Owner–Contractor Work Structures: Process Approach

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Abstract: This paper describes a process to assist project managers, within owner companies, define work relationships between owners and their contractors for capital project development, and execution. The owner–contractor work structure process was developed by the Construction Industry Institute as a step-by-step process for making rational decisions about the most appropriate owner–contractor work structure for capital projects. A work structure is described by a set of project competencies and the extent of involvement of the owner and contractor in performing, leading, and/or providing input with respect to those project competencies. The process is described using a formal process modeling technique. Three case studies, conducted to validate the owner–contractor work structure process, are discussed. The results from these case studies suggested some basic changes to the process that would enhance its use in practice. A modified owner–contractor work structure process is then presented.

DOI: 10.1061/(ASCE)0733-9364(2004)130:5(680)

CE Database subject headings: Contractors; Owners; Project management; Construction industry.

Introduction

Organizations respond to a changing business environment by adapting to the demands of that environment. For organizational groups that develop and execute capital projects, maintaining profitability while delivering quality products and services is frequently accompanied by: (1) downsizing; (2) reducing or eliminating central project engineering organizations; (3) shifting project responsibilities to business units or operating facilities; or (4) outsourcing more work to contractors. Concurrent with these phenomena is the gradual attrition through retirement of a whole generation of experienced project managers having a background in engineering. The combined effect of such changes may leave owners inadequately equipped to develop and execute capital projects. In this environment, the groups responsible for capital projects tend to focus their efforts on front-end project development activities that have the greatest influence on project outcomes. In order to maximize the chances of project success, the assessment of the resources and capabilities of each project stakeholder, and the relationship of each of these stakeholders within the owner organization, becomes critical. To assist owner companies in this assessment, the Construction Industry Institute (CII) has developed an owner–contractor work structure (OCWS) process (CII 1997). The OCWS process is a step-by-step approach for making rational decisions about the most appropriate owner–contractor work structure for capital projects.

This paper presents the modeling technique used to develop the original OCWS process. The OCWS process is described. Recommended improvements to the process are identified based on the results of three company-specific case studies.

Objectives

The fundamental problem that this research sought to address was the need to develop an approach that helps determine the most appropriate owner–contractor work structure for successful capital project development and execution. The key research questions for seeking a solution to this problem were as follows:

1. How have organizational changes impacted owner development and execution of capital projects?
2. What project work is considered critical to owners and what factors determine the critical nature of this work?
3. How and when are work relationships determined and sourcing decisions made, and what factors are considered in these evaluations?
4. What is the influence of skills and skill level in sourcing decisions?
5. How are cost and resource parameters evaluated for making tactical assignments of roles and responsibilities based on strategic objectives of the organization?
6. How does an organization evaluate if the most appropriate decisions have been made regarding work relationships and sourcing these relationships?

The primary objective of this research was to create a process framework that owners could implement to ensure that the strategic objectives of their organization serve as a basis for evaluating the use of in-house resources versus contracting community

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Note. Discussion open until March 1, 2005. Separate discussions must be submitted for individual papers. To extend the closing date by one month, a written request must be filed with the ASCE Managing Editor. The manuscript for this paper was submitted for review and possible publication on July 24, 2002; approved on December 16, 2002. This paper is part of the ***Journal of Construction Engineering and Management***, Vol. 130, No. 5, October 1, 2004. ©ASCE, ISSN 0733-9364/2004/5-680–690/$18.00.

