Head of division / Head of laboratory (หัวหน้าฝ่าย หรือ หัวหน้าห้องปฏิบัติการ)

E) Assessor (ผู้ประเมิน)

การใช้งานระบบตามสิทธิที่อนุญาต

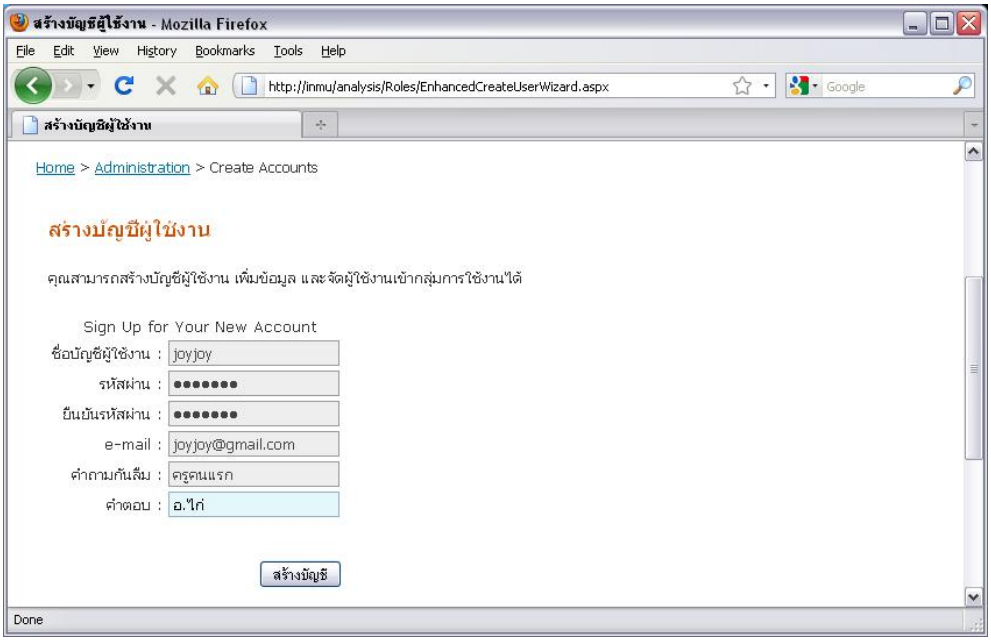
A) Administrator (ผู้ดูแลระบบ)

เมื่อเข้ามาหน้าแรกของผู้ดูแลระบบจะปรากฏ เมนู ดังรูป

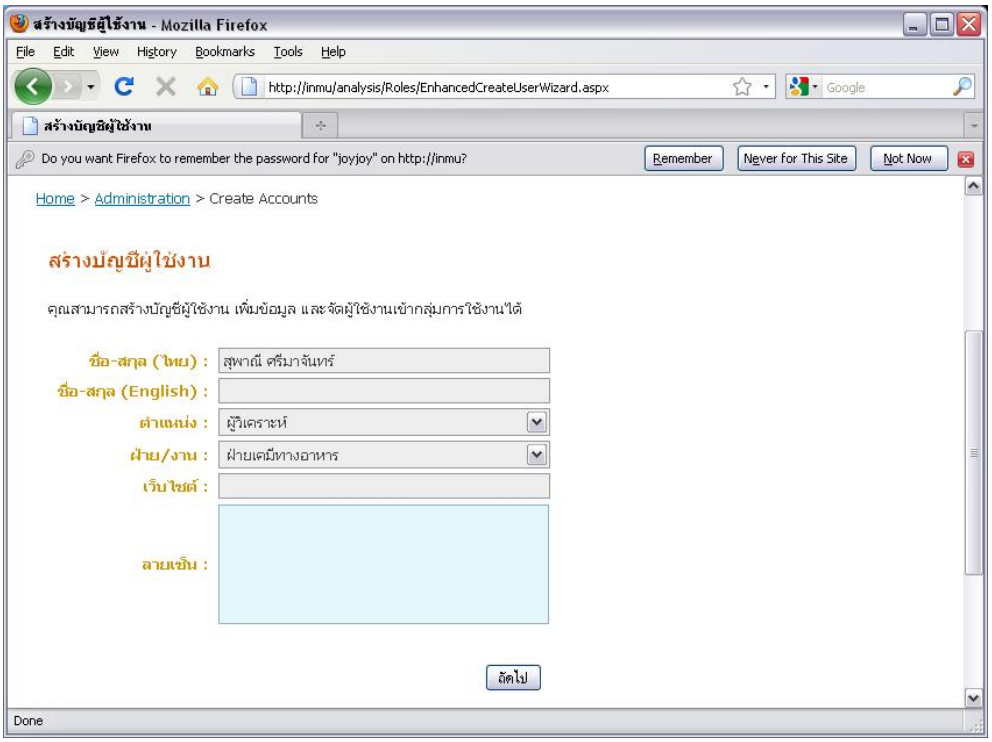


- **Create users (สร้างบัญชีผู้ใช้งาน)**

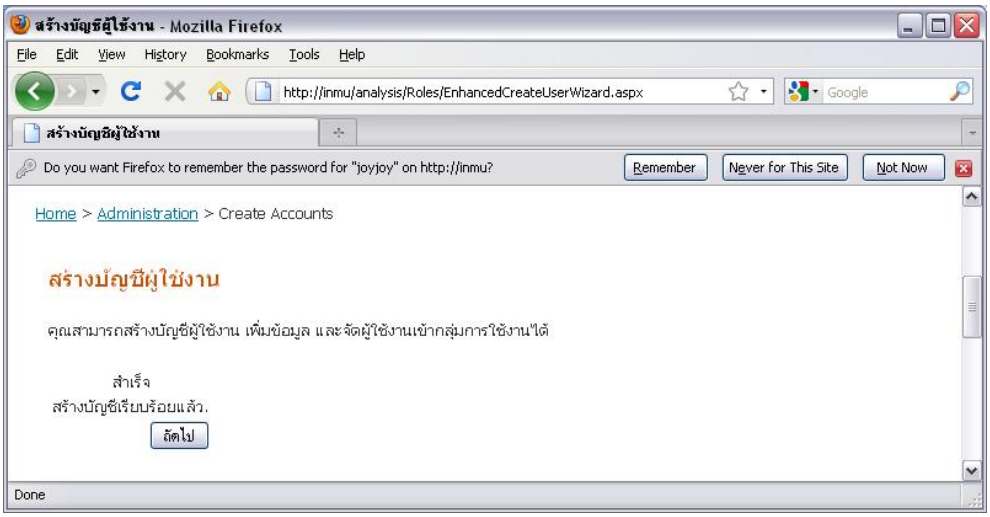
  - คลิกเมนู “create users” เมื่อต้องการสร้างบัญชีผู้ใช้งานใหม่



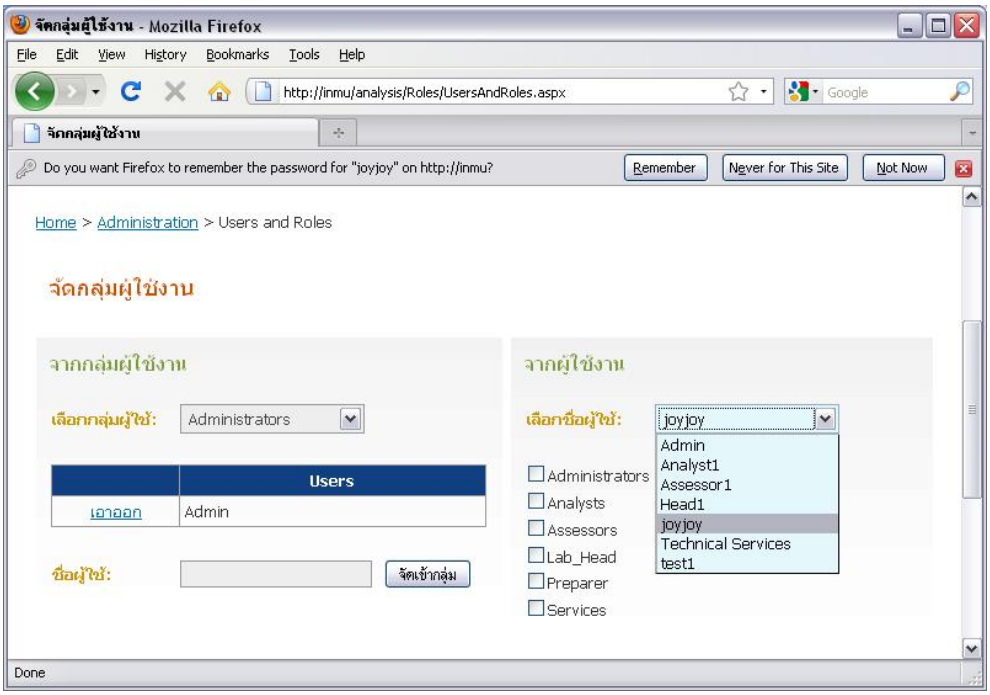
- คลิกปุ่ม “สร้างบัญชี” จะปรากฏหน้าจอให้ใส่ข้อมูลผู้ใช้



