Developing an ARIS-House-Based Method from Existing Information Systems to Project-Based Enterprise Resource Planning for General Contractor

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Abstract: In recent years, general contractors in the construction industry have gradually begun to implement a system called enterprise resource planning (ERP). During the ERP implementation process, contractors performed required analyses on daily operation functions demanded by the enterprise. The analyses focused on function mapping to ensure that ERP satisfies all the requirements, including the functions of existing information systems, and meets future requirements. The process of function mapping in the construction industry typically involves a series of lengthy and time-consuming meetings, and face-to-face discussions; systematic analysis procedure was lacking. This research will propose a novel function mapping approach, the Architecture of Integrated Information Systems (ARIS)-house-based (AHB) method, to enhance the effectiveness of meetings and improve the efficiency of discussions. In addition, AHB method will use the structure of ARIS-house diagram to guide the function mapping process, streamline existing information systems, meet future requirements, and successfully implement ERP. Finally, this research will use a case study to verify the effectiveness of the AHB method for contractor to implement ERP.

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Introduction

Enterprises are constantly being challenged due to the modern globalization environment and rapid changes in science and technology. In order to compete with these dynamic conditions of globalization, diversity, and automation, enterprises must be ready to adapt. As a general definition, enterprise resource planning (ERP) is an application of information technology and the internet to construct high functionality and excellent integration for enterprise systems. The construction industry, in which ERP will be examined, is based on project management, which varies from other industries and is rooted in operations management theory. Before ERP gained popularity in the construction industry, contractors implemented other disparate information systems to deal with different kinds of daily operations (Jung et al. 2004). However, neither automated data nor functions-related operations were interconnected, even though they were present in the system. As contractors recognized demand for automated systems to interconnect data and functions-related operations, they began to implement ERP to increase competitiveness and flexibility. Many modules of ERP are interconnected, and all of the processes are included as part of the daily operations of the entire enterprise (Scheer 2000). Furthermore, these existing processes can be managed by ERP, and information will only come from one database, which can reduce the duplicate data entry and guarantee up-to-date information for all divisions in the enterprise. All functions existing in information systems will have to be transferred into the modules of ERP. The purpose of this research, therefore, is to provide general contractors with an efficient tool for transforming their existing information systems into a single cohesive one, in order to become more efficient in today's competitive environment.

Construction Enterprise Resource Planning

The ERP implementation was initially designed to manage manufacturing systems and was used in material requirement planning to manage and plan materials storage in the 1970s. Thereafter, the resources of facilities, equipment, and laborers were incorporated and planned together to develop Manufacturing Resource Planning (MRPII). Finally, the manufacturing-oriented system was integrated with procurement, financing, accounting, human resources, and other management applications into ERP (Teltumbde 2000; Shi and Halpin 2003).

ERP is a computer program that provides a general platform on a single database that can easily share information and facili-

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tate communication among all departments (Davenport 1998; Shi and Halpin 2003). ERP allows the communication of internal information across departments in different locations. The enterprise system offers a multilevel communication flow and information recording mechanism that satisfies all computer knowledge that an enterprise needs to operate (Scheer and Habermann 2000).

The construction ERP (CERP) should include three modules on the application framework: project system (PS), material management (MM), and project maintenance (PM). The modular functions contain cost management, schedule management, subcontractor management, construction planning, field equipment management; field materials warehouse management, procurement management, and facility operations and management (Shi and Halpin 2003). This article introduces the ERP implementation in the manufacturing industry. It further explores the application models that are embedded in information system and the fundamentals of the knowledge-based database. When an enterprise implements ERP, it is necessary to analyze future requirements and operation process (Scheer 2000). Establishing a roadmap of an enterprise's current operation process enables the parties' readiness for choosing ERP (Ehie and Madsen 2005).

O'Connor analyzed different requirements for ERP modules used in the literature review and case study. After his interaction with the owners, and integrating all documents and meeting notes, O'Connor suggested that future research should be focused on a quantitative research study, which should include the problems of data integration and the different characteristics of ERP implementation processes (O'Connor and Dodd 2000).

To specify critical success factors is another important issue in ERP, such as operational process discipline, small internal team, project management capabilities, external end-user training, management support, qualified consultant, communication cooperation, and technological complexity (Bueno and Salmeron 2008; Snider et al. 2009; Chen et al. 2009). A successful implementation experience of ERP in Taiwan includes a planned ERP implementation of twelve procedures, three phases of management, and a list of potential problems (Chen et al. 2000; Lin et al. 2003).

Most of the literature related to CERP emphasized the broader infrastructure concept, and lack of the practical processes during ERP implementation. To this end, this study will focus on the development of a novel function mapping approach and the Architecture of Integrated Information Systems (ARIS)-house-based (AHB) method to examine both existing information system and future requirements of ERP.

Architecture of Integrated Information Systems

ARIS, a method of an evaluation model, was presented by the University of the Saarland (Aichele et al. 1999; Scheer 1994). The main concept is based on considerations of the entire enterprise, including those of employees, documents, resources, management, and operations processes. The ARIS is an important tool for processing analysis in information-system implementation (Chang et al. 2007). Thus, ARIS is composed of four views: organization view, data view, function view, and control view. The four views are grouped into ARIS-house diagram (Scheer 1994, 2000; Scheer et al. 1997). This study transformed existing information systems and future demands into ARIS-house diagram. The diagram will then be compared with the diagrams of ERP modules.

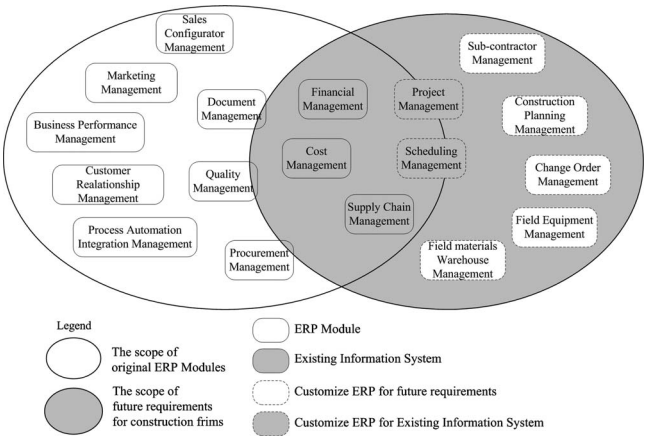

Fig. 1. Relation of ERP and existing information system

Problem Statement

The characteristics between the project-based management in construction industry and the product-based management in manufacturing industry are quite different. Fig. 1 illustrates the difference of ERP modules between manufacturing industry and construction industry. As the result, the ERP implementation of function mapping from product-based ERP system to project-based ERP system in construction industry typically involves a series of lengthy and time-consuming consultant and meetings.