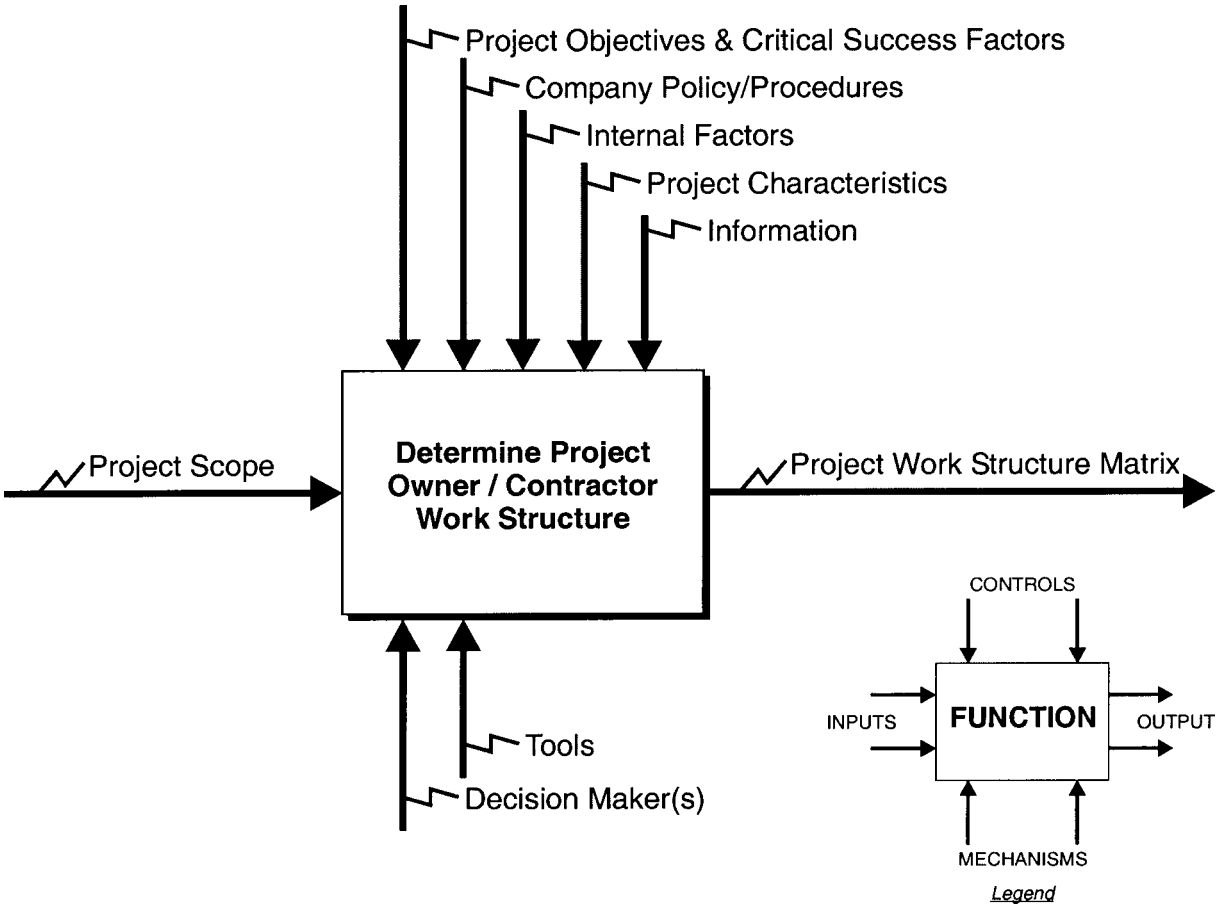

Fig. 1. Determine work structure—integrated computer-aided manufacturing definition summary diagram

resources. The process would help the owner identify the most appropriate sourcing approach for a capital project and for the capital program as a whole, and define the most suitable work relationship(s) between the owner and the contractor(s).

A second research objective was to conduct case studies involving implementation of the OCWS process. These case studies confirmed the steps of the process and their value in developing aligned work structures for capital projects and capital programs. The intent of the case studies was not to assess financial benefits of the process, as this would require further analysis once a newly proposed work structure was adapted by the owner organization. This type of analysis was beyond the scope of the research.

The OCWS process was modified as a result of the case studies. The modified OCWS process is presented in the form of a decision flow chart to serve as a graphical illustration of the decision making process through which owners and contractors can form potentially successful work structures.

Literature Review

Review of construction and management literature did not identify specific material about owner–contractor organizational work structures. The management literature showed a movement toward defining and focusing on core competencies, as a way of competing in a global economy. Prahlad and Hamel coined the term "core competencies" in 1990 (Prahlad and Hamel 1990), to help top executives rethink the concept of the corporation itself. In the words of Peter Drucker (1994), "core competencies define where an organization must excel in order to maintain leadership." Since core competencies drive an owner's involvement in project development and execution and the formation of owner/contractor work structures, competencies and the sourcing of competencies were particularly relevant issues in this research. If a competency is deemed core, the owner will be highly involved in performing the competency. If it is deemed noncore, the competency is a candidate for outsourcing.

Published literature on capital project planning or owner and contractor relationships, such as Patterson and Uz (1988) and Arber (1992), has dwelled on issues that do not explicitly address the need for a decision process focused on the owner–contractor work relationship, or a framework for institutionalizing this relationship. Arber's paper does highlight the importance of project management as a focal point of an owner's activities. This consideration emphasizes the importance of the owner retaining the project management function or parts of this function in-house, instead of outsourcing this function.

A review of the existing literature also indicates that the term "owner–contractor relationship," is used in varying contexts by researchers (Gibson et al. 1999). It is nevertheless evident that there has been a lack of a comprehensive, formal approach to determining the most appropriate mix of work relationships, or the "work structure" between the owner and the contractor(s), for successful development and execution of a capital project or a mutually beneficial alliance.

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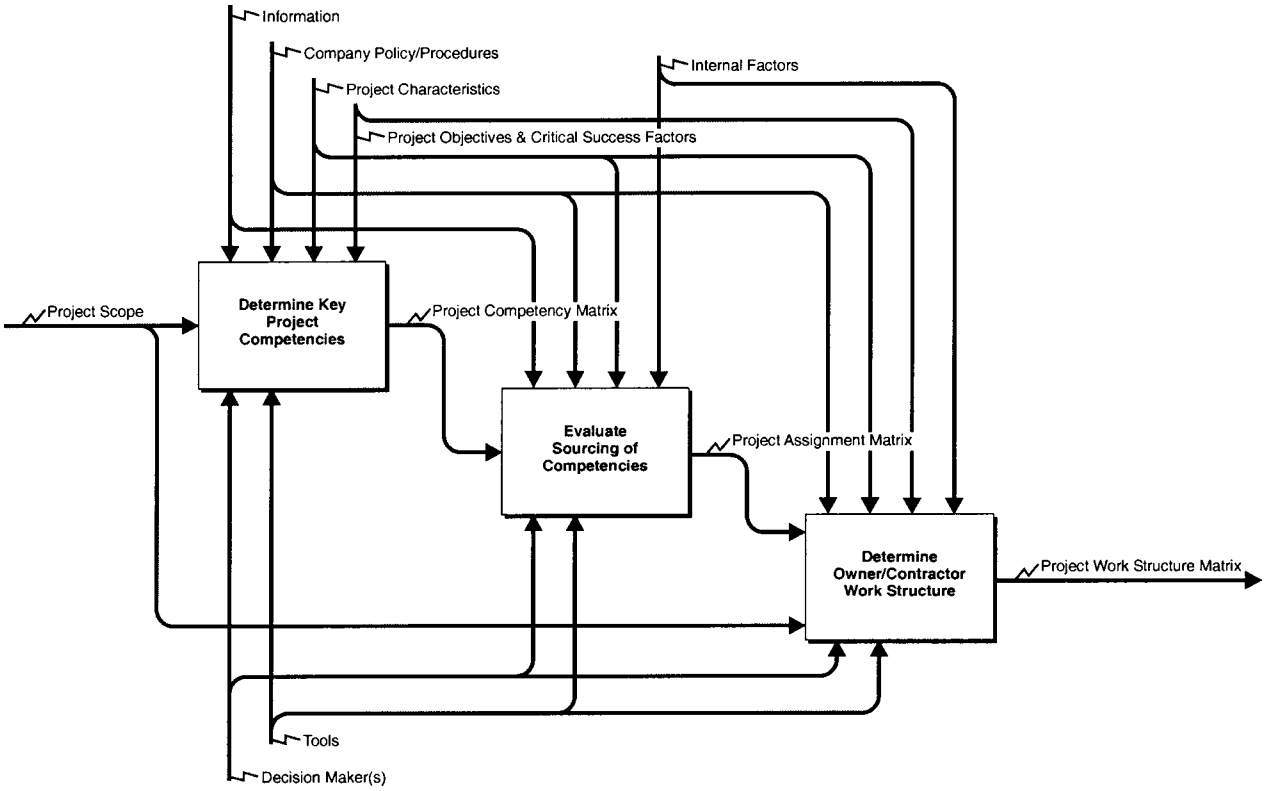