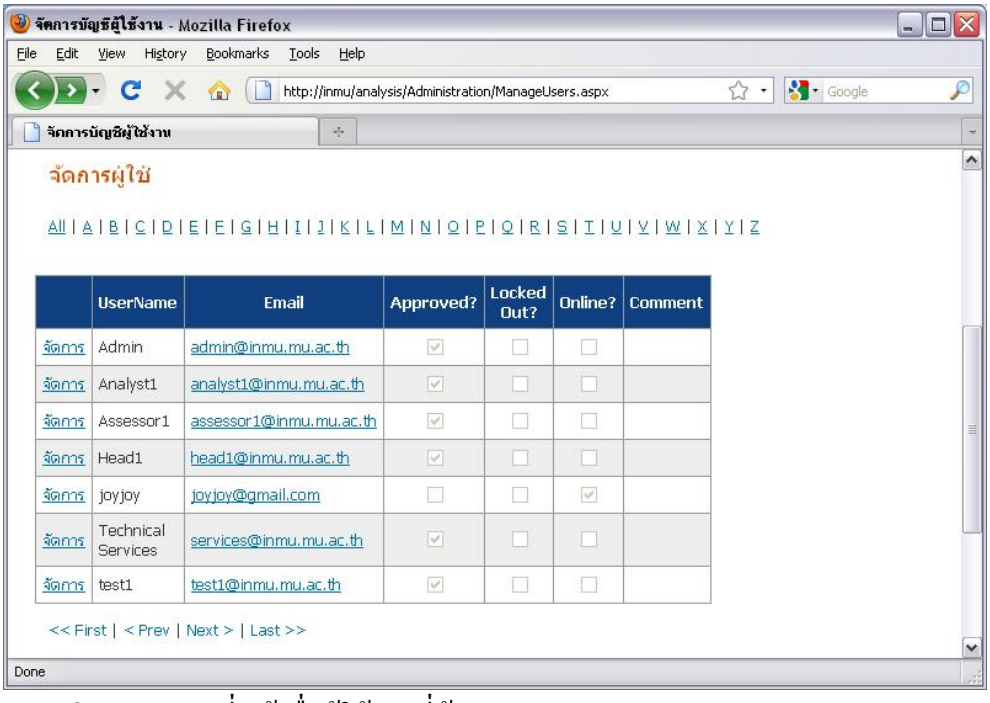
- คลิกปุ่ม “ถัดไป” จะปรากฏหน้าจอแจ้งว่าสร้างบัญชีเรียบร้อยแล้ว



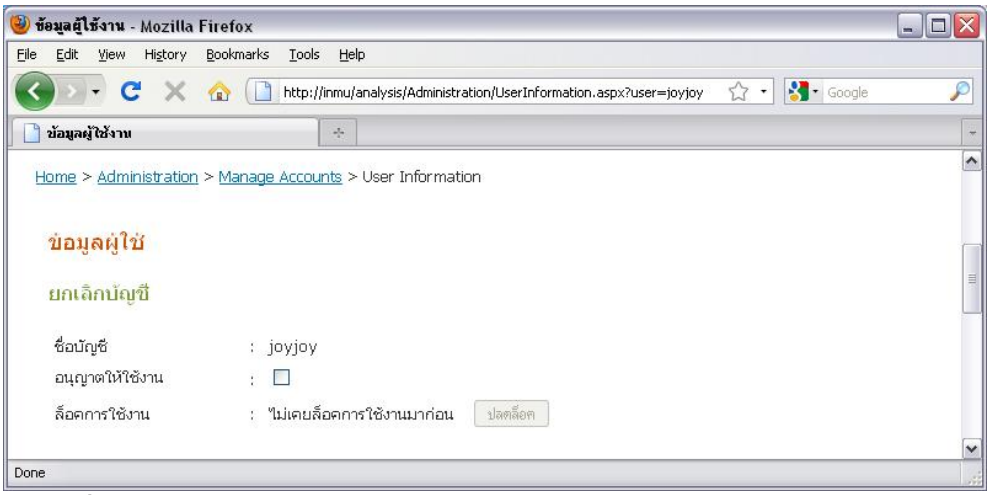
- คลิกปุ่ม “ถัดไป” จะปรากฏหน้าจอเข้าสู่เมนู จัดกลุ่มผู้ใช้งาน สามารถนำบัญชีผู้ใช้งานที่สร้างแล้วเข้ากลุ่มโดยเลือกผู้ใช้ และเช็คเครื่องหมายถูกหน้ากลุ่มที่ต้องการ



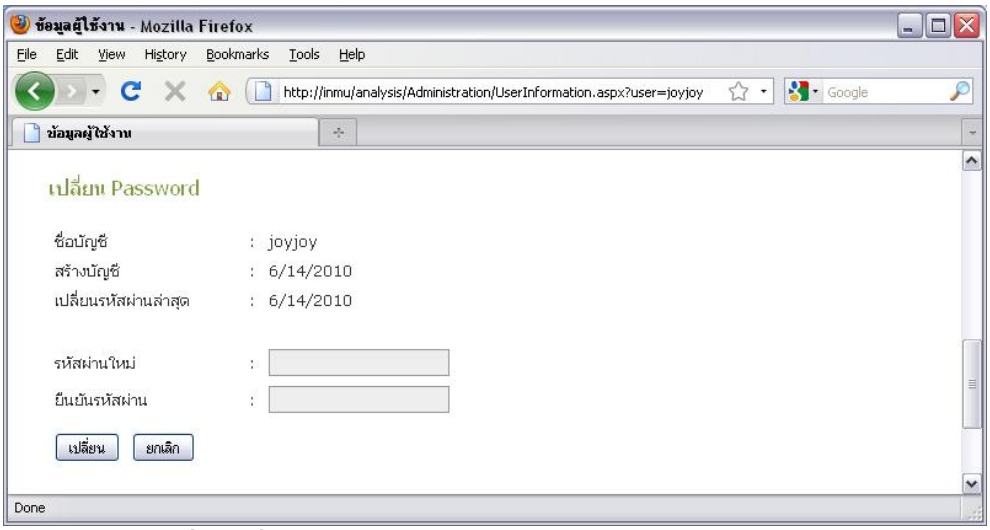
- **Mange users (จัดการบัญชีผู้ใช้งาน)**
  - คลิกเมนู “mange users” เมื่อต้องการจัดการบัญชีผู้ใช้งาน
    เช่น อนุญาตให้เข้าใช้ระบบ (Approved) / lock บัญชี / ดูสถานะการ online



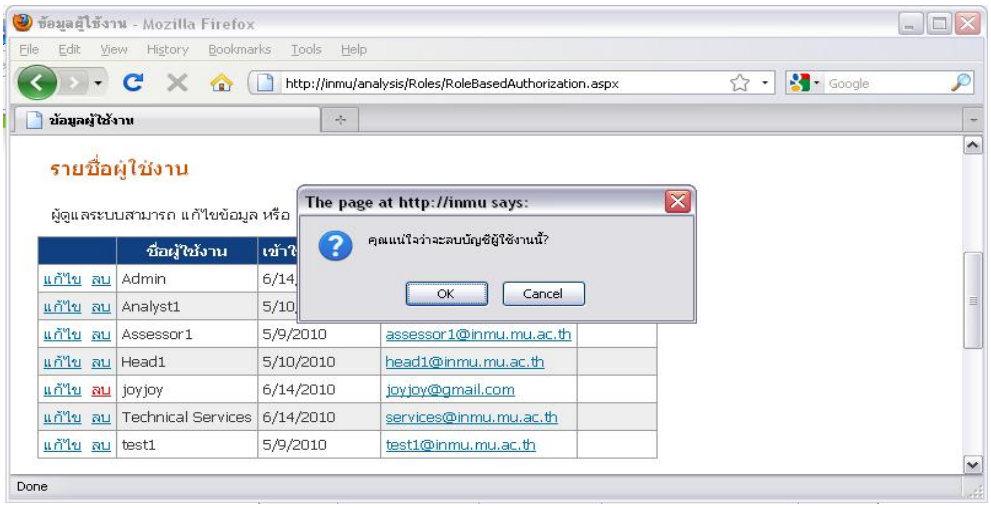
  - คลิก “จัดการ” ที่หน้าชื่อผู้ใช้งานที่ต้องการ
    เช็คเครื่องหมายถูกที่ “อนุญาตให้ใช้งาน”