Moreover, many general contractors have used existing information systems to deal with daily project management, such as management information system (MIS) and construction project management information system (CPMIS). For instance, when a general contractor decides to implement ERP, the contractor will need to conduct requirements analysis of the functions considering both existing information systems and future demands. Because of the inconsistency of information flow and operation process in existing information system, future demands and ERP system, it makes the function mapping process in ERP implementation more complicated.

Even though there are several function mapping approaches for different aims, such as the aims for value analysis, fault analysis, concept analysis, and reuse analysis (King and Sivaloganathan 1998), but none of aforementioned complete function analysis, organization analysis, process analysis and data analysis at the same time in the ERP implementation. In order to accomplish labor and process saving in ERP implementation, the objective of this research is to develop a novel function mapping approach for effectively assisting an ERP project.

Research Methodology

The purpose of this study is to explore the process of successfully transforming existing information systems with anticipated future demand into the ERP system modules. The basic assumption of this research is that general contractor has used information systems and decided to implement ERP. The next task is to complete corresponding function mapping between existing and new systems.

Before general contractor decides to implement ERP, general contractor usually has already used different information systems to help engineers manage the construction projects data. However, these systems lack automated interconnectivity, which has

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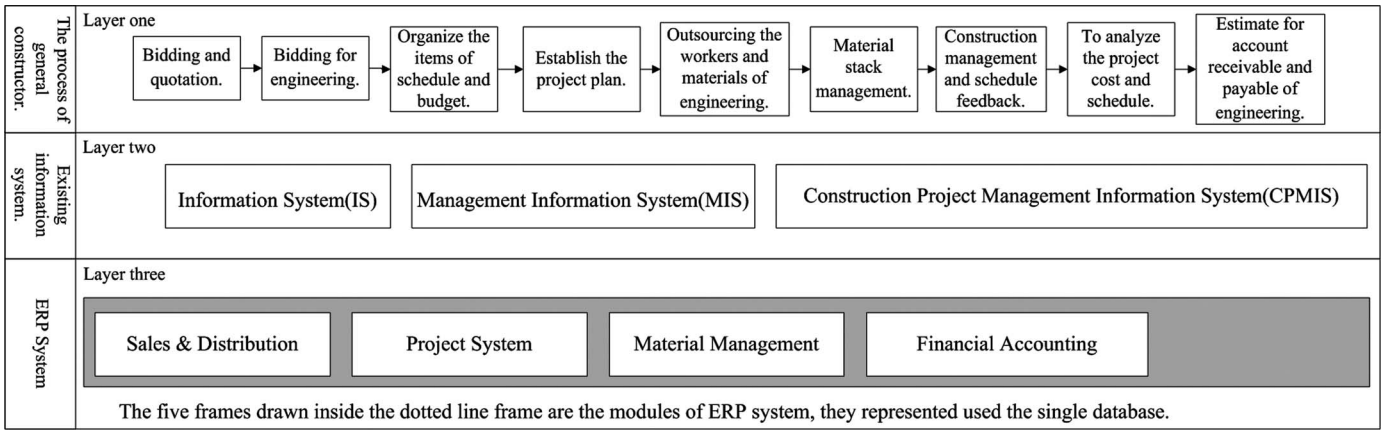

Fig. 2. Relationship among the process of the general contractor, existing information system, and ERP

compelled the contractors to implement ERP. ERP substitutes the disparate and cumbersome systems with an integrated, interconnected, and simplified system that connects different processes from different modules. The data used and shared between modules comes from a single database, rather than from multiple databases (Shi and Halpin 2003).

In Fig. 2, the processes of daily operations for contractors are shown in Layer One. Existing information systems using different databases, such as MIS, CPMIS, etc., are displayed in Layer Two. The different modules using the single database of ERP, such as sales and distribution (SD), project system (PS), materials management (MM), financial accounting (FI), controlling (CO), etc., are depicted in layer three. Due to existing information systems, ERP must provide all functions in existing information systems and future requirements.

As previously indicated, this research will present the AHB method to transform existing information systems and future requirements to ERP modules. With the application of ARIS (Architecture of Integrated Information Systems) (Scheer 2000,1994; Scheer et al. 1997), the ARIS-house diagram consists of the output data in a logical sequential pattern. The AHB method presents seven procedures (see Fig. 3). The first procedure describes four views of existing information system, including organizations, processes, system, and data. The second procedure analyzes existing information systems and transfers them to ARIS-house diagram. The third procedure describes future requirements. The fourth procedure analyzes future requirements and transfers them to ARIS-house diagram. The fifth procedure describes the modules of ERP. The sixth procedure analyzes the ERP Modules and transfers them to ARIS-house diagram. The last procedure provides a comparison for all ARIS-house diagrams.

Procedure (1): Describe Existing Information Systems

A description of current existing systems is the first procedure of this method. The relationship of existing information systems with data, process, organization, and system will be implemented and created in six tables, which respectively are data mapping to system (which data are needed by some systems), data mapping to organization (which data are needed by whom), data mapping to process (which data are needed in which processes), process mapping to system (which systems are needed in which processes), process mapping to organization (which processes are needed by whom), and organization mapping to system (which systems are needed by whom). Organization stands for who operates this function or system; system stands for existing information systems and functions; data stands for the information used in the systems; and process stands for the processes of the daily operations in the organization.

Table of Data Mapping to System (D-S)

The table will show which raw data contained in the systems, such as a CPMIS consisting of on-site data of a project and materials data from a subcontractor.

Table of Data Mapping to Organization (D-O)

The table will show which raw data are used by which department in the organization, such as financing data are used by the finance department, a contract communicate with the sales department, or materials data needed by construction project department.