Fig. 2. Owner/contractor work structure process—level 1 integrated computer-aided manufacturing definition diagram

Modeling Process

The literature review indicated that a formal approach to determining owner/contractor work structures did not exist. Further, interviews with 23 companies associated with the Construction Industry Institute (15 owner and eight contractor companies) found that most owners did not have a formal process for determining which project functions the owner should perform and which should be outsourced. Further, owners continue to struggle with defining the most appropriate level of involvement between the owner and contractor(s) when performing project functions. Thus, a process that comprehensively addresses these issues needed to be developed.

The integrated computer-aided manufacturing definition (IDEF0) modeling technique was selected as the technique to help create a new process to aid owners in determining appropriate work structures for development and execution of capital projects. The IDEF0 is a graphical technique, useful for modeling functional relationships that describe processes (Mayer 1992). This technique provides a systematic approach to developing a process model. It defines the functions of the process in a hierarchical breakdown and then captures the required information needed to perform each function. The use of IDEF0 in developing the owner contractor work structure process for a capital program level application is discussed by Anderson et al. (2001). A more detailed description of IDEF0 modeling can be found in Anderson et al. (2000a) and Gibson et al. (1995).

Information, synthesized from existing literature, formed the basis for developing a preliminary owner–contractor work structure process model. Project development and execution approaches were also examined, including best practices from CII research. This activity provided information on how a company organizes to develop and execute projects and how staffing decisions are made. Round table discussions with 13 members of a CII research team (seven owner and six contractor company representatives) were conducted to help define process functions and information required to perform these functions. Twenty three structured group interviews involving 40 owner company representatives and 17 contractor company representatives provided information about how projects are developed and executed, how project functions are staffed, and which functions are critical to owners and which ones can be outsourced to contractors.

Information influencing function performance was defined using factors that were identified during the 23 group interviews. For example, at the capital program level, company policy or procedures provide guidance that influences the classification of functions as core or non-core for the owner. At the project level, project characteristics such as technology and location guide the classification of functions as core or noncore. All this information was assimilated, key terms defined, and a model was created using the IDEF0 technique.

Key Terms in Owner–Contractor Work Structure Process

The OCWS process provides a qualitative definition of work relationships that can exist between an owner and contractor(s), depending on the extent of their individual involvement in the planning, design or execution of project functions. The work relationships can be defined for a particular project, or the entire owner capital program. Since the process was conceived of as an owner driven process, it was developed from the owner's perspective. A key feature of the process was the concept of competencies, which is widely used in the management literature on strategy (Prahlad and Hamel 1990; Drucker 1994). While applying

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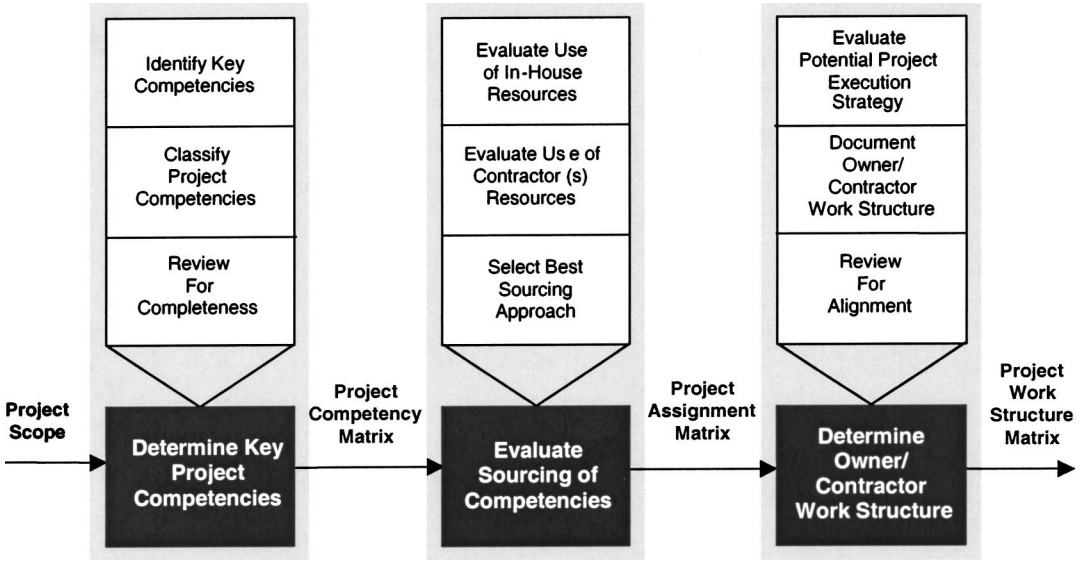

Fig. 3. Owner–contractor work structure process: project approach

this concept to owner–contractor work structures, competencies are defined as work processes comprised of functions and associated critical capabilities needed to develop and execute capital projects. Anderson et al. (2001) discussed the conceptual framework of the OCWS process in greater detail.