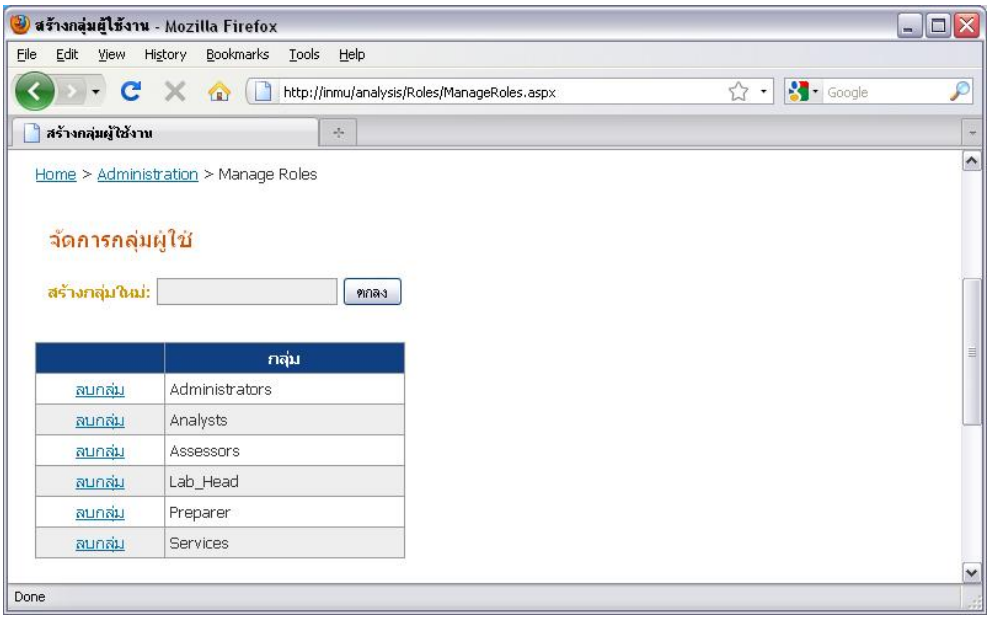
- เปลี่ยนรหัสผ่านผู้ใช้



- คลิก “ลบ” ที่หน้าชื่อหากต้องการลบผู้ใช้ โดยจะแสดงข้อความยืนยันก่อนการลบ

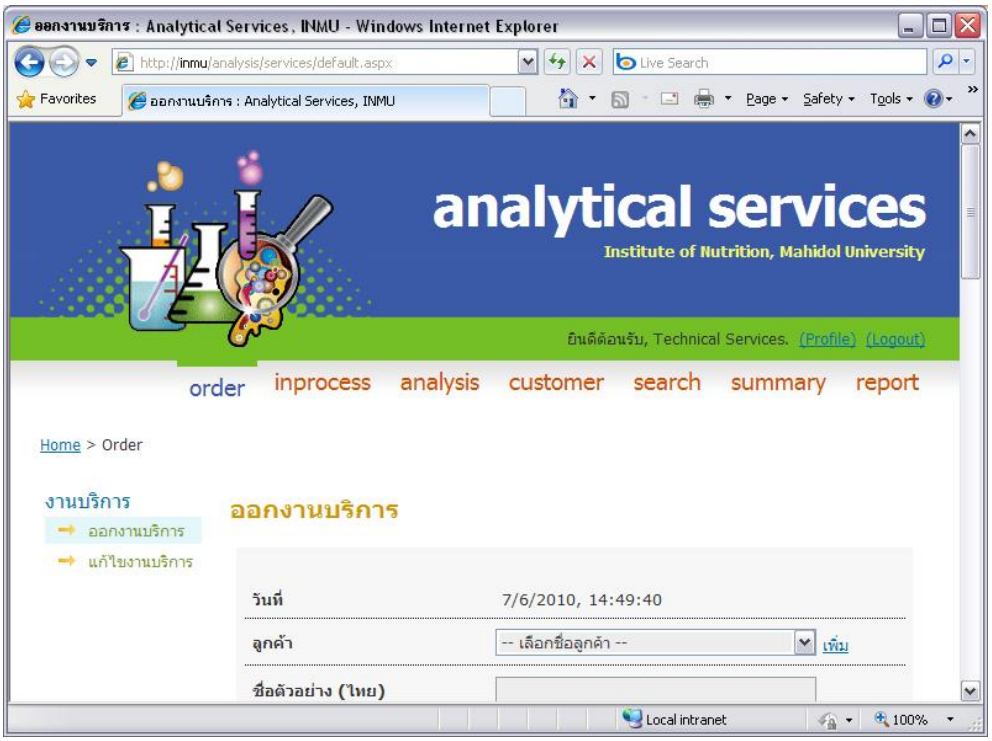


- **Manage roles (สร้างกลุ่มผู้ใช้งาน)**
  - สร้าง และ ลบ กลุ่มผู้ใช้งาน



B) Technical Services (เจ้าหน้าที่งานบริการวิเคราะห์)

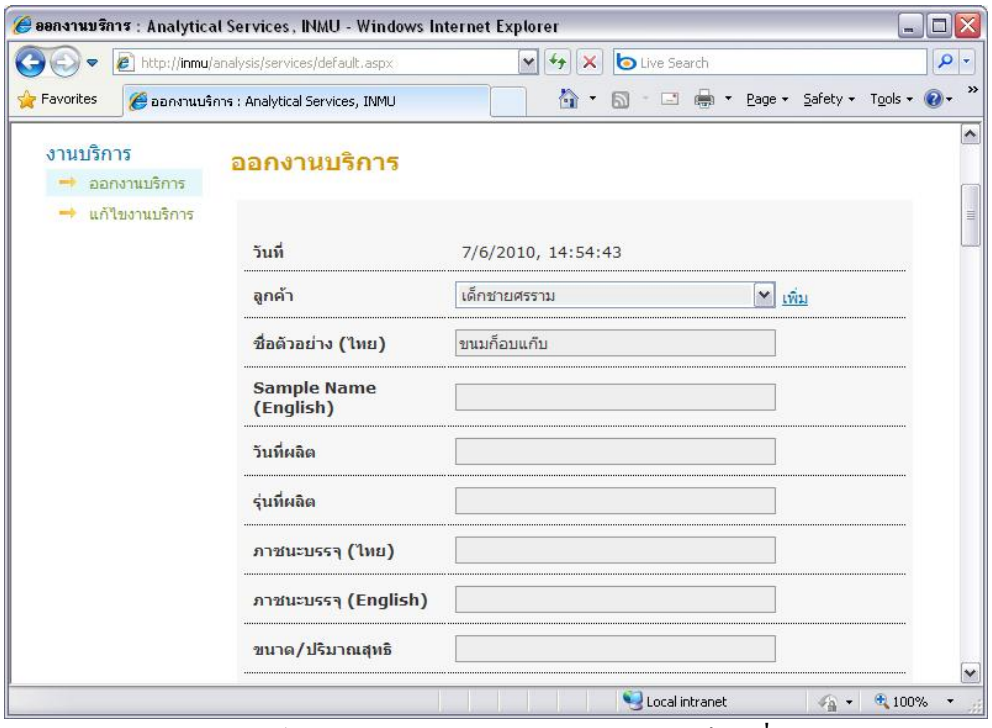
เมื่อเข้ามาหน้าแรกของงานบริการวิเคราะห์ จะปรากฏ เมนู ดังรูป



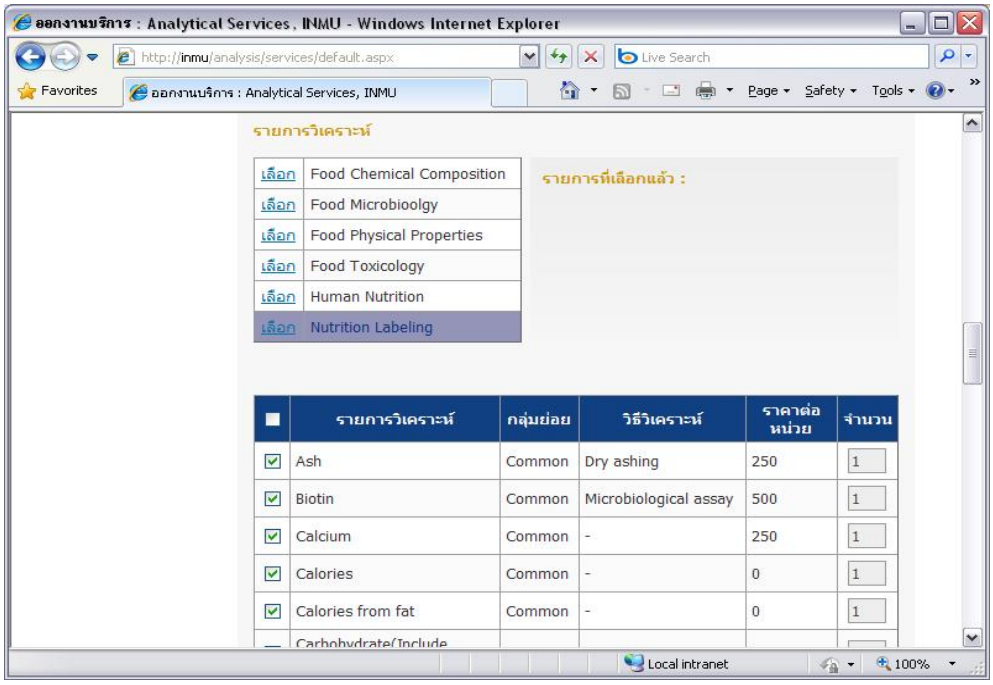
- **Order (ออกงานบริการ)**

1. ออกงานบริการ

- เลือกเมนู “ออกงานบริการ” จากเมนูทางซ้ายมือ และกรอกข้อมูลงานบริการ



- เลือกรายการวิเคราะห์ โดยคลิก “เลือก” หน้ากลุ่มงาน และเช็คเครื่องหมายหน้ารายการสารวิเคราะห์ที่ต้องการสั่งวิเคราะห์