Table of Data Mapping to Process (D-P)

The table will explain the data that are used during the processes of daily operations for planning project schedules, data of actual project schedules that might be used to assist in schedule management, or data of contracts might be used for establishing the construction plan.

Table of Process Mapping to System (P-S)

The table will show the operations processes that could be used in existing information system, such as the construction management process that would be used by existing information systems (EIM) and CPMIS, or the quality management process that would be used by quality management system.

Table of Process Mapping to Organization (P-O)

The table will explain which processes are implemented by which department of the organization, such as the process of bidding which is implemented by sales department or the process of construction management which is implemented on-site by the project managers.

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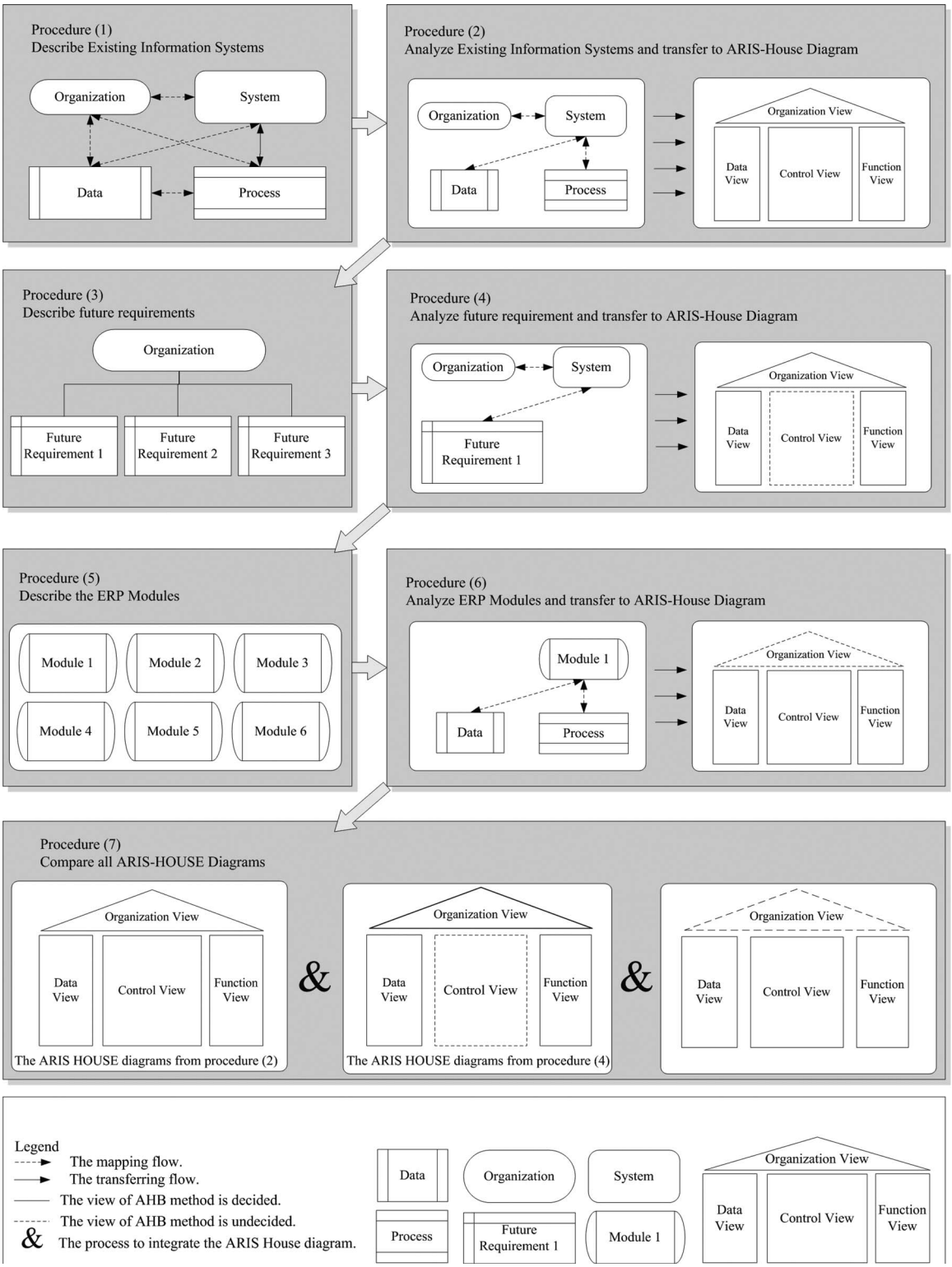

Fig. 3. Seven procedures of AHB method

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Table of Organization Mapping to System (O-S)

The table will show which systems are used by which department of the organization, such as the project management department will use PMIS or the engineering department will use MIS. According to the foregoing explanations, these six tables describe the loop relationship of the current situation. However, in order to simplify the six tables, this research excluded the duplicate tables, and retained three tables (P-S, O-S, D-S) to analyze.

Procedure (2): Analyze Existing Information Systems and Transfer to ARIS-House Diagram

The second procedure will transfer three tables (P-S, O-S, D-S) to ARIS-house diagram based on the results of the first procedure. The organization, the data, the function of system, and the process that were analyzed in existing system are transferred to ARIS-house diagram. They were prepared for mapping processes to ARIS-house diagram created from the module of ERP.

The first step in the process is to select one of the functions for existing information system, which is the most frequently used item. The next step is to check selected functions that overlap with the other tables. The third step is to integrate overlapping functions from the three tables, and establish ARIS-house diagram.

The ARIS-house diagram has four views: organization view, data view, control view, and function view. Organization view identifies which department of the organization will use the information systems. Data view displays which raw data will be inputted, outputted, and revised within the information systems. Function view displays the functions of the information system that will be used. Control view identifies the operation process, which connects with units of the organization, data, and function views.

In existing information systems, there are several disparate databases and system functions. The information transfer from one system to another system usually requires repeated manual input and output of data. Therefore, existing information system that is transferred to the ARIS-house diagram will be incomplete in the control view, because no bonding function exists as well as that in the modules of ERP. The scale of ARIS-house diagram can be modified, but it depends on either the entire information systems or only on a single function of the information system that can be analyzed.