The key terms in the OCWS process are as follows:

1. **Owner:** The organization that owns, or is responsible and accountable for the development, construction and operational performance of the capital facility.
2. **Contractor:** Design, construction, consulting or supplier organization that provides services to the owner organization.
3. **Owner/contractor work structure:** the strategic distribution of roles and responsibilities that are defined in terms of owner–contractor work relationships for each competency, based on key project competencies.
4. **Competency:** a project work process that is comprised of functions and associated critical capabilities needed to develop and execute a capital project.
5. **Functions:** activities and tasks that describe the work involved in performing a competency.
6. **Critical capabilities:** the knowledge, abilities, skills and experience that are necessary to perform competency functions.
7. **Core competency:** a competency that must be performed in-house by the owner and is critical to capital program or project success.
8. **Noncore competency:** a competency that could either be outsourced or performed in-house, depending on the project circumstances.
9. **Work relationship:** a relationship defining the extent of involvement of the owner and the contractor, in performing, leading, and/or providing input with respect to a competency.

Five types of owner–contractor work relationships are defined to characterize the owner–contractor work relationship continuum. The five relationships are identified as OP, OP/CI, OL/CP, CP/OI and CP. These are defined as follows:

1. OP: Owner performs all functions involved in the competency using owner resources and the owner's work process.
2. OP/CI: Owner performs most functions using the owner work process with contractor input. Majority of the work is performed using owner resources. Contractor provides input, or acts as a consultant.
3. OL/CP: Owner leads the performance of functions using the owner's work process, and the contractor provides the resources. Owner leads by setting guidelines, directing, reviewing and approving the work. The contractor performs most of the competency work functions according to the owner's work process.
4. CP/OI: Contractor performs most functions using the contractor's work process with input from the owner. Majority of the work is performed using contractor's resources.
5. CP: Contractor performs all functions involved in the competency using contractor resources and the contractor's work process. The owner can still supply input and guidance by performing project management oversight.

Owner–Contractor Work Structure Process Model

Fig. 1 shows the summary level OCWS work process and identifies process boundaries based on the IDEF0 methodology. A key input for the process is the project scope. Project scope defines the owner's project needs or requirements that include capacity characteristics of the facility and products the facility produces. Project scope also includes such elements as facility components and operating conditions. Output from this process is a project work structure matrix. This matrix identifies core and noncore competencies, work relationships, and the distribution of these work relationships over project phases.

The OCWS process is further divided into three major functional areas. Fig. 2 shows this first level of decomposition that encompasses the following three functional areas: (1) determine key project competencies; (2) evaluate sourcing of competencies; and (3) determine owner/contractor work structure. The first two functional areas were created as a result of the literature review. Owner companies were examining the work they perform in terms of competencies and core competencies. Hence, the concept of competencies was adopted for use in developing the first func-

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WORK STRUCTURE									
No.	COMPETENCY	CORE	NON-CORE	PROPOSED WORK STRUCTURE					COMMENTS
				OP	OP/CI	OL/CP	CP/OI	CP	
I	**Project Management Competencies**								
1	**AFE Cost Estimating**: Estimate to obtain Authority For Expenditure.	X				X			+/- 15%. Based on project design basis. May use some contractor work processes.
2	**Conceptual Cost Estimating**: Preparation of estimates at various stages of scope development through project option selection.		X				X		Owner input consists of information on the process and the plant site.
3	**Control Cost Estimating**: Preparation of estimates for purposes of procurement and project control.		X				X		+/- 5 to 10%. Based on material take-off. Owner provides input on estimate basis and estimate approval.
4	**Project Controls**: Identification and reporting of actual and potential cost and schedule deviations.		X					X	

Fig. 4. Partial sample of work structure matrix

tional area of the OCWS project work structure process. The sourcing of each competency is the next crucial decision in the process. This led to the creation of the second functional area. The third functional area was developed as a result of examining project execution manuals, literature on preproject planning, and on-site interviews. Each of these three functional areas were developed further using the IDEF0 modeling technique (Sullivan et al. 1997).

A list of 30 project competencies was developed by the CII research team and confirmed through the 23 group interviews. These 30 competencies serve as a starting point for the users of the OCWS process (Sullivan et al. 1997 and CII 1997). One example of a competency from that list is conceptual cost estimating, which is defined as the preparation of estimates at various stages of scope development for purposes of project option selection. Each competency is further defined in terms of its functions and critical capabilities. Defining competencies in terms of their functions and critical capabilities provides greater detail and assists in classifying competencies as core or noncore to the owner. The functions and critical capabilities for conceptual cost estimating are as follows:

1. Functions for conceptual cost estimating
   - determine estimate basis (scope) for facility components;
   - determine historical cost basis for facility components;
   - convert estimate basis to cost;
   - compare with previous facility costs;
   - check key cost estimating relationships/ratios;
   - review cost estimates with project team; and
   - approve cost estimates by corporate management including acceptable ranges.
2. Critical capabilities for conceptual cost estimating
   - ability to visualize entire project;
   - understanding of technology involved;
   - having construction knowledge and experience;
   - understanding of how major facility components fit together;
   - understanding of estimating process, estimating techniques and methods, data sources, and cost elements such as cost relationships and ratios;
   - ability to review and understand estimates; and
   - having project controls background with design/construction experience.

During implementation of the OCWS process, project competencies are documented on a competency worksheet, and the work relationship decisions are documented on the work structure worksheet. An alignment worksheet was developed to help the owner and the contractor(s) check the alignment of their work relationships (CII 1997).