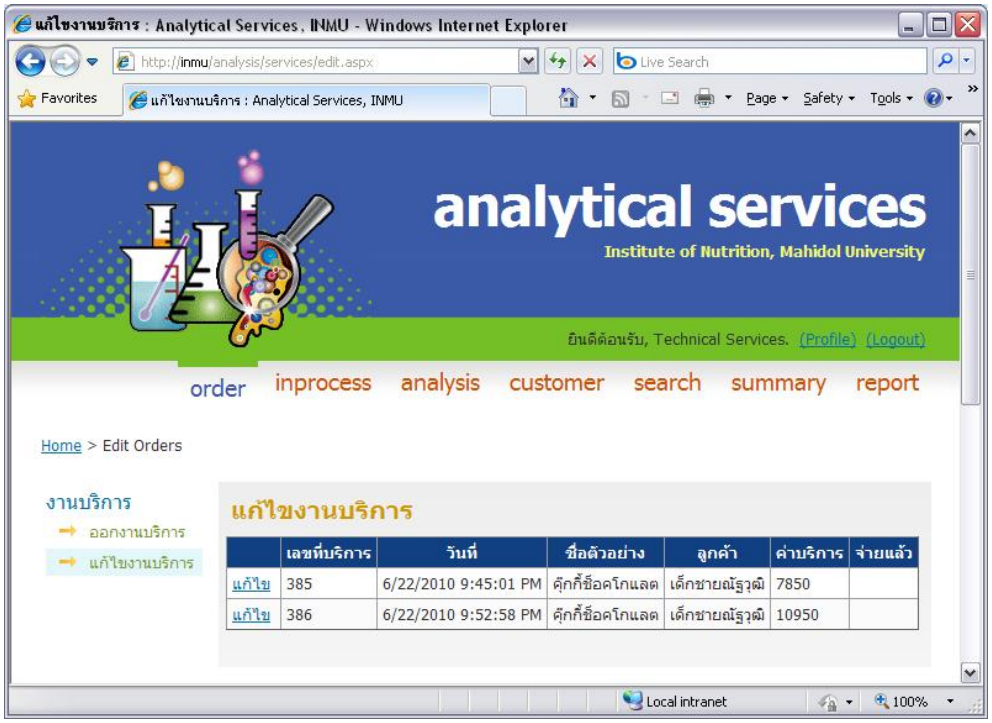


- เมื่อกดปุ่ม “Save” จะปรากฏ Message แจ้งว่าบันทึกข้อมูลเรียบร้อยแล้ว

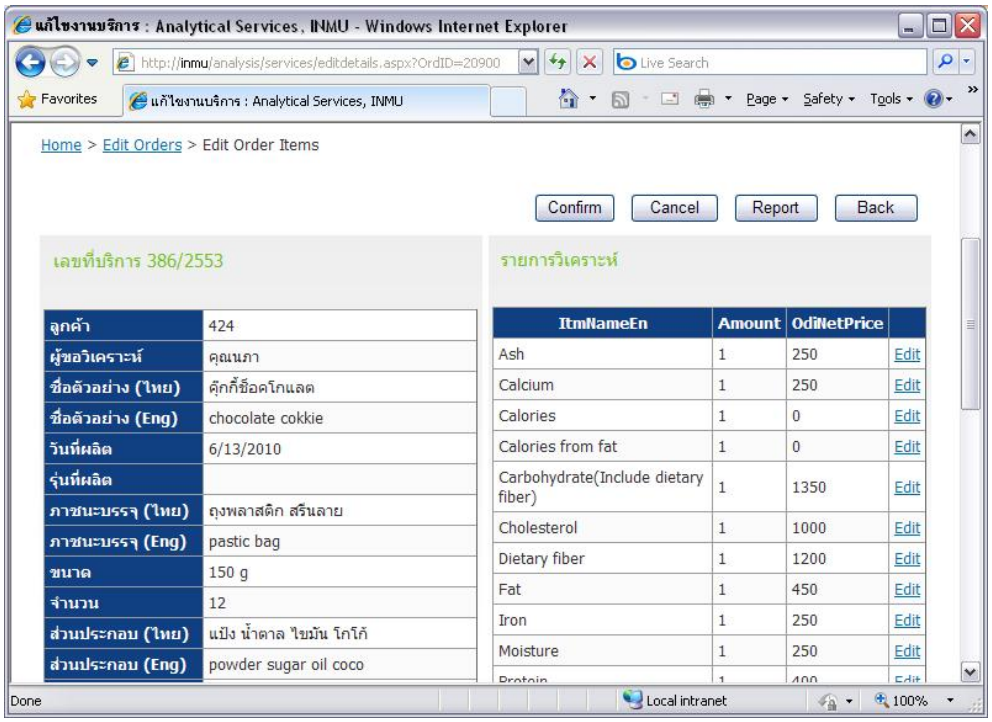
- และแสดงรายการที่เลือกแล้ว พร้อมค่าบริการ

2. แก้ไขงานบริการ

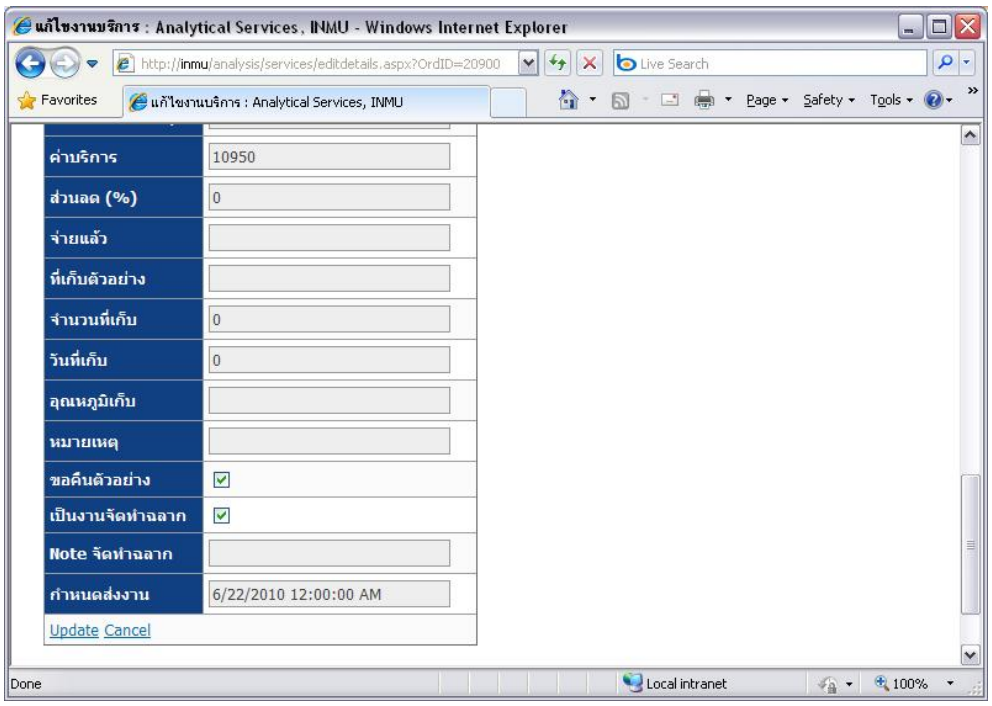
- เลือกเมนู “แก้ไขงานบริการ” จากเมนูทางซ้ายมือ จะปรากฏรายการคำร้องขอรับบริการ



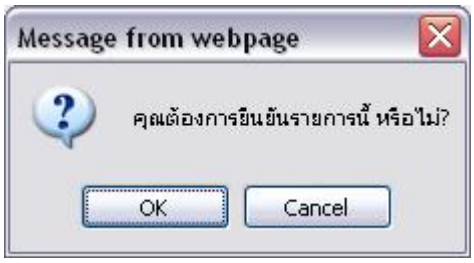
- คลิก “แก้ไข” ที่หน้ารายการคำร้องที่ต้องการ จะปรากฏข้อมูลรายการวิเคราะห์นั้นๆ

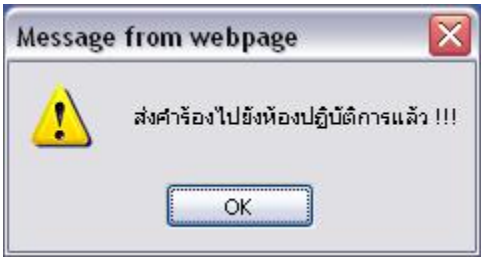


- คลิก “แก้ไข” ที่ใต้รายการ จะสามารถแก้ไขข้อมูลของงานบริการได้

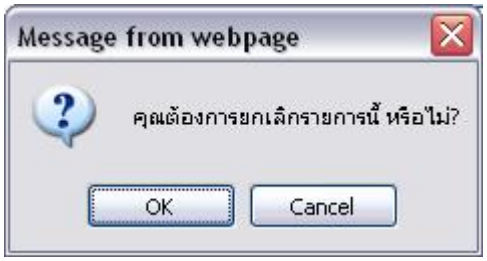


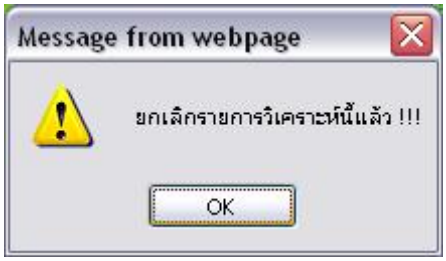
- กดปุ่ม “Confirm” เพื่อยืนยันคำร้อง และส่งคำสั่งวิเคราะห์ไปยังห้องปฏิบัติการ





- กดปุ่ม “Cancel” เพื่อยกเลิกคำร้อง



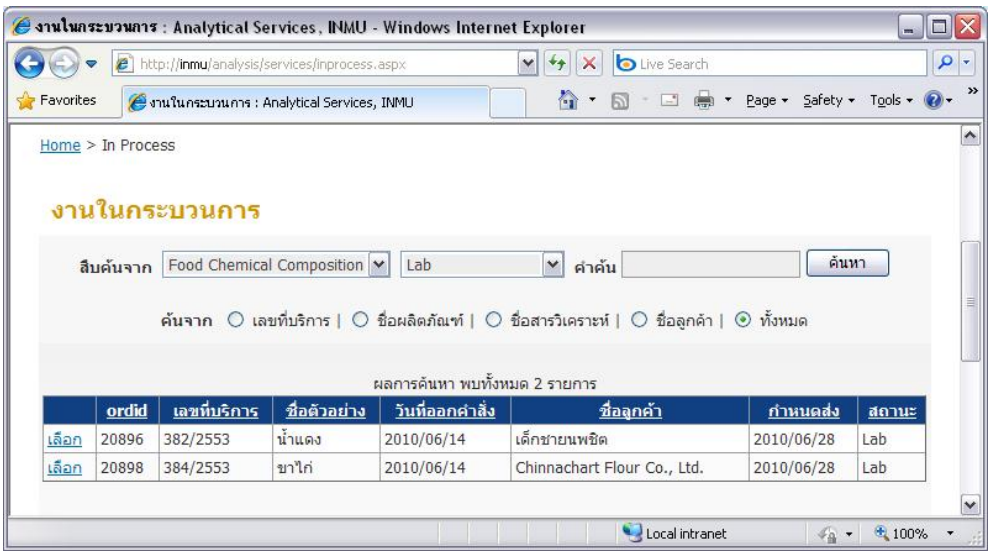


- กดปุ่ม “Report” เพื่อพิมพ์ใบเสนอราคา
- กดปุ่ม “Back” เพื่อกลับไปหน้าแสดงรายการคำร้อง

- **Inprocess (งานในกระบวนการ)**

  สืบค้นงานในกระบวนการ สามารถสืบค้นได้จาก กลุ่มวิเคราะห์ – สถานะ – เลขที่บริการ – ชื่อผลิตภัณฑ์ – ชื่อสารวิเคราะห์ – ชื่อลูกค้า – คำสำคัญ

  - เมื่อกรอกคำสำคัญ หรือ เลือกเงื่อนไขที่ต้องการและกดปุ่ม “ค้นหา”

