Information Strategy Planning in Construction: Framework and Processes

Boong Yeol Ryoo[1], Soo Yong Kim[2] and Young Dai Lee[3]

[1]Assistant Professor, 3137 TAMU Department of Construction Science, Texas A&M University, College Station, TX 7843-3137, U.S.A, bryoo@tamu.edu
[2]Professor, Department of Civil Engineering, Pukyong National University, San 100, Yongdangdong, Namgu Busan, 608-739, Korea, kims@pknu.ac.kr
[3]Professor, Department of Civil Engineering, Pukyong National University, San 100, Yongdangdong, Namgu Busan, 608-739, Korea, ydlee@pknu.ac.kr

Abstract

The intended objective of ISP is to develop a comprehensive plan for integrated systems development. Thus, Information Strategy Planning (ISP) is the first step in order for general contractors in the construction industry to introduce Information technology (IT) to their business and project management. Due to a lack of understanding of the role of ISP in systems development, it has been often ignored or not been considered by them. In order to design and develop an integrated system flawlessly, a well-defined software development methodology must be adopted. However, most existing methodologies are proprietary intellectual property of System Integrators (SI) whose fees are too expensive to most contractors. Their methodologies are generic and it requires a thorough understanding of their methodology and business processes in construction in order to implement in an integrated systems development in construction. This paper presents a comprehensive framework of ISP for construction contractors. Methods and tools for each step will be presented and desirable deliverables will be followed. Thus, without professional system integrators, they are able to explore information technologies that might support their business needs. It also can help them to evaluate existing systems, examine their IT and business environments, define a system architecture and functional architecture, and assess the impact on their organization.

Keywords: Information Strategy Planning (ISP), System Integration (SI), software Development Methodologies, Software Development Life Cycle (SDLC)

1. Introduction

In the construction industry, information systems have been designed and developed by computer scientists who do not have adequate understanding of the characteristics of construction business and construction projects. The construction companies also do not have sufficient knowledge of how information systems should be designed and developed in accordance with their needs. The management of system development projects must be thoroughly planned in order to put all systems and their components together [1].

Software Development Life Cycle (SDLC) models have been used in Information Technology (IT) industry. SDLC is a conceptual model for system integrators to manage software development projects. It covers from planning to operation and maintenance of a system's life cycle. However, software engineering techniques have been known to the IT industry whereas a little known to the construction industry [2]. System integrators often employ a software development methodology which has been used as a tool for producing and documenting project deliverables. Based on information engineering knowledge, comprehensive software development methodologies have been devised by system integrators. The methodologies include deliverables by phase, a project management model, a quality control model, and reasonable analysis methods and appropriate tools. Deliverables along with efficient methods and specific tools are defined and categorized throughout the software development project life cycle. Accessing such methodologies is limited since those are proprietary intellectual property of the system integrator.

Information Strategy Planning (ISP) is the basis and the first step of system integration. Without a proper ISP, system integration would not succeed [3]. Due to its characteristics, it is very hard to execute

complete ISP comprehensively for construction contractors because it involves the analysis of business environment and information technology environment in the industry.

This paper presents a framework and architecture of Information Strategy Planning for general contractors. The framework is based on case studies and generic software development methodologies. It includes major tasks by phase and deliverables. Thus general contractors will be able to evaluate their deliverables.

2. Software Development Life Cycle

A framework of essential tasks to design and develop an integrated system is called "System Development Life Cycle (SDLC)". Traditionally "phased life-cycle model" and "waterfall model" have been put into practice. The models divide a software development project into six key phases such as Planning, Analysis, Design, Development, Testing, and Operation and Maintenance.

More practical models including "prototyping model," "spiral model," "iterative and incremental development model," and "component-based development" have been introduced to the information technology industry. Potential problems still exist because the models focus on design and programming and testing. Capturing industry specific business processes and knowledge has not been specified.

2.1 SDLC Methodologies

Three distinct approaches have been considered as shown in Table 1. The concept of software development methodologies has been moved forward from Process-Oriented, to Data-Oriented, and to Object-Oriented Design. In early stage of software engineering, the process modelling method was used in structured analysis and design. Yourdon/DeMarco [4] and Gane/Sarson proposed a process-driven approach to bring both data and control flow of a system together. DFD is Data Flow Diagram. James Martin [5][6] proposed a data-driven approach. Booch [7] and Yourdon/Coad [8][9] proposed objected-oriented approach.