A key aspect of implementing the OCWS process is that this process can be applied at the corporate level for setting corporate policy, or the process can be applied to a specific project for determination of an owner–contractor work structure for a project. The corporate level application of the OCWS process is very similar to a project level application, with two key differences. In a corporate level application, the drivers behind core/noncore competency classification are independent of resource

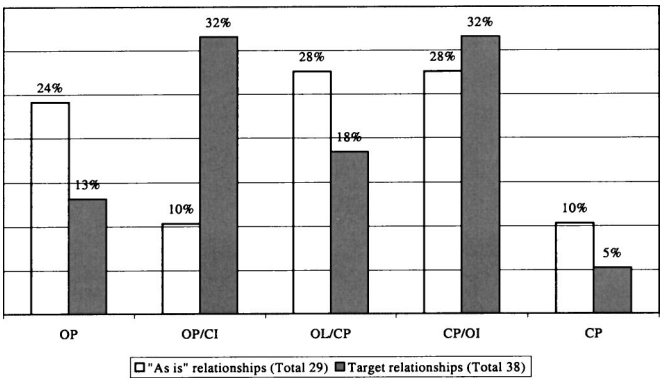

Fig. 5. Distribution of owner–contractor work relationships—company A

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availability considerations. In addition, the corporate level application does not include the step of evaluating the project execution strategy, or any consideration of project phases (Anderson et al. 2001). While many of the 30 competencies have an industrial construction focus, new competencies can be added or existing competencies can modified to align with other construction industry sector projects (e.g., buildings).

The steps involved in each of the three functional areas of the OCWS process for project level implementation are illustrated in Fig. 3. To test the applicability and usefulness of the OCWS process, case studies involving applications of this process were proposed.

Case Study Approach for Testing Owner–Contractor Work Structure Process

The essence of case study analysis is to illuminate a decision or set of decisions—why they were taken, how they were implemented, and with what result (Yin 1989). Since the OCWS process involves a set of decisions, and it was necessary to develop a deeper understanding of how the process could be implemented in practical applications, the case study approach was chosen to test the OCWS process. The research design for the case studies followed the guidelines provided in a widely used book on the subject by Yin (1989).

1. Definition of the case: The research design relied on multiple, independent case studies. Each case study involved detailed investigation of a particular scenario of owner–contractor work relationships. In some cases, the relationships were studied at the level of the overall capital program within the owner company, and in other cases the relationships were studied in the context of a specific capital project. The investigations were performed either in the preproject planning phase or as a postcompletion review.
2. Boundaries of the case: Each case was bounded by the time frame of the research. The number of participants varied in each case, depending on the nature of the study and the participating company's expectations.
3. Purpose of conducting the case study: Each case study was carried out with the objective of implementing the OCWS process, either at the corporate level for the capital program, or for a particular project.
4. Case study instruments: Two distinct approaches were used to conduct the case studies. (1) The first approach relied on on-site interviews, using a case study protocol (interview instrument) covering general information about the participants and the project, available documentation pertaining to owner–contractor work structures, the process of determining owner–contractor work relationships and alignment of roles and responsibilities. (2) The second approach involved application of the OCWS process to assist the owner company in forming the most appropriate owner–contractor work structure. This approach was relatively more time consuming since it did not rely on standardized instruments. Company-specific proposals were developed for this purpose, describing the manner in which the researchers sought to address the problem of forming optimal work relationships.
5. Administering the case study: On acceptance of the proposal and after finalizing the instruments, each case study proceeded according to a mutually agreed upon schedule. In the course of each case study, several documents and minutes of meetings were generated. This material was used to finalize the product of the case studies.
6. Output of the case studies: The knowledge acquired in the course of the case studies led to several proposed modifications to the original OCWS process. The modified process is described in a subsequent section.

Owner–Contractor Work Structure Implementation Case Studies

Three different case studies involving implementation of the OCWS process were conducted (Anderson et al. 2000b). The case studies involved a refining company, a chemical company, and a power company. Two of these companies were interested in a facilitated implementation of the OCWS process, and the third company was interviewed about a recent use of OCWS process in that company for an overseas project.

Case Study 1—Company A

This case study involved a facilitated implementation of the OCWS process. The case study included a series of interviews followed by a workshop, involving participants from the management team of a large refining company in the United States (hereafter "Company A"). The objective of using the OCWS process was to assist Company A in forming a proposed strategic alliance with an engineering–procurement–construction contractor for outsourcing portions of their capital projects on a continuing basis.

The capital project organization of Company A consisted of project teams using a matrix organization concept, without a centralized engineering group. The configuration of project teams was primarily based on the size of the project. On small projects valued at less than $1 million, one project engineer was typically responsible for several projects. Project teams were formed for large projects, with varying participation from members representing various functional areas such as process engineering, electrical, instrumentation, operations, maintenance, construction, project controls, safety, environmental, and the business units.

Methodology

The specific methodology adopted for evaluating this case consisted of two tasks. The first task involved on-site interviews with project management personnel at the company's three plant locations. The objective of these interviews was to acquire background information on current work structures that would serve as an input to the OCWS process application, as planned for the second task. The three interviews also provided important insights into the manner in which Company A conceived, planned, and executed capital projects.

The second task involved a workshop that was conducted over one working day and included six company representatives. Information obtained from the three site interviews was synthesized in preparation for the OCWS process workshop. The CII list of 30 competencies was used as a starting point for competency evaluation and classification in the workshop.