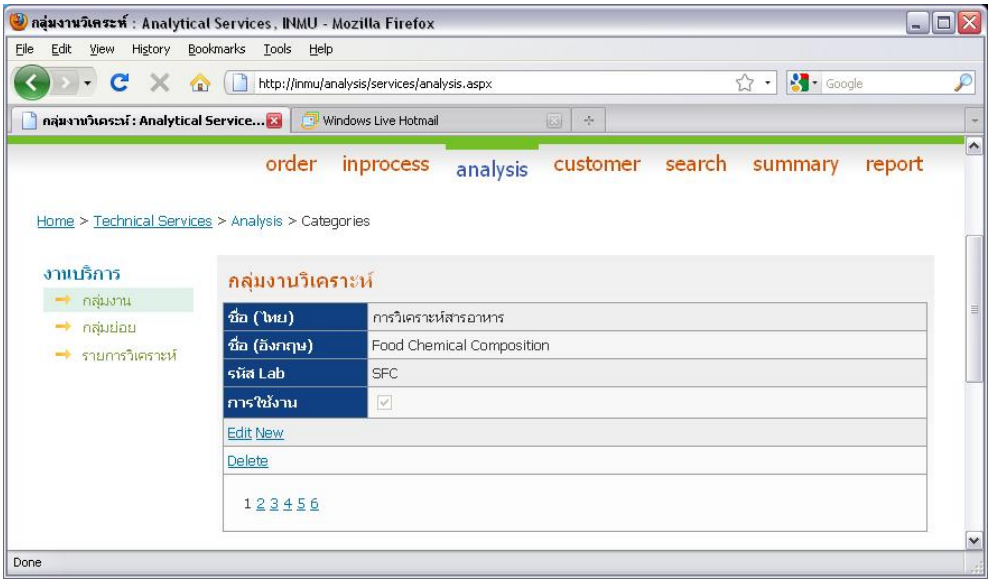


- **Analysis (ฐานข้อมูลรายการวิเคราะห์)**

1. กลุ่มงานวิเคราะห์

เลือกเมนู “กลุ่มงาน” จากเมนูทางซ้ายมือ

คลิก Edit เพื่อแก้ไข / New เพื่อเพิ่มกลุ่มงานใหม่ / Delete เพื่อลบกลุ่มงาน

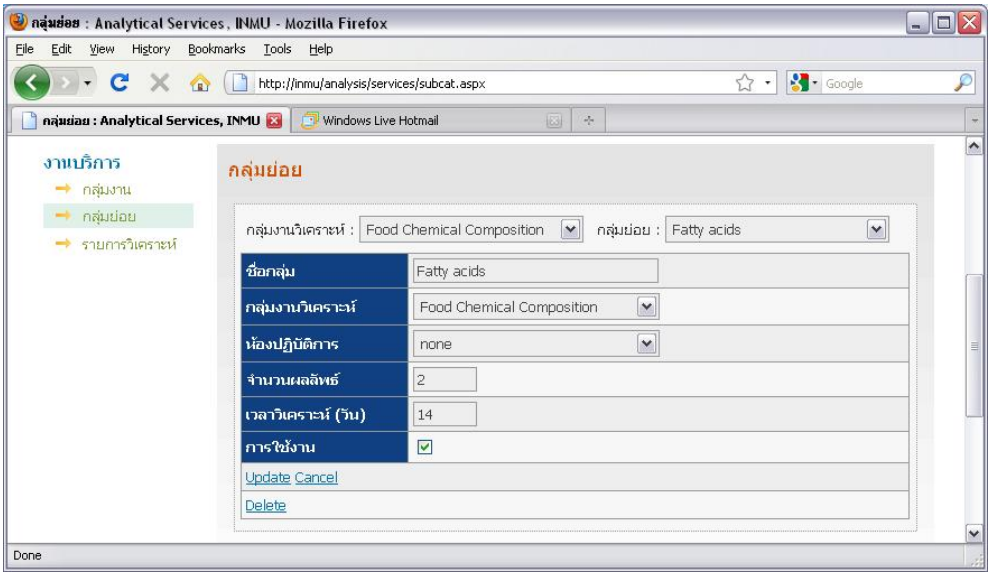


2. กลุ่มย่อย

เลือกเมนู “กลุ่มย่อย” จากเมนูทางซ้ายมือ

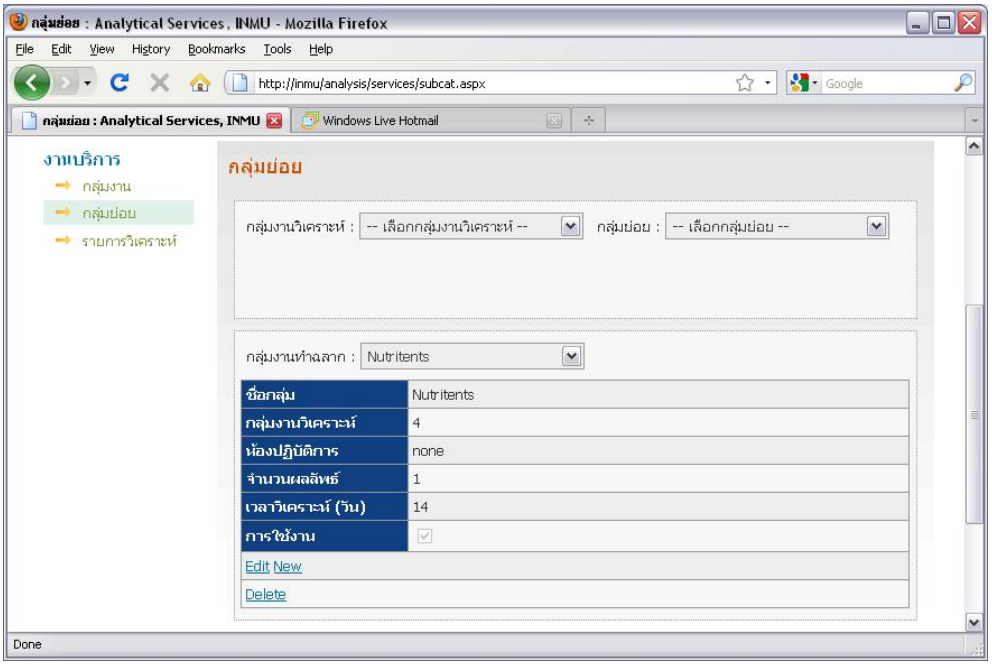
กลุ่มงานวิเคราะห์ เลือก กลุ่มงานวิเคราะห์ และกลุ่มย่อย ที่ต้องการ จาก dropdown list

คลิก Edit เพื่อแก้ไข / New เพื่อเพิ่มกลุ่มย่อยใหม่ / Delete เพื่อลบกลุ่มย่อย



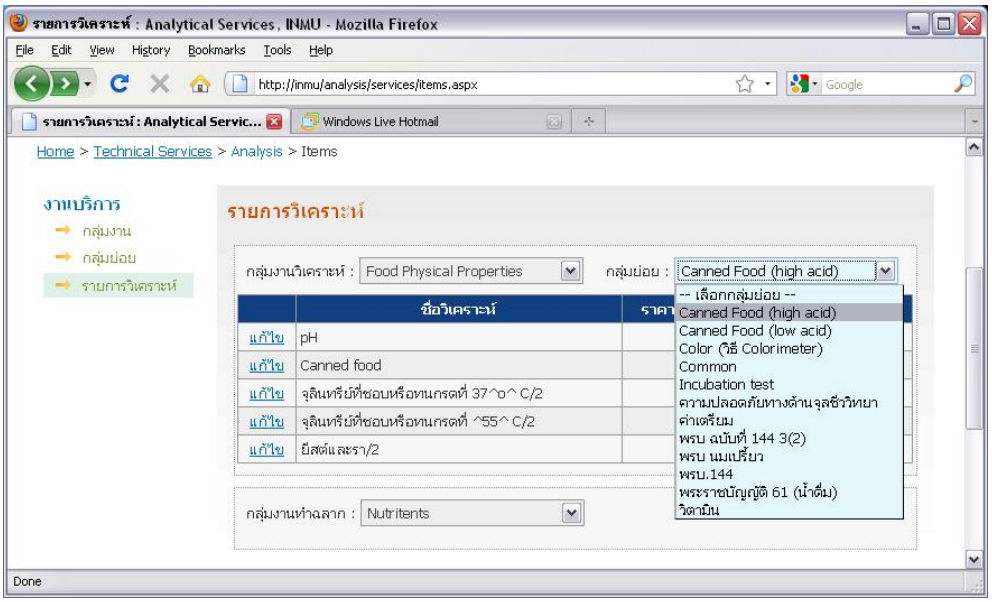
กลุ่มงานทำฉลาก เลือกกลุ่มงานทำฉลาก จาก dropdown list

คลิก Edit เพื่อแก้ไข / New เพื่อเพิ่มกลุ่มย่อยใหม่ / Delete เพื่อลบกลุ่มย่อย



3. รายการวิเคราะห์

เลือก กลุ่มงานวิเคราะห์ และกลุ่มย่อย ที่ต้องการ จาก dropdown list จะปรากฏรายการสารวิเคราะห์ในกลุ่มนั้นๆ หากต้องการแก้ไขรายการใด คลิก “แก้ไข” หน้ารายการนั้น



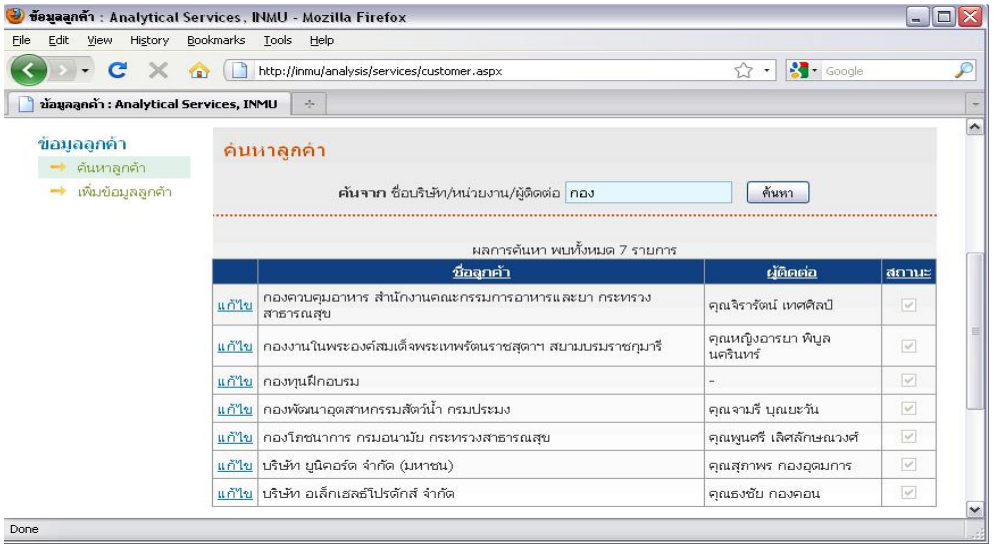
- **Customer (ฐานข้อมูลลูกค้า)**

1. ค้นหาลูกค้า

เลือกเมนู “ค้นหาลูกค้า” จากเมนูทางซ้ายมือ

พิมพ์คำที่ต้องการสืบค้น และกดปุ่ม “ค้นหา”