Table 1 Characteristic of System Development Approaches

Approach	*Developers*	*Description*
Structured analysis	Yourdon/DeMarco Gane/Sarson	Unit system-oriented and Process-oriented Convert business requirements into specifications Good for computerization of existing business process
Information Engineering	James Martin	Data-oriented Plan project management throughout the project life cycle Good for enterprise system integration
Object-Oriented Analysis/Design	Grady Booch Yourdon/Coad	Object-oriented Convert functional requirements into implementation classes Good to define dependency for complex systems

2.2 CASE Tools

Even though such software development methodologies have been introduced in the information technology industry many years ago, implementing such a methodology in real projects is very complicated because of a lack of understanding of the methodologies and CASE Tools. It is also hard to measure the

performance and productivity of a software development project. In many cases, success of a software development project has been relying on the knowledge, experience, and skills of team members.

As shown in Table 2, well-known system development methodologies have been introduced by business consultation firms. These are available from the firms or their business partners. Often these methodologies are not easily accessible due to expensive fees.

Method/1 focuses on three issues: what is the business environment that the client faces, in which desired direction the client would go, and what activities must be completed in order to achieve the issues [10]. Method/1 tries to help to identify functions, analyze data, and design the architecture of intended systems.

Navigator proposes system design and development tasks in more than 250 subject areas throughout project life cycle. It describes how three distinct components of system development, i.e., data, process, and information technology, can be formulated. Application Development Workbench (ADW) is a Computer-Aided Software Engineering (CASE) tool by Sterling Software and system developers are able to share resources in design and development.

In 4Front, business strategy, people, organization, processes, information technology come together. Thus understanding business strategy is important before developing a system. Information Engineering Methodology (IEM) has been adopted by Texas Instruments (TI) and it uses Information Engineering Facility (IEF) which is the first computerized methodology.

Table 2 Commercial System Development Methodologies

Methodologies	*CASE Tool*	*Developer*	*Phases*
Method/1	Foundation	Accenture	Oldest methodology and used by more than 300 organizations
Navigator	ADW	Ernest & Young	More than 250 subject areas
4Front	Excelerator	Deloitte	Planning, design and development
IEM (Information Engineering Methodology)	IEF (Information Engineering Facility)	Texas Instruments (James Martin)	Covers ISP phase to implementation phase
SSADM (LSDM)	System Engineer	LBMS	Used in the analysis and design stages of systems development
SILC (Systems Integration Life Cycle)	SHL Transform	SHL	Includes deliverables from design and development phases

3. Information Strategy Planning

Information Strategy Planning (ISP) is the process of exploring essential tasks for systems development by studying client's business plans and goals [11]. To identify major tasks and required deliverables from ISP for construction contractors, two surveys were conducted to investigate the business and information technology strategies and future plan for system development. Ninety-nine small and medium-size contractors participated in the first survey and twenty-three contractors were participated the second survey.

3.1 ISP Survey

Two surveys were sent out to small and medium size contractors and their annual volume of work is under $1.5 Billion. As shown in Figure 1, the volume of the majority of the respondents was less than $250

million which are considered as small-size forms. 31% of them were greater than $250 million but less than $750 million where as 21% of them were more than $1.5 billion.

According the survey, most contractors were not aware of such methodologies. Because of additional expenses in hiring well-known consultation firms as shown in Table 2, the contractors have been attempted to build up an information strategy planning without external assistance. This enforced them to purchase off the shelf systems for various management as shown in Table 3. This shows system integration between related systems is needed but it has not been seriously considered. One of the common misunderstanding, 57% of the respondents, was a project management system, an estimating application or a contract management application has been considered as an Enterprise Resource Planning (ERP) system. Only 14% of the respondents have been used a commercial ERP system.

For example, ERP is a key system in corporate level management. Important decisions to buy an ERP system have been made by top management (45%) and Project Management System (PMS) by the same top management (46%). Finance, accounting, human resources, and asset management had more priority than other management modules. Majority of contractors (53%) want to purchase commercial ERP systems where as only 19% of the contractors want to have custom-build management information systems. Approximately 80% of the respondents set aside a budget of less than $500,000 for an ERP system implementation even though they understand that ERP is compatible with the way of the business practice in the construction industry.

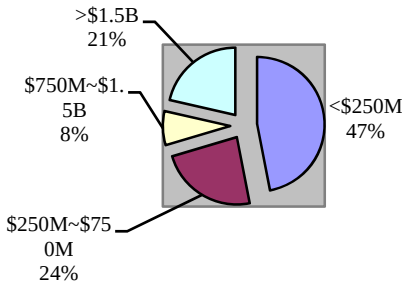

Figure 1 Size of Respondents

Table 3 Plan for System Integration

Future Plan	No. of Respondants	Percent (%)
Develop MIS	19	18%
Buy off-the-shelf ERP	53	51%
Integrate multiple modules	11	11%
Buy functional systems	16	16%
Other	4	4%

The average satisfaction rate on corporate level systems was 2.65 on 5 point scale when their integration rate was 3.28 on 5 point scale. This showed that the level of integration among the systems was poor because they did not have proper assistance from information technology professionals. The survey also showed most of contractors did not aware of the importance of information strategy planning and did not hire a standard methodology. Notably, they were not able to financially execute such tasks because their budget was limited or none.