Procedure (3): Describe Future Requirements

If the general contractor demands that future requirements be excluded from existing information system, the third procedure would analyze these future requirements. The first step is to collect all future requirements from all departments, while analyzing related raw data and demanded data from certain departments. After contractor arranges the functions, organizations, and data of future requirements, the information is prepared for transferring to ARIS-house diagram.

Procedure (4): Analyze Future Requirements and Transfer to ARIS-House Diagram

The role of transferring future requirements to ARIS-house diagram is different from existing information system to ARIS-house diagram, because existing information system has already been in effect for a period of time. The organizations, process, function, and data for three fundamental tables have detailed descriptions. However, the functions of future requirements only describe initial concept of function, data, and organization, but not within process. For that reason, future requirements transferred to ARIS-house diagram will be incomplete in the control view. The result of ARIS-house diagram will be representing future requirement and comparing with both existing information and ERP modules in Procedure (7).

Procedure (5): Describe the Modules of Enterprise Resource Planning

Assume in this research that general contractors have decided to apply ERP, and the ERP modules were being prepared for transferring to ARIS-house diagram. Before transferring procedure, the modules of ERP should be analyzed. The first step is to link the operational processes of general contractor to ERP modules. This step would translate the operational processes from manufacturing industry to construction industry. Then, major processes of general contractor would be selected, then separated to the corresponding ERP module.

Procedure (6): Analyze ERP Modules and Transfer to ARIS-House Diagram

After ERP modules are analyzed by selected and separated, next procedure is to apply ERP modules to establish ARIS-house diagram. In the process of ERP implementation, business process reengineering is applied, which changes business process, and business organization. Since ERP has not been implemented, analysis about which functions will be used by who has not yet been conducted. For that reason, ARIS-house diagram for ERP modules will be incomplete in the organization view. The result of ARIS-house diagram will be representing the ERP modules and comparing with both existing information and future requirements in Procedure (7).

Procedure (7): Compare All ARIS-House Diagrams

The ARIS-house diagrams in existing information systems, future requirements, and ERP modules will be created through the procedures described earlier. With the mapping processes of two different diagrams, control view may be lacking from the diagram of existing information systems, and organization view may be lacking from the diagram of ERP. In this case, the main areas that need to be compared in ARIS-house diagram are function view and data view. The function view may have different function names from existing information systems and ERP. However, when these diagrams are compared, mapping processes should emphasize the objective of the function. Thereafter, the data view can double check what data are the input and output of function. The mapping process was constructed according to the same raw data and could be used by the function of existing system and ERP simultaneously. Then, the raw data of data view from existing information system are mapped to data view module of ERP. This represents existing information system that could transfer to ERP. The organization view will follow the function view of ex-

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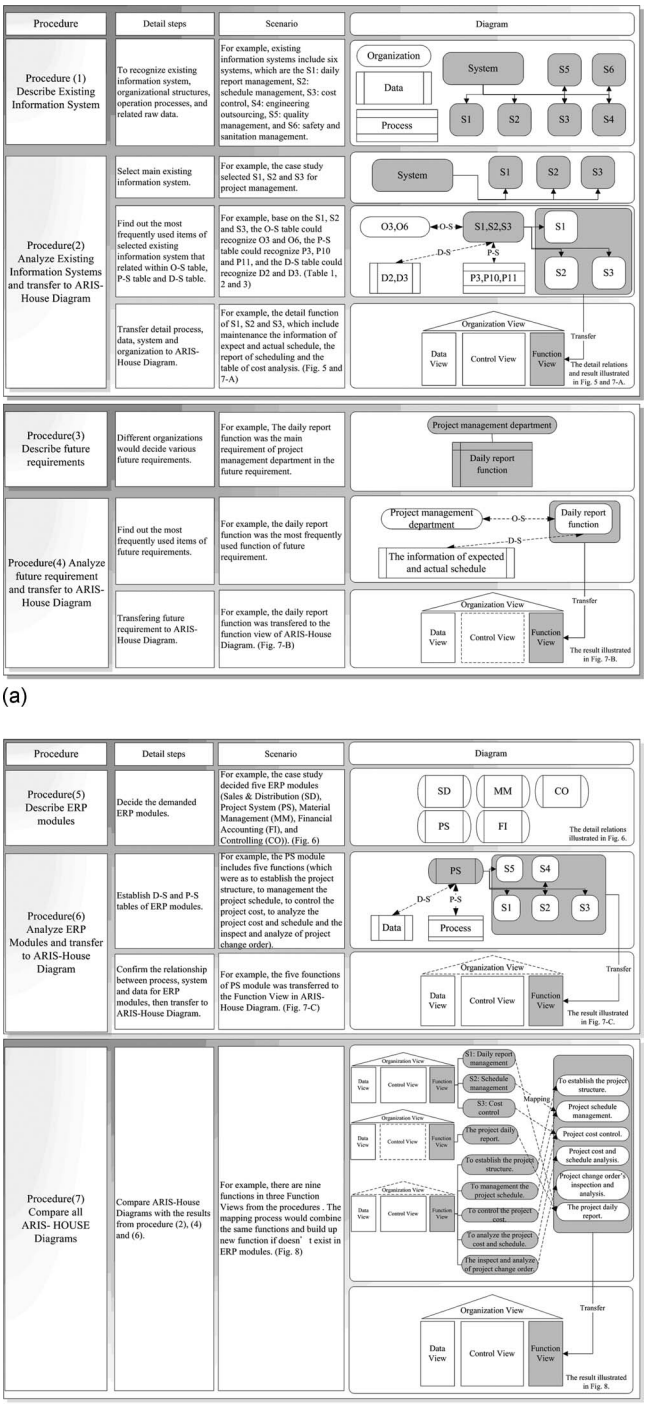

(a)

(b)

Fig. 4. Scenario and diagram for seven procedures of AHB method

isting information system, if the function view can transfer to ERP.

Case Study

The case study of this research is derived from a well-known general contractor established in 1977 in Taiwan, which was a rare enterprise with a strong horizontal and vertical integration. There are 500 employees in the entire enterprise. Their business scope includes construction, design, precast, mechanical, interior design, building security services, elder care and nursing homes, real estate, etc. This general contractor began to develop its MIS in 1983, and began an evaluation on ERP implementation in June 2001. In November 2001, 42 full-time employees were assigned to complete ERP implementation at a project office. In June 2002, the ERP was implemented throughout the company, which became the first general contractor using SAP, ERP, in the Pan-Asia area.