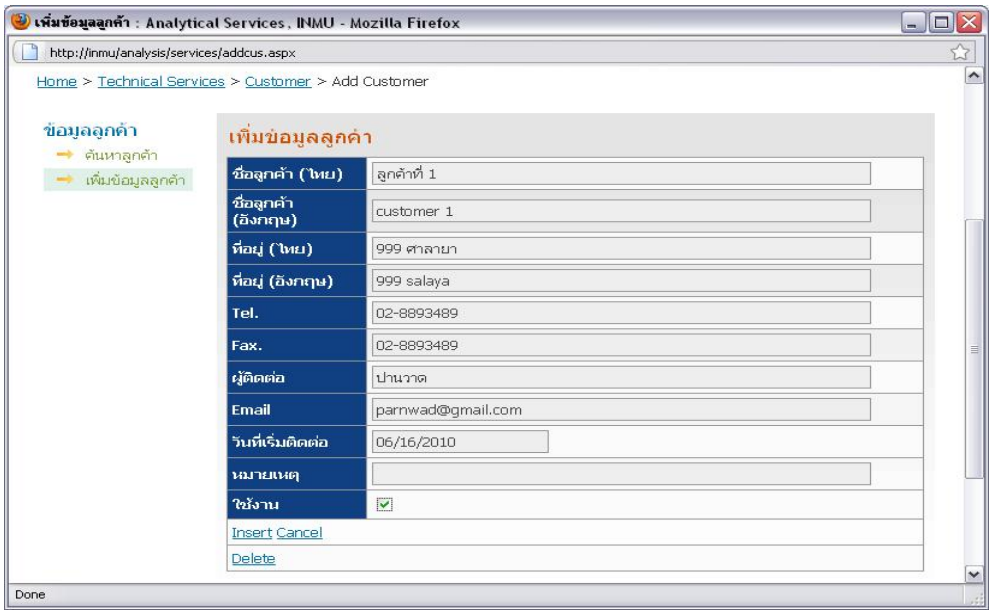
สามารถแก้ไขข้อมูลโดย คลิก “แก้ไข” หน้าชื่อลูกค้าที่ต้องการ



2. เพิ่มข้อมูลลูกค้า

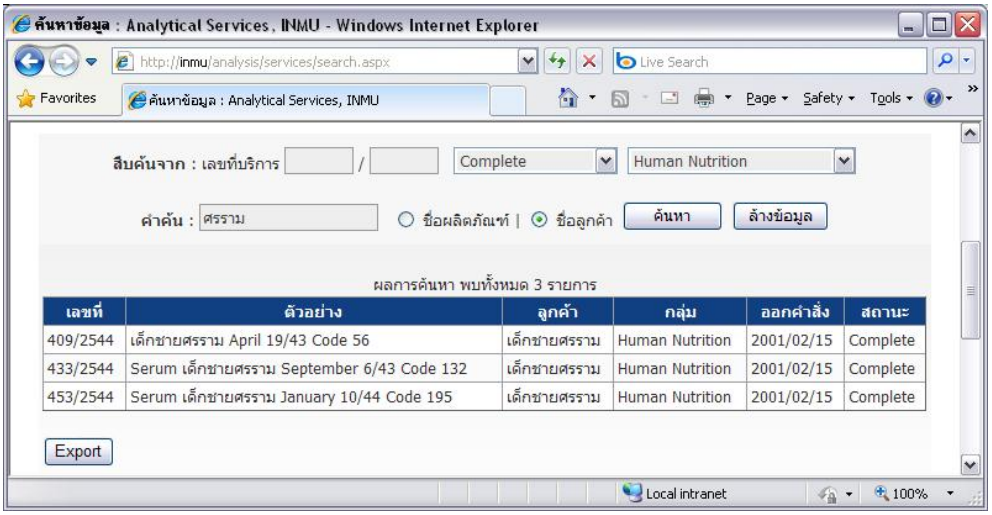
เลือกเมนู “เพิ่มข้อมูลลูกค้า” จากเมนูทางซ้ายมือ

คลิกปุ่ม “New” จะปรากฏหน้าให้กรอกข้อมูล เมื่อข้อมูลครบถ้วนแล้วคลิกปุ่ม “Insert” ข้อมูลลูกค้าจะถูกเก็บเข้าฐานข้อมูล



- **Search (สืบค้นข้อมูล)**

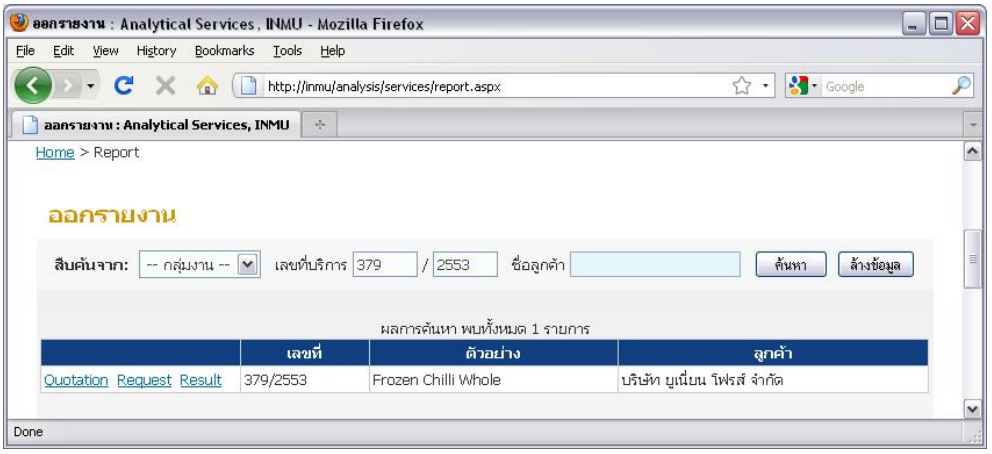
  เลือกเมนู “search” จะปรากฏช่องเพื่อค้นหางานบริการที่ต้องการ



- **Report (ออกรายงาน)**

  เลือกเมนู “report” จะปรากฏช่องเพื่อค้นหางานบริการที่ต้องการออกรายงาน

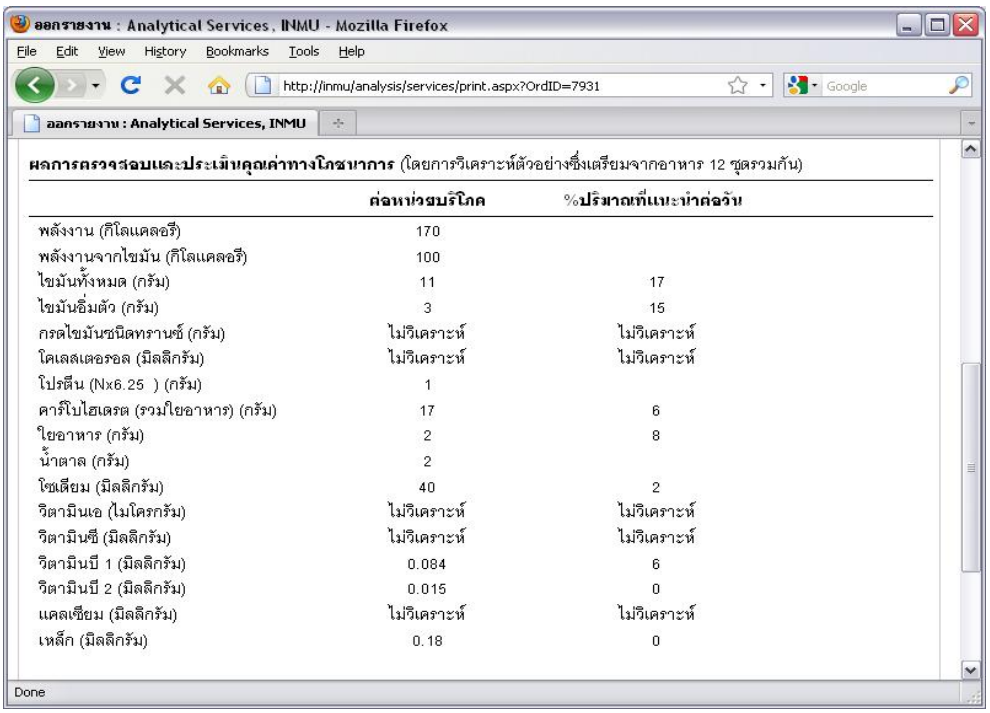
  - กรอกข้อมูล คำค้นหา แล้วกดปุ่ม “ค้นหา” จะปรากฏรายการที่สืบค้นได้



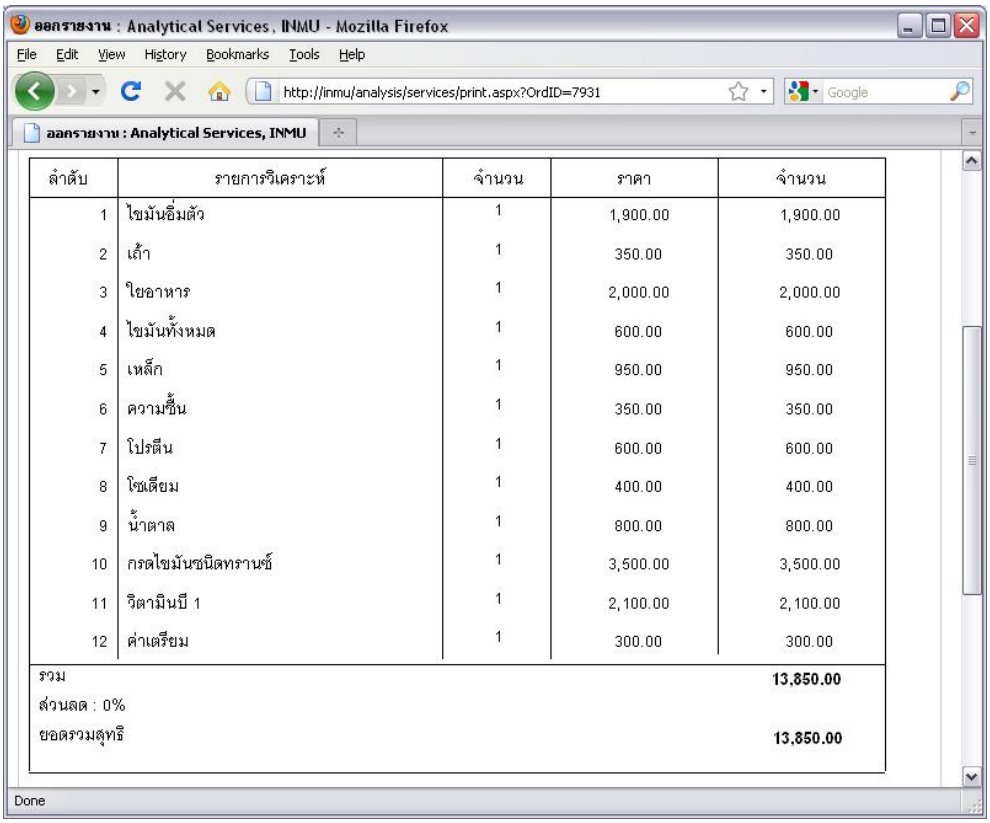
  - คลิก “Request” ที่หน้ารายการ เพื่อพิมพ์ใบลงผลการวิเคราะห์