3.2 Case Studies

The objective of this study was to identify essential tasks. Through the study a set of tasks or ISP was presented as shown in Table 3. Six construction firms were studied. Three of them were construction management firms and the other three are program management firms. One of the chief roles of program management firms is to execute heavy construction projects and development projects. Broader business environment both in national and global should be studied in their ISP. Construction management firms required the study of narrow business environment including the market analysis. Thus combining broader

and barrow business environment can be beneficial for contractors to predict the image of future systems and required information technology.

3.3 Framework of ISP

In initiation phase, five phases can be considered in order to complete an information strategy planning project: Project Planning, Business Environment Analysis of Current and Future Market, Information Systems and Information Technology of Current and Future Market, Recommendations for Future System Integration, and Project Management. The project plan includes the scope of work, project team, project schedule, and the project execution plan. In order for successful project completion, key items for the project plan were considered such as project goals, project strategy and its structure, methods, staff and skills.

System integrators' perspective, the management of deliverables is critical. All tasks performed during the project must be documented. Business processes are broken down into three levels: main, group, and unit. Business actions at corporate level processes fall into main processes. These main processes are further broken into group processes for team level actions. Unit processes are to define specific procedures for individual members of the group.

In the beginning of ISP phase, the required corporate level information will be asked to complete an information strategy planning for general contractors. The defined vision and goals were among the items. Long-term and short-term plan related to the goals were collected. Especially corporate level strategy, business level strategy and organization level strategy on key business areas were defined. Corporate level strategy is to cope with where the industry is going. Business level strategy is more specific strategy and may vary depending on the types of business areas. Organization strategy is for home office management, human resources management, customer relationship management, and supply chain management. Thus, corporate level strategy should be supported by business level strategy and its functional strategy. Some certain techniques can be used for specific tasks such as Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis to evaluate the contractor's vision and goals, and plans. For public firms, it is important to validate if its vision and goals are incorporated with the national and industry trends. Through this step, some Critical Success Factor (CSF) can be identified.

4. Conclusions and Suggestions

Construction firms need a practical template so that where they can use it for system integration projects. This research presents a template that small and medium size contractors can use prior to their system integration projects. It will help the contractors to understand its current operational performance and clarify its future strategy in a systematic way.

Understand the business strategy is critical. Business environment analysis such as the identification of factors for business, IT and organization is also essential. Basic statistics tools were used to study the past trend and forecast the future trend of external business environment. Some specific methods such as SWOT, CSF, and matrix analysis were used to measure internal business environment such as business, organization and information technology.

Gap analysis was seriously considered in order for successful implementation. By benchmarking and case studies, potential mistakes can be eliminated. It helped contractors to realize the gap between desired systems and actual systems they have. Feasibility study, both technical and functional, was performed in order to prepare an IT implementation plan. Selecting a proper SDLC methodology and CASE tool is crucial even for ISP. Thus contractors can carry out ISP in a systematic way.

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Table 4 Tasks for Information Strategy Planning by Phases

Phase	Tasks	Deliverables
Project planning	Set scope of work Organize project team and assign responsibility Call for pre-project meeting	Project plan - Scope of work (objectives), Schedule, and project team and responsibility
Project execution plan	Identify line-items Perform benefit/cost analysis, return on investment	Project execution plan - deliverables
Review of current strategy and policies	Make out corporate vision, objectives, goals, and long-term/short-term plans Investigate industry and major markets Review existing business plan Identify critical success factors	Business environment review Business strategy review Critical success factors System development plan
Review current business processes	Assess organization: functions & business processes Study industry Perform interviews Perform past trend analysis Perform SWOT Analysis Review profit models	Owner's requirements Existing business process model Future business process model
Review current information technology	Examine information management team Review applications/systems (hardware, software, and network) Evaluate information technology infrastructure Suggest suitable information technology	Report on applications Report on information technology infrastructure Analysis report on information management team
Future business processes	Study competitors, clients, and partners Identify future markets Study information technology trends Perform benchmarking Prioritize suggestions Redesign current business processes	Benchmarking report Information technology trends report Priority report Scope of work report
Future information technology	Describe information management structure Propose framework for system integration Propose information technology structure Suggest information management team	Information strategy plan System integration plan System management plan
Project Closeout	Review and submit deliverables	Documentation