In case study, the following seven procedures will focus on project management, and present the practical process in AHB method (Fig. 4 illustrated the scenario and diagram for seven procedures of AHB method). Furthermore, this research will design a questionnaire to verify whether AHB method is well adopted for transferring existing information system and future requirements to ERP system.

Procedure (1): Describe Existing Information Systems

The first procedure will describe current conditions, including existing information systems, organizational structures, operation processes, and related raw data. The existing information system consists of six systems: daily report management, schedule management, cost control, engineering outsourcing, quality management, and safety and sanitation management.

The organizational structure encompasses ten management departments: finance, sales, construction engineering, human resources, subcontractor, project management, estimate, account, maintenance, and quality and safety. The operational process involves 14 processes: bidding and quotation, bidding for engineering, organizing schedule and budget elements, outsourcing the workers and materials of engineering, search for subcontractor, quotation of subcontractor, contract of subcontractor, quality management, materials stack management, construction management and schedule feedback, estimate for account receivable and payable of engineering, handling the receivable and payable accounts, profit analysis, and cash flow management.

The raw data contain six data domains: daily report table, scheduling control table, procurement contracts, quality and safety inspection, estimation and valuation table, and documents of project management. In coding the six existing information systems, following system elements are organized for analysis (from S1 to S6), 10 departments of organization structure (from O1 to O10), fourteen operation processes (from P1 to P14), and six related raw data (from D1 to D6). These coding results can be presented as shown in Tables 1–3.

Procedure (2): Analyze Existing Information Systems and Transfer to ARIS-House Diagram

Three tables are used to analyze the current conditions, which include following: O-S (the departments of organization to existing information systems), P-S (the operation processes to existing information systems), and D-S (the related raw data to existing information systems). These three tables are used to locate the related existing information system, department of organization structure, operation processes, and raw data on project management.

In the case study, the system requirements for project management are S1: daily report management, S2: schedule management, and S3: cost control, which were transferred to function view of

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Table 1. Department of Organization within Existing Information System

Organization		Existing information system					
		S1	S2	S3	S4	S5	S6
O1	Finance department		●	●			
O2	Marketing department						
O3	Construction engineering department	●	●	●	●	●	●
O4	Human resource department						
O5	Contract outsourcing department		●	●	●		
O6	Project management department	●	●	●	●	●	●
O7	Estimate department			●			
O8	Account department						
O9	Maintenance department						
O10	Quality and safety department		●			●	

Note: ●=existing information system has been used in this organization. S1=daily report management; S2=schedule management; S3=cost control; S4=engineering outsourcing; S5=quality control management; and S6=safety management.

ARIS-house diagram. Following the systems of S1, S2, and S3 on the table of O-S, P-S, and D-S; the related department of organization structure were found to be O1, O3, O5, O6, O7, and O10 (see Table 1.); the related operation processes were found to be P3, P8, P10, and P11 (see Table 2); and the related raw data were found to be D1, D2, D3, and D5 (see Table 3).

In this step, observed from Table 1, the existing information system, S1 S2, and S3, can locate the most frequently used items, which are O3 and O6. As the result, O3 and O6 were drawn up in the organization view. In the same manner, from Table 2, it shows that P3 was the relative important process, and from Table 3, it indicates that D2 and D3 were the major data. The results from the analysis of these three tables of O-S, P-S, and D-S, could determine the related department of organization structure for organization view, the related operation process for control view, and raw data for data view of ARIS-house diagram [see Figs. 5, 6, and 7(a)].

Table 2. Operation Process within Existing Information System

Process		Existing information system					
		S1	S2	S3	S4	S5	S6
P1	Bidding and quotation						
P2	Bidding for construction project						
P3	Organizing the items of schedule and budget	●	●	●	●	●	●
P4	Outsourcing the workers and materials of engineering				●		
P5	Search for subcontractor				●		
P6	Quotation of subcontractor				●		
P7	Contract of subcontractor				●		
P8	Quality management		●				
P9	Material stack management					●	
P10	Construction management and schedule feedback		●				
P11	Estimate for account receivable and payable of engineering		●				
P12	Handling the receivable and payable accounts						
P13	Profit analysis						
P14	Cash flow management						

Note: ●=existing information system has been used in this process. S1=daily report management; S2=schedule management; S3=cost control; S4=engineering outsourcing; S5=quality control management; and S6=safety management.

Table 3. Data within Existing Information System

Data		Existing information system					
		S1	S2	S3	S4	S5	S6
D1	Daily report table	●					
D2	Scheduling control table		●	●			
D3	Contracts of procurement	●	●		●		
D4	Inspecting the quality and safety					●	●
D5	Estimation and valuation table			●			
D6	Documents of project management					●	●

Note: ●=data had been used in existing information system. S1=daily report management; S2=schedule management; S3=cost control; S4=engineering outsourcing; S5=quality control management; and S6=safety management.