    สามารถสั่งพิมพ์ได้โดยกดที่รูป printer มุมซ้ายบนของ Browser

- คลิก “Result” ที่หน้ารายการ เพื่อดูคำสั่งวิเคราะห์และผลการวิเคราะห์



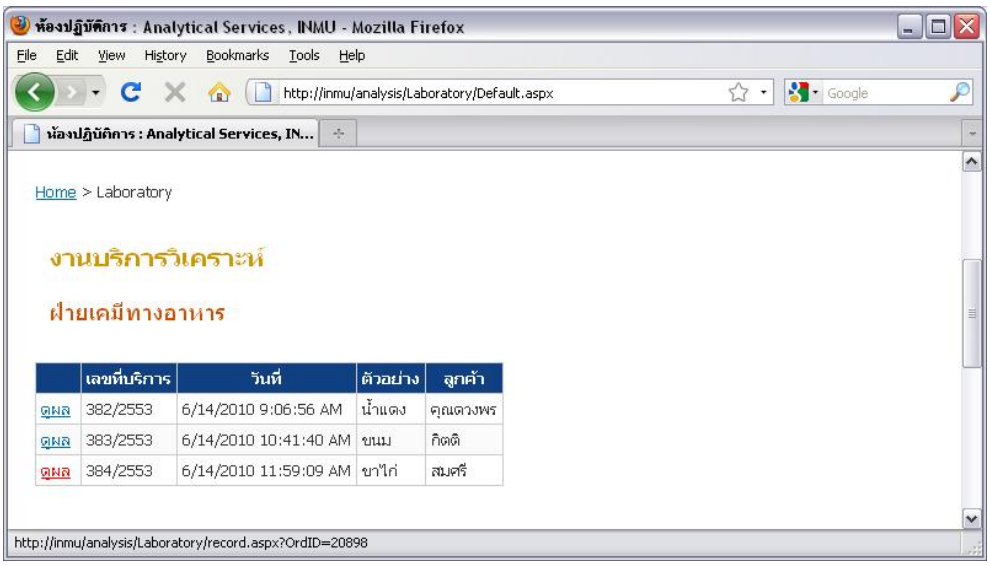
- คลิก “Quotation” ที่หน้ารายการ เพื่อดูใบเสนอราคา



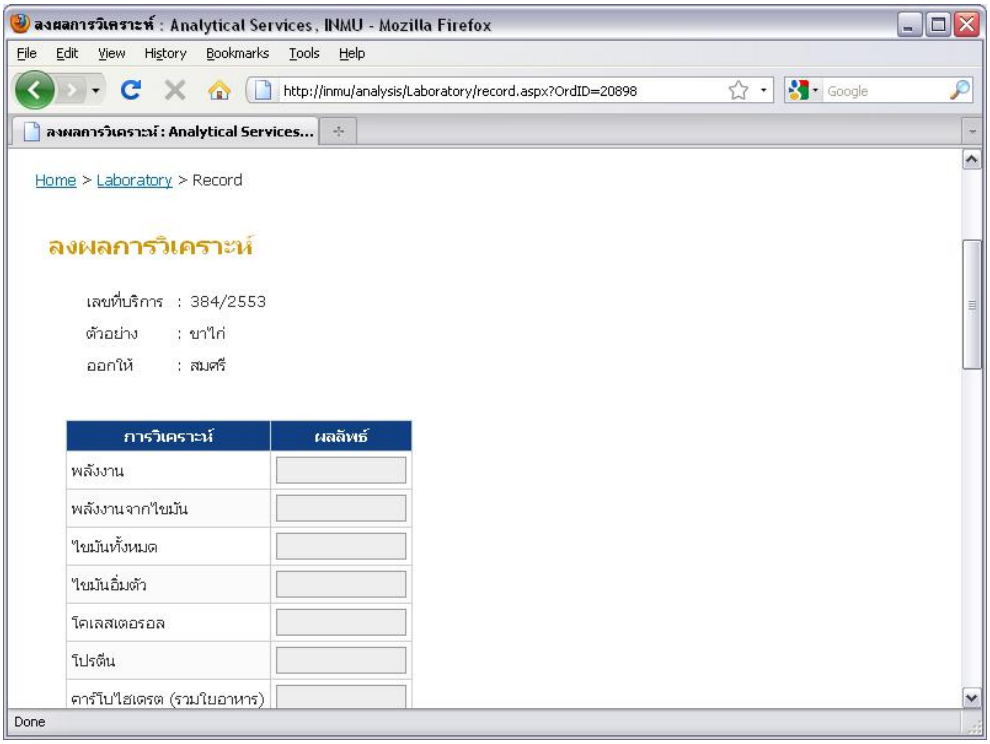
ลำดับ	รายการวิเคราะห์	จำนวน	ราคา	จำนวน
1	ไขมันอิ่มตัว	1	1,900.00	1,900.00
2	เถ้า	1	350.00	350.00
3	ใยอาหาร	1	2,000.00	2,000.00
4	ไขมันทั้งหมด	1	600.00	600.00
5	เหล็ก	1	950.00	950.00
6	ความชื้น	1	350.00	350.00
7	โปรตีน	1	600.00	600.00
8	โซเดียม	1	400.00	400.00
9	น้ำตาล	1	800.00	800.00
10	กรดไขมันชนิดทรานซ์	1	3,500.00	3,500.00
11	วิตามินบี 1	1	2,100.00	2,100.00
12	ค่าเตรียม	1	300.00	300.00
รวม				**13,850.00**
ส่วนลด : 0%				
ยอดรวมสุทธิ				**13,850.00**

C) Analyst (ผู้วิเคราะห์)

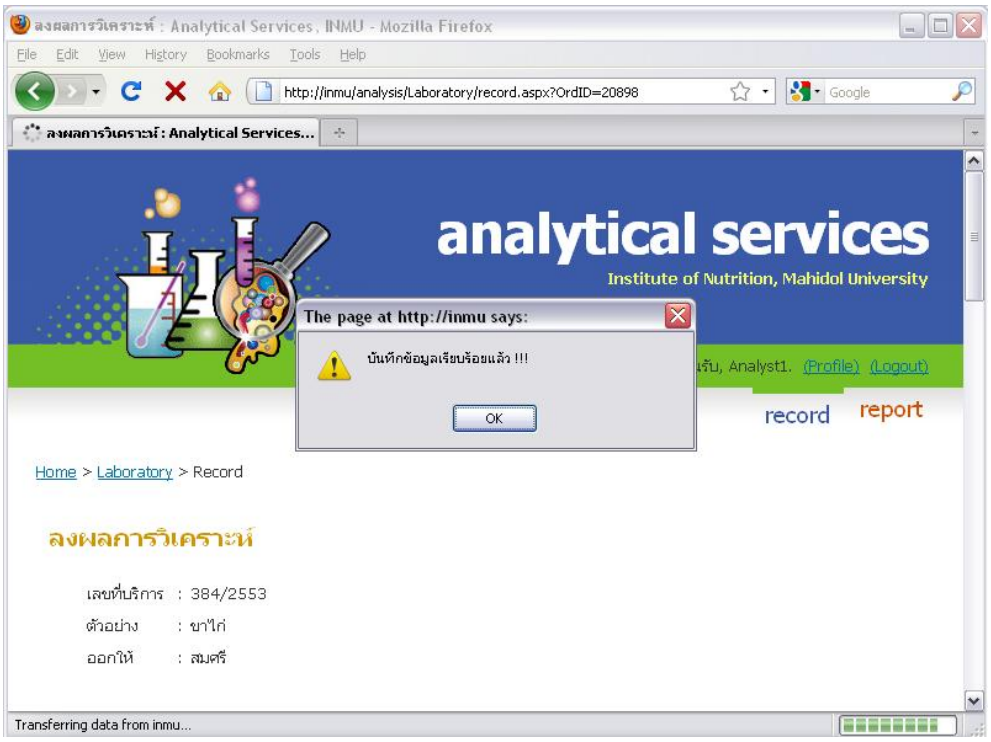
- เมื่อเข้ามาแล้วจะปรากฏคำสั่งวิเคราะห์ของฝ่ายงานที่ผู้วิเคราะห์สังกัดอยู่



- คลิกเลือก “ดูผล” ที่หน้าคำสั่งที่ต้องการจะปรากฏช่องให้กรอกผลวิเคราะห์ตามที่ได้รับมอบหมาย