Owner–Contractor Work Structure Process Application Workshop

The workshop involved a total of six project management representatives from the three refining facilities. The workshop commenced with an overview of the application of the owner/contractor work structure process to capital programs, and was

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followed by application of the process based on the Company A's objective of evaluating and selecting an alliance contractor. Participation from each facility ensured comprehensive evaluation, classification and sourcing of competencies, defined in terms of work relationships. The CII list of competencies was revised and tailored for the proposed alliance, resulting in 38 project competencies. The workshop proceedings involved several lengthy discussions, facilitating a reconciliation of the different perspectives held by the participants. A partial sample of the final work structure that resulted from these discussions is shown in Fig. 4. The number of competencies evolved to better fit the type of capital project work that Company A performs. For example, a new competency added was authority for expenditure cost estimating (see Fig. 4). This competency was deemed important to Company A's capital project development and execution process and was not clearly identified in the original 30 competencies.

Analysis of Sourcing and Work Structure Decisions

Decisions made in the workshop indicated that 24 out of the total 38 competencies were identified as core to Company A for the proposed alliance. Most of the competencies considered non-core were associated with project activities that could easily be performed by the alliance contractor such as control cost estimating, detailed design, and construction. A summary of work relationships indicated that, for the 24 core competencies, five owner performed (OP) relationships, 12 OP/contractor input (CI) relationships, and seven owner leads (OL)/contractor performed (CP) relationships were assigned. Twelve CP/owner input (OI) relationships and two CP relationships were assigned to the 12 noncore competencies.

A comparison of the percent of competences assigned to each work relationship is deleneated in Fig. 5. Two histograms are shown, the current or "as is " work relationship distribution and the "target" work relationship distribution based on output from the OCWS process application. This comparison is shown to indicate the overall impact of the alliance relationship on Company A's existing work structure for developing and implementing capital projects. Fig. 5 shows a decrease in work performed directly by either the Company A (OP) or the alliance contractor (CP). As expected, in the proposed alliance relationship there would be an increased number of shared work relationships (OP/CI, OL/CP, and CP/OI) between Company A and the alliance contractor.

The distribution of work relationships shown in Fig. 5 is based on the work relationships initially assigned to competencies. While assigning work relationships to each of the competencies, the workshop participants acknowledged the need to clearly define what the "input" would be in case of OP/CI and CP/OI relationships.

Results

This case study tested the OCWS process in a practical setting. Key findings from this case study were as follows:

1. The process provided a useful approach for generating a discussion on core/noncore competencies, appropriate sourcing approaches, and the work relationships.
2. The process served well as an internal alignment tool between various project participants of Company A with respect to competencies and the work relationships assigned to competencies for the proposed alliance.
3. The results of the process could be used to solicit information through the proposal from potential contractors on how best they can meet the competency and work relationship requirements defined by the owner organization.
4. The process can be improved by clearly defining the "input" and "lead" roles, and by making it easier to use.

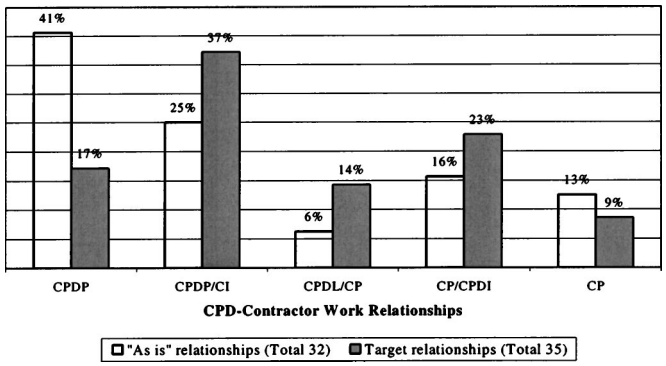

Fig. 6. Distribution of owner–contractor work relationships—company C

Case Study 2—Company B

This case study was based on an interview and discussion with the Director of Engineering for a large United States chemical company (hereafter "Company B"). The topic of discussion was the application of OCWS process on a $22 million capital project in Europe. The case study was conducted in retrospect, after the project was complete. Since none of the actual documents were available, the interviewee completed the OCWS worksheets during the interview, based on his knowledge of the OCWS process application implemented during project development. The advantages and deficiencies of the OCWS process were discussed during the interview, with the objective of identifying potential improvements in the process.

Background and Methodology

Company B used the OCWS process for developing a capital project involving the construction of a one-of-a-kind facility, using proprietary technology. The engineering department used the process in conjunction with the contractor, after the project development phase was completed but before project execution commenced. When the contractor was selected, Company B had already completed the process design and some detailed engineering. The key objectives of the application of this process were as follows:

- communicate the competencies required on the project;
- decide the sourcing of each competency;
- determine the most appropriate work relationship for each competency; and
- ensure that the owner and the contractor were well aligned and did not work at odds.

A negotiated target price contract with a bonus/penalty clause was used, owing to the nature of the project and the prevailing contracting practices in that part of Europe.

Analysis of Sourcing and Work Structure Decisions

A comparison of 30 competencies in the project competency worksheets suggested that six competencies were not required on this project. The project involved the construction of a one of a kind facility, a new contractor and a new location for Company B. Thus, the alliance/partnering competency, for example, was not

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Table 1. Comparison of Existing and Modified Owner–Contractor Work Structure (OCWS) Process

No.	Original OCWS process	Modified OCWS process
1	Cumbersome description of the process; likely to be a disincentive for potential users	Objective and concise step-by-step description of the process; facilitates understanding and generates interest
2	Illustrations are not easy to follow	Simplified illustrations easy-to-understand decision flow diagram
3	Detail competency definitions in terms of functions and critical capabilities is not provided	Provides a list of 30 capital project competencies, approximately 176 functions and about 150 critical capabilities
4	Identification of core competency drivers is not adequately emphasized	A step is introduced to identify the drivers, thereby making it mandatory
5	In-house and contractor resources are evaluated prior to selecting the corporate or project sourcing approach	In-house and contractor resources are evaluated while selecting project sourcing approach *only*; corporate sourcing is based on strategic objectives
6	Support roles (Input and Lead) in the relationships are not defined	Support roles are defined in terms of functions, on a Support Role Definition worksheet
7	The step to evaluate owner and contractor resources does not provide any tool for such an evaluation	An additional step is introduced to estimate full-time-equivalents of personnel required

required for the project. Thirteen out of the remaining 24 competencies were classified as core, and 11 were classified as noncore.