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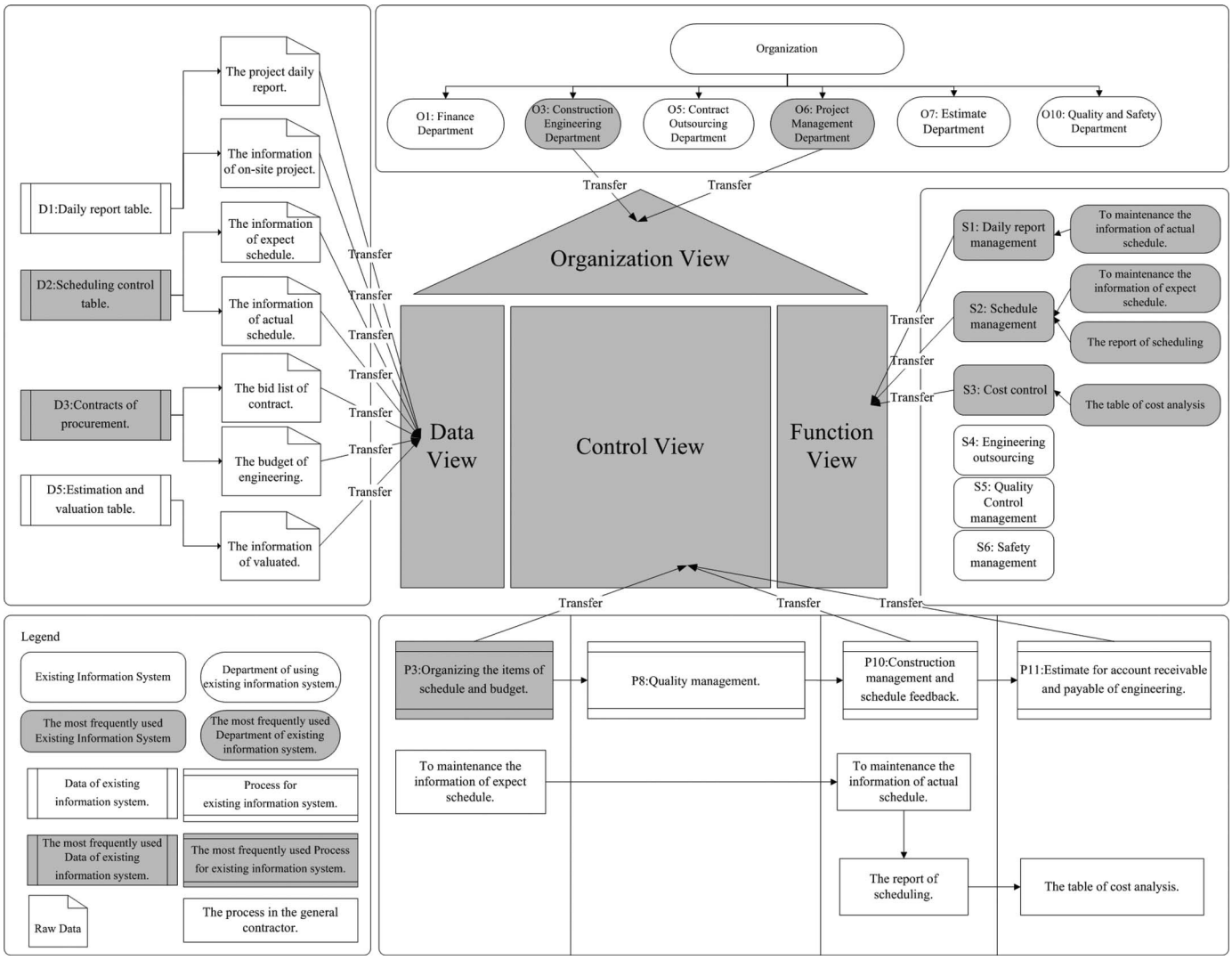

Fig. 5. Detail transferring steps in Procedure (2) of case study

Procedure (3): Describe Future Requirements

The future project management requirement, i.e., the daily report function, was not part of existing information systems. This requirement was submitted by construction engineering department, and the related raw data were information of expected and actual schedule.

Procedure (4): Analyze Future Requirement and Transfer to ARIS-House Diagram

In ARIS-house diagram, the daily report function would be transferred to function view, the project management department to organization view, and the information of expected and actual schedule to data view of ARIS-house diagram [see Fig. 7(b)].

Procedure (5): Describe the Modules of ERP

An ERP implementation can be applied after confirming the general contractor's entire existing information systems framework. In the initial stages of ERP implementation, an overall interview of the construction enterprise's requirements is demanded and five modules [sales and distribution (SD), project system (PS), material management (MM), financial accounting (FI), and controlling (CO)] are applied. The operation processes with all functions and requirements of the five modules are shown as Fig. 6. This case study chose the PS module to precede AHB method. The following will describe detailed functions, process, and raw data of relationship in the PS module.

The PS module contains five functions: to establish project structure, to manage the project schedule, to control the project cost, to analyze the project cost and schedule, and to inspect and analyze the project change order. The PS module also includes five processes: project schedule management, to acquire budget cost of work performed and budgeted cost of work scheduled, project cost control, project cost and schedule analysis, and project change order's inspection and analysis. Finally, the PS module has six raw data sets: the contract bidding list, the project budget, the schedule report, the process of estimating and evaluating, the memorandum, and the information of the on-site project.

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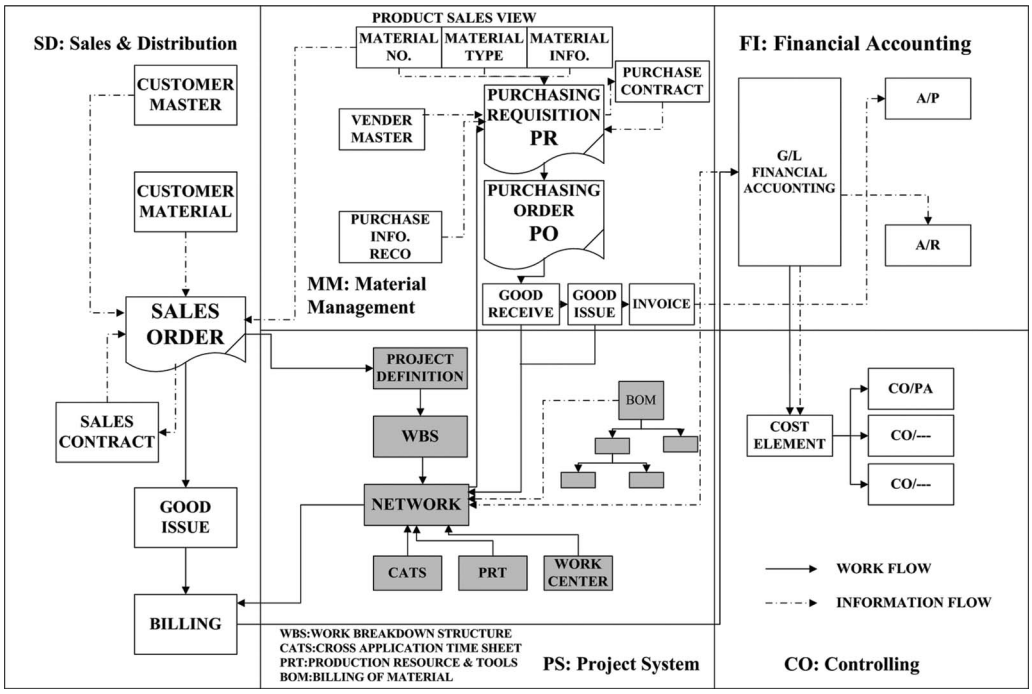