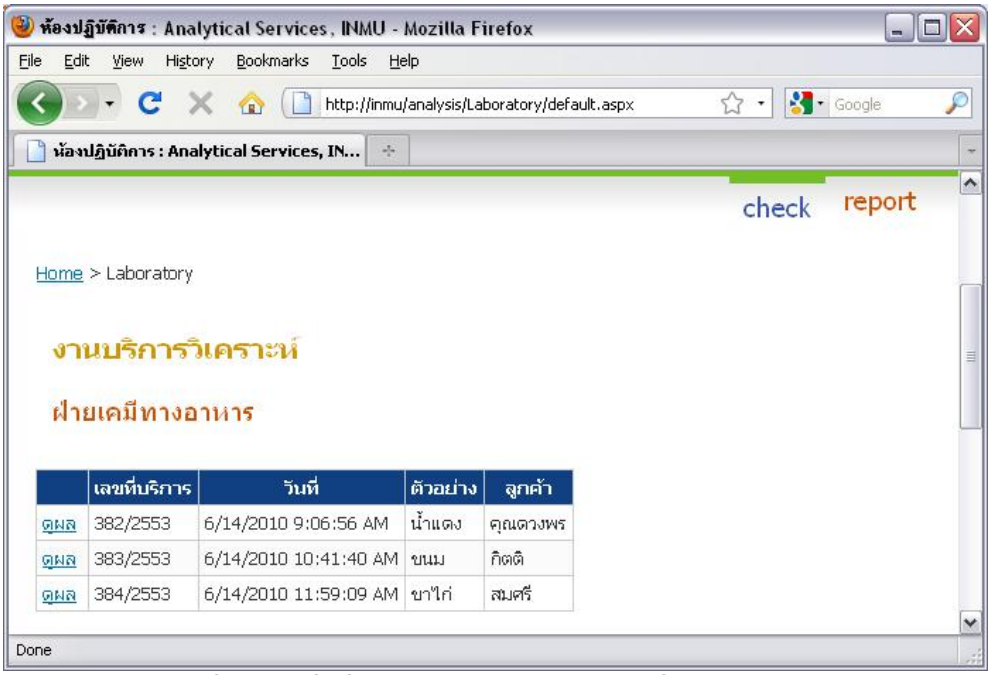


- เมื่อกด “บันทึก” จะมี message แจ้งว่า บันทึกข้อมูลเรียบร้อยแล้ว

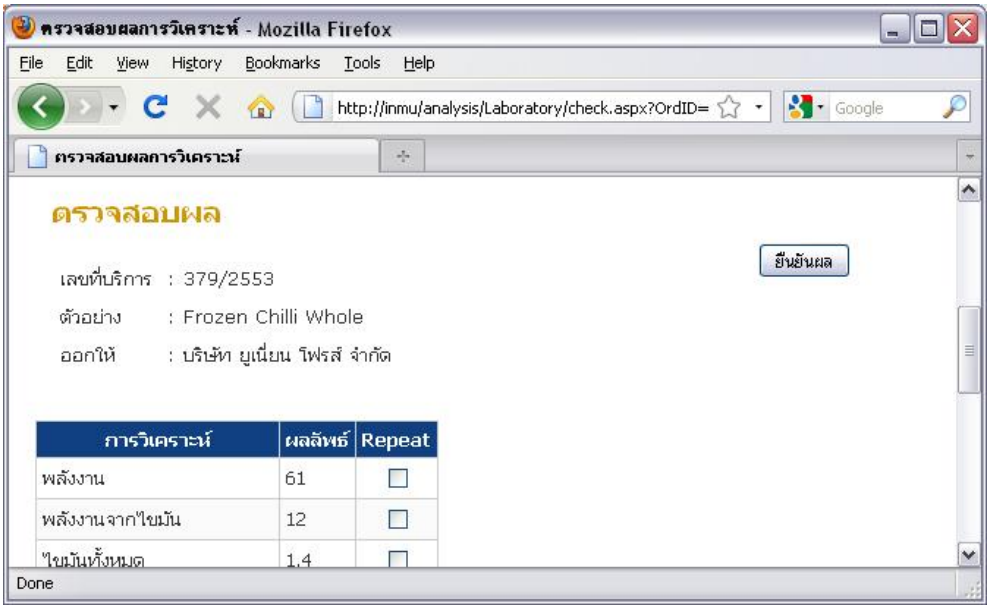


D) Head of division / Head of laboratory (หัวหน้าฝ่าย หรือ หัวหน้าห้องปฏิบัติการ)

เมื่อเข้ามาหน้าแรกของหัวหน้าฝ่าย / หัวหน้าห้องปฏิบัติการ / ผู้ตรวจสอบผล จะปรากฏคำสั่งวิเคราะห์ที่ต้องตรวจสอบ ดังรูป

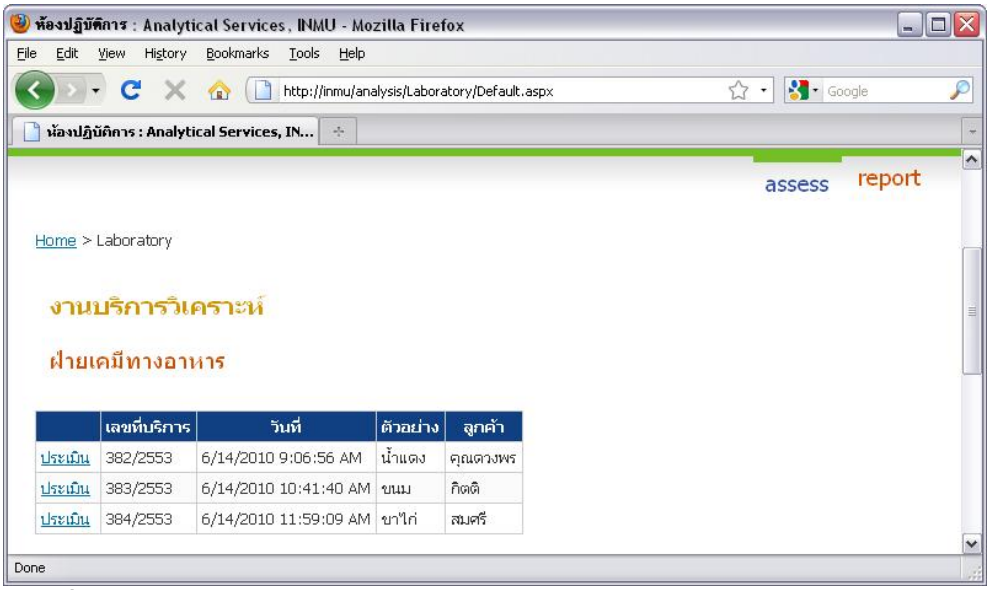


- คลิกเลือก “ดูผล” ที่หน้าคำสั่งที่ต้องการ จะปรากฏผลลัพธ์ที่ผู้วิเคราะห์บันทึกไว้
- หากต้องการสั่งให้วิเคราะห์ซ้ำให้เช็คเครื่องหมายถูกที่รายการนั้นๆ แล้วกดปุ่ม “บันทึก” คำสั่งจะถูกส่งไปยังผู้วิเคราะห์อีกครั้ง
- หากต้องการยืนยันผลการวิเคราะห์ให้คลิกปุ่ม “ยืนยัน” ผลการวิเคราะห์จะถูกส่งไปยังฝ่ายบริการวิชาการ หรือ ผู้ประเมินกรณีที่เป็นการจัดทำฉลากโภชนาการ

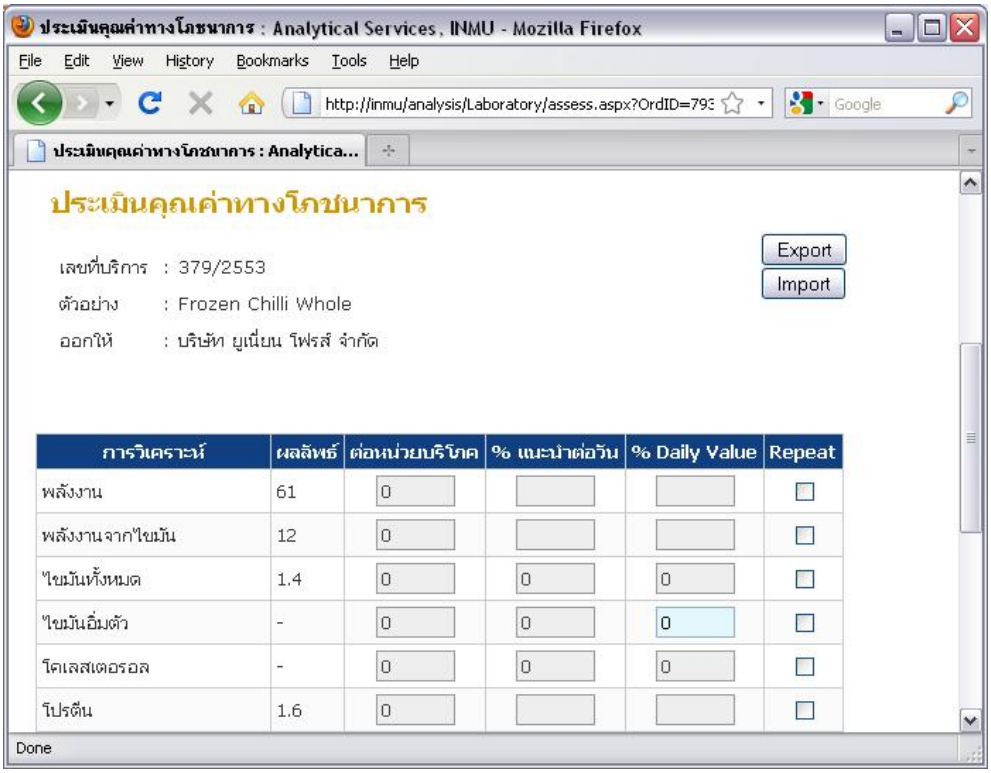


E) Assessor (ผู้ประเมิน)

เมื่อเข้ามาหน้าแรกของผู้ประเมิน จะเห็นคำสั่งประเมินของตน ดังรูป



- เมื่อคลิก “ประเมิน” จะเข้าสู่หน้าแสดงผลจากการวิเคราะห์และช่องสำหรับใส่ผลการประเมิน สำหรับผู้ประเมินคนที่ 2 จะมีช่องสำหรับเช็คเครื่องหมายกรณีต้องการให้ตรวจสอบผลประเมินอีกครั้ง
- ปุ่ม “Export” สำหรับส่งออกข้อมูลผลลัพธ์เป็นไฟล์ text หรือ excel
- ปุ่ม “Import” สำหรับนำเข้าข้อมูลจาก text file ลงสู่ช่องข้อมูล



BIOGRAPHY

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