Results

The OCWS process served as a useful tool for the project management team and immediate supervisors to communicate competency requirements and work relationships during the development of this overseas capital project. It provided a link between the strategic objectives of the company defined at the upper management level and the tactical assignment of roles and responsibilities defined at the on-site project management level. Key findings of this process application were as follows:

1. Overall, the process was helpful in planning the execution of the capital project, especially with the involvement of unfamiliar contractors.
2. The process provided an excellent tool for communication and facilitated alignment between project participants that had diverse backgrounds and different project development and execution systems.

Case Study 3—Company C

This case study involved a facilitated implementation of the OCWS process. The case study involved the application of the corporate level OCWS process in a large power company (hereafter "Company C"). The objective of this effort was to provide a basis for restructuring their Capital Projects Division (CPD) and estimate CPD full time equivalents required to support project competencies. Management's goal was to redefine CPD's role as a provider of project management services to all plant sites. Executive management also felt that despite being the owner, the company was more involved than necessary in "doing" design and construction rather than "managing" design and construction. Therefore, management decided to restructure the capital projects division while focusing on the company's core business of electricity production.

Owner–Contractor Work Structure Process Application

This study was conducted at the time when Company C was in a state of transition, with a long-term objective of adapting to a more competitive business environment by redirecting its focus on its core business of electricity production. Although the construction work on large projects was normally outsourced to contractors, the CPD had traditionally played a major role in the construction activities on plant sites. The CPD was typically accountable for managing the execution of the project on behalf of the plants. However, the plants could choose to execute a project with their plant staff. An overall objective of the OCWS process application was to reduce Company C's dependence on its own personnel for activities that were outside the core business of electricity production.

The CPD team prepared a detailed evaluation of the capital project management activities in the company, prior to conducting a workshop. The focus of this evaluation was on the identification of capital program competencies based on the initial list of 30 competencies in the OCWS process, and defining the functions and associated critical capabilities necessary for successful development and implementation of capital projects. CPD identified 32 competencies as reflecting current practice. Three additional competencies were added to better represent the future role of the CPD in their capital project process.

Process Application Workshop

Ten managers representing engineering, project management, construction management, procurement, human resources, and the corporate office attended the 2 day process application workshop. At the beginning of the workshop an overview of the OCWS process provided the team members with a better appreciation of the process. A brainstorming session was conducted prior to core/noncore classification of each competency, to determine the drivers of core competencies. Based on the drivers, the competencies were classified as core and noncore, and the classifications documented on a worksheet.

The next step involved determination of the most appropriate work relationship(s) for each competency. This step in the process application generated some significant discussion on the specific roles considered appropriate for the CPD, the manufacturing plants, and the contractors. The discussion helped to attain the necessary alignment of the perspectives of each of the team members. After determining the work relationships, the team carried out an assessment of the "as is" work relationships between the