Fig. 6. Structure of ERP in the case study

Procedure (6): Analyze the ERP Modules and Transfer to ARIS-House Diagram

Due to the ERP implementation, this process was not previously defined for the organization. The tables for analyzing the ERP will include P-S and D-S tables, but not O-S table. After establishing these two tables, next step is to find related operation process, and raw data on the PS module. All functions, processes, and data were demanded for the PS module. After analyzing current conditions of existing information system on the PS module, the results yielded following: all functions could transfer to function view; all processes could transfer to control view; and all raw data could transfer to data view of ARIS-house diagram. In the PS module, six raw data would be transferring to data view, the five functions would be transferring to function view, and the five processes would be transferring to control view [see Fig. 7(c)].

Procedure (7): Compare All ARIS-House Diagrams

After completing the previously described procedures, the next step is to compare all ARIS-house diagrams that include analyzing existing information systems [see Fig. 7(a)], analyzing future requirement [see Fig. 7(b)] and analyzing ERP modules as well as transferring to ARIS-house diagrams [see Fig. 7(c)]. The major areas of comparisons of ARIS-house diagrams are function view and data view.

In function view of ARIS-house diagram of MIS for project management [see Fig. 7(a)], "To maintain the information of expected schedule" and "To maintain the information of actual schedule" should be regarded as the functions of "to manage the project schedule" of the function view of ARIS-house diagram of PS module [see Fig. 7(c)]. In function view of ARIS-house diagram of MIS for project management [see Fig. 7(a)], "the table of cost analysis" and "the report of scheduling" should be regarded as the functions of "to analyze the project cost and schedule" of function view of ARIS-Diagram of PS module [see Fig. 7(c)].

In data view of ARIS-house diagrams of MIS for project management and future requirements [see Figs. 6 and 7(b)], "the information of expected schedule" and "the information of actual schedule" should be regarded as the data of "the information of on-site project" of data view of ARIS-house diagram of PS module [see Fig. 7(b)].

Therefore, it is concluded that the function and data of project management of existing information system can be included in PS module of ERP. However, function view of ARIS-house diagram of future requirements [see Fig. 7(b)], "the project daily report" as a future requirement would not be included function view of the PS module of ERP. In this case, function view of "the project daily report" should be added in the final ARIS-house diagram of PS module (see Fig. 8). An inquiry with consultant of ERP as to whether the implementation can be developed or customized is recommended.

Users' Feedback

Existing information system for managing project information is only limited to a department's use of the project, whether general contractor develops it internally or purchases a commercial information system. If existing information system needs to be linked with the systems in other departments, it is often done through repeated, manual input or transfer of information, because the databases are not interconnected within the system. Furthermore, the shared data may be inconsistent between departments, may become compromised, or may be lost.

In this study, ERP shared information systematically and automatically. ERP can help solve all interdepartmental data sharing immediately, and can address inconsistent data problems in existing information system.

The general issue for contractors is how to transfer existing information system to ERP during implementation. The tradi-

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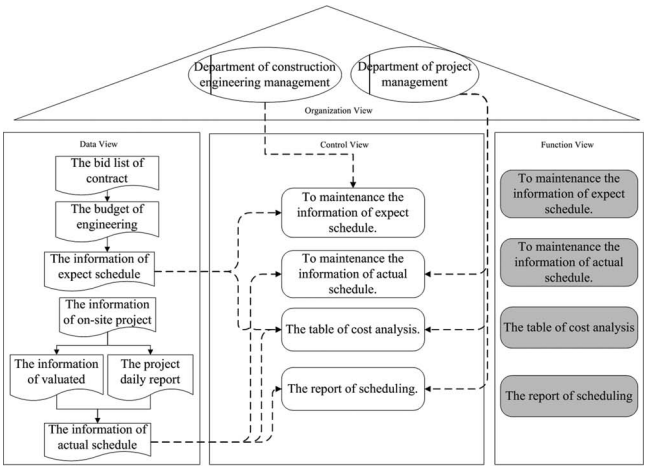
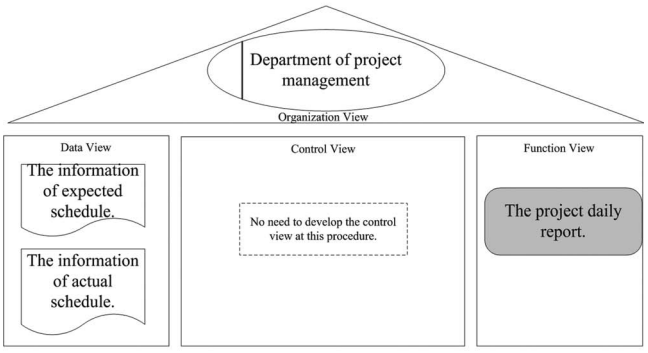
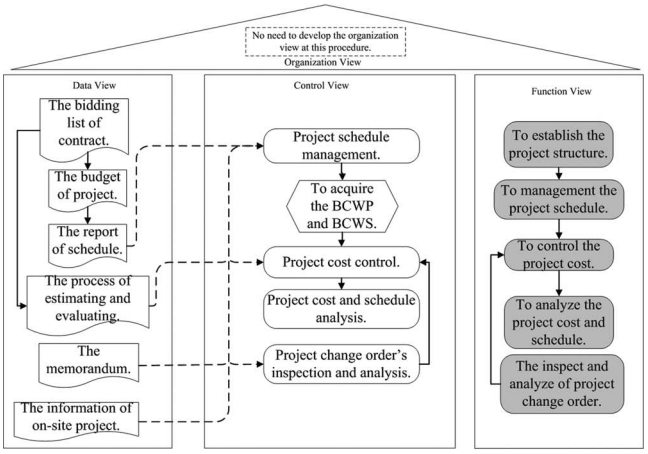


A. The ARIS-HOUSE diagram of MIS for Project Management.



B. The ARIS-HOUSE Diagram of Future requirements.



C. The ARIS-House Diagram of PS module.

Fig. 7. ARTS-house diagrams of existing information, future requirement, and ERP module

tional method resulted in a series of time-consuming meetings and face-to-face discussions by senior engineers. There was no systematic method in place. This research presents the AHB method to solve that problem. AHB method can analyze the organization, process, and data relationships with the general contractor's information system. It can manage a fragmented existing information system, and it can prevent the same problem in ERP. To prove AHB method supports ERP implementation process, this research designs a questionnaire to investigate the AHB method based ERP implement process.

The questionnaire contains four items, which focus on whether

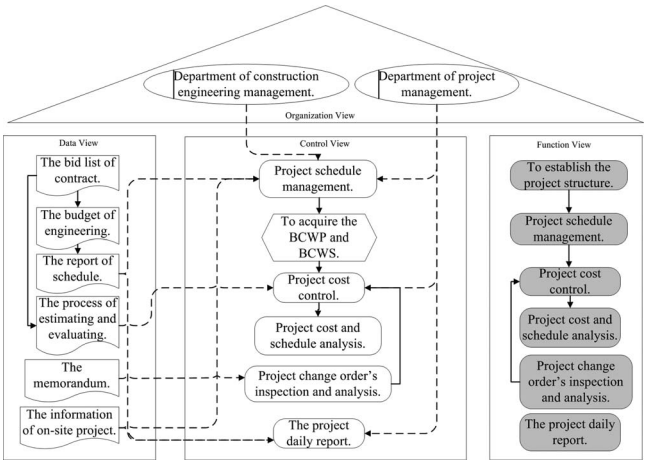


Fig. 8. Final ARIS-house diagram of PS module

the AHB method based ERP implement process can accomplish labor and process saving, precise function of daily operation, and efficiency evaluation of entire management (Q1: the AHB method based ERP implement process can accomplish labor saving; Q2: the AHB method based ERP implement process can accomplish process saving; Q3: the AHB method based ERP implement process reduces errors in daily operation; Q4: the AHB method based ERP implement process enhances the efficiency of the enterprise management). In the practical process of implementing ERP, AHB method will apply primarily to the PS module, as well as to other modules. Some functions might not be included in original ERP scale, which can be resolved under customized conditions. Before ERP can be implemented in the enterprise, the consultant may opt to conduct an interview with top managers and team members of the ERP project to evaluate the logicality and rationality of these ARIS-house diagrams. After ERP implementation is applied, holding regular interviews with users is necessary to gauge/assess integrity and rationality of functions. The results can be a basis for ongoing improvement on functions.

The questionnaire administered to 44 employees of ERP project who operated an existing information system, and then transferred to operate ERP. The 34 returned questionnaires will be

Table 4. Questionnaire Results of All Departments

	Evaluation			
Departments	Q1	Q2	Q3	Q4
Estimate department	2.98	2.99	3.23	3.42
Marketing department	3	3	5	4
Contract outsourcing department	4.07	4.12	4.2	4.24
Quality and safety department	3.48	3.55	4.06	4.11
Construction engineering management department	4.17	4	4	4.17
Finance department	2.78	3	3.44	3.56
Project management department	3.18	3.17	3.29	3.34
The average	3.38	3.40	3.89	3.83

Note: Q1=AHB method based ERP implement process can accomplish labor saving; Q2=AHB method based ERP implement process can accomplish process saving; Q3=AHB method based ERP implement process reduces errors in daily operation; and Q4=AHB method based ERP implement process enhances efficiency of the enterprise management. Five point satisfaction scales: 1—very dissatisfied; 2—dissatisfied; 3—neutral; 4—satisfied; 5—very satisfied.

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Table 5. Questionnaire Results of Estimate Departments

Major task	Evaluation			
	Q1	Q2	Q3	Q4
Creating the project budget	2	2	3	4
The task of project change budget	3	3	4	4
To request contract and control budget	4	4	4	4
To set up the order from owner	4	4	4	4
To maintain the main file of material	2	3	3	4
The task of fixed assets and the request funds of maintained equipments	2	3	4	4
The task of request the expense of department	2	3	4	4

Note: Q1=AHB method based ERP implement process can accomplish labor saving. Q2=AHB method based ERP implement process can accomplish process saving; Q3=AHB method based ERP implement process reduces errors in daily operation; and Q4=AHB method based ERP implement process enhances efficiency of the enterprise management. Five point satisfaction scales: 1—very dissatisfied; 2—dissatisfied; 3—neutral; 4—satisfied; 5—very satisfied.

analyzed using Likert's five-point scale. Rating scale is ranged from 1 to 5, with 1 signifying very dissatisfied, and 5 signifying very satisfied. As indicated, the questionnaire asks respondents to evaluate whether the AHB method based ERP implement process can accomplish labor saving, process saving, precise functions of daily operations, and the efficiency evaluation of entire management. The survey results are presented in Table 4. ERP is confirmed to be feasible, since all responses reflect above average scores in the area of labor saving, process saving, precise functions of daily operations and the efficiency of entire management.

Notably, the survey results from the estimate department, which is the initial department to input original data for a project, such as establishing construction budget, showed mostly below-average scores; the survey results from this department are displayed in Table 5. The estimate department's daily operations caused initial works in entire operation process. However, based on ERP concepts, the process of inputting data are still necessary even though ERP may execute a single input to decrease repeated jobs. Since all of the foregoing data input is original ERP data, it is essential to manually input and double-check data in order to avoid erroneous information. In this case, the results from Estimate Department are generally lower. After the sample contractor applies ERP, key users are highly satisfied with the functions provided by ERP. Functions that were deficient were not transferred to ERP system, and repeated jobs and time-consuming data input were decreased. This result verifies the efficiency and rationality of system functions based on this method analysis.

Conclusions

The objective of this research is to develop a novel function mapping approach named the AHB method to support ERP implementation. Existing information system and future requirements, and ERP are connected by AHB method to show the value ERP can offer to general contractor. Otherwise, it may be necessary to execute a customized project. Case study of general contractor in Taiwan demonstrates that AHB method effectively assists the function mapping of an ERP project and results in labor savings. General contractor and ERP consultant successfully transferred the process of function mapping from many time-consuming meetings to a logical analysis method, reduced labor-consuming meetings, and increased the efficiency and precision of an ERP project.

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