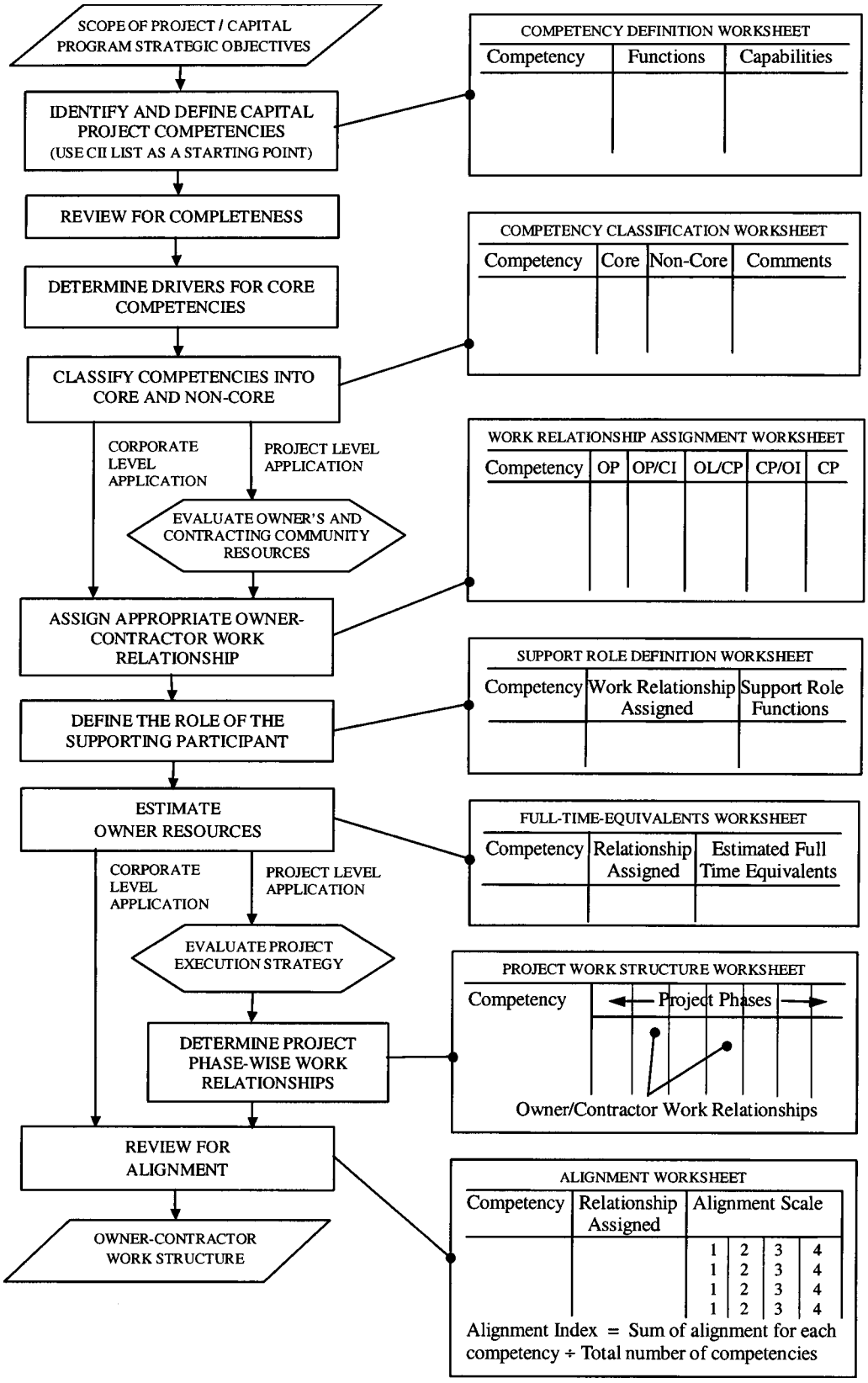

Fig. 7. Steps in modified owner–contractor work structure process and process worksheets

stakeholders, to assess the shift from high CPD involvement to higher plant involvement in some competencies, and higher contractor involvement in others. A comparison of the percent of competences assigned to each work relationship is deleneated in Fig. 6. This figure shows a shift of CPD involvement toward more shared relationships and less direct involvement in performing competencies (e.g., OP).

Results

The application of OCWS process for the capital projects organization at this company demonstrated that the process worked very well to provide useful input as a basis for structuring capital projects organizations that are properly aligned with the company's strategic objectives. The findings during this application of the process were as follows:

1. The process helped the decision makers to conduct a review of the organization's competencies to align them with strategic objectives of the company and the business units (plants).
2. The process forced discussion, consensus, definition and decisions.
3. The process required input from various sources.
4. Defining functions and critical capabilities, to the extent possible, was crucial for creating a common language that facilitates an understanding of competencies and the associated work relationships.
5. It is important to document the functions and capabilities that will be provided by the supporting entity ("input" and "lead" roles) in a work relationship.
6. Estimating of owner resources required for each competency is difficult and likely to be inaccurate since some resources are distributed over a number of competencies.
7. The process required facilitation by an unbiased individual with a thorough understanding of the owner organization.
8. The process was flexible for meeting a wide range of requirements and expectations.

Overall, Company C's use of the OCWS process constituted an extensive and insightful application of the process.

Modified Owner–Contractor Work Structure Process

The three case studies demonstrated the utility of the owner/contractor work structure process for forming optimal owner–contractor work structures. The case studies also underscored the need to modify the original process to eliminate weak areas in the process. Although the weaknesses did not amount to any fundamental changes in the original process, they did nevertheless warrant some changes in the decision flow and the description of the process.

Findings from the three case studies were incorporated into the OCWS process and a modified process was developed. The specific areas that called for changes in the process, and the corresponding modifications, are provided in Table 1.

The modified OCWS process and the corresponding worksheets are shown in Fig. 7. A more detailed discussion of the steps of the modified OCWS process can be found in Anderson et al. (2000b). It is important to note the distinction in the application at the corporate level and at the capital project level. Although the key concepts are the same at both these levels, the corporate level application should precede the capital project level application. The results of the corporate level application serve as a strategic guideline for using the process for a specific capital project. At the capital project level, there is also an additional element of "project phasewise" determination of owner–contractor work relationships. The notion of phases is absent at the corporate level, since it entails strategic evaluation of work relationships on a periodic basis, for as long as the company builds capital facilities.

Conclusions

Using a structured approach for developing owner–contractor work structures is a critical activity. The OCWS process provides a mechanism to facilitate that activity. The development, testing, and improvements to the OCWS process led to the following conclusions:

1. The process provides a useful mechanism for generating discussions on strategic classification of capital project competencies into core and noncore, and for determining the most appropriate sourcing strategy and work relationship for each competency.
2. The process works well for creating a common language based on project competencies, their functions, and critical capabilities. Therefore, it provides an excellent tool for communication when the project participants come from diverse backgrounds and their understanding of the project development and execution process differs significantly.
3. The process is particularly suitable for assisting management when structuring a capital projects organization, since it helps the decision-makers conduct a review of the organization's competencies and aligns them with the strategic objectives of the company and the business units.
4. The process provides a mechanism for assessing alignment within the owner organization, and also between the owner and other stakeholders.
5. Meaningful and defendable implementation of the process requires time and appropriate resources.

The case studies provided valuable evidence to suggest that the OCWS process worked well in three different scenarios, and that the modified process as described in the preceding section is a useful tool in the development and execution of capital projects. Case studies also suggest that the process is flexible and likely can be adapted for different applications, such as building projects. Although only three companies were involved in the case studies, this is a more in-depth investigative approach compared to conducting a survey involving a larger sample. Therefore, findings from the case studies provided evidence to support the conclusions of this research.

Acknowledgments

This research was supported by grants from the Construction Industry Institute (CII) and the Center for Construction Industry Studies (CCIS) at the University of Texas at Austin. The writers would like to thank the membership of the CII Owner/Contractor Work Structure Research Team and the CCIS study team for their guidance, wisdom, patience, and encouragement throughout the research process.

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