

S11-3**BUSINESS PROCESS ENGINEERING IN THE CONSTRUCTION INDUSTRY****Brenda L. P. Yip¹, Ping Yung²,**¹ Assistant Professor, Department of Real Estate and Construction, The University of Hong Kong, Hong Kong² Lecture, Department of Built Environment, The University of Nottingham Trent, UK

ABSTRACT: Business process engineering (BPE) is a top-down management approach for increasing efficiency and productivity through radical and fundamental changes to the business processes of the organization. BPE requires firms to initially develop a model of the existing business processes of the firm to distinguish functional tasks from processes used for coordinating inputs, activities and outputs. The model is used for understanding the business processes in the organization and to simulate the effect of changes to the processes. The model can also be used to justify business processes, which involves assessing whether the business process provides value to the customer in its current configuration. Justification requires a careful examination of the key business processes used by the firm to identify systemic shortcomings in the process and to create a new business process to produce greater efficiency. BPE also considers automating as many business processes as possible to increase operational efficiency and the integration of business process tasks. The construction industry has been slow to adopt BPE because of its project approach in which a major firm contracts with various functional service providers and regards each project as unique. The industry focuses on functional task efficiency rather than business process efficiency. There is no formal methodology or criteria for determining whether a business process is effective for a construction firm in its current configuration. The use of performance measures such as costs, task duration times or other metrics can be useful in evaluating the effectiveness of an existing business process and for modeling the possible outcome of a fundamental and radical change to the process.

Keywords: Business Process Engineering, Construction Industry, Enterprise Model, Enterprise Resource Planning, Virtual Design Team

1. INTRODUCTION

Business process engineering (BPE) is a widely advocated approach to create closer alignment between business processes and measurable objectives performance objectives of the firm such as cost, customer satisfaction, or quality [1]. A business process includes any structured and logically related set of activities an organization uses to transform inputs to goods and services valued by the customer [2]. A business process can be envisioned as a formal system for transforming tangible or intangible raw material inputs into a finished product output valued by the customer. Because of the complexity of the modern business environment, firms use many separate but related business processes to create the output. Specific business processes also vary among industries and firms. Nonetheless, all business processes rely on support from employees and technology to perform the operations to transform inputs into a more valuable output [3]. In most firms, managers design individual business processes to accomplish a limited task contributing to the transformation of the inputs. The organizational culture and traditional methods for accomplishing tasks also establish the boundaries for

business processes. The narrow focus of managers towards business processes often leads to difficulties with integrating staff, technology and operational processes to maximize efficiency and to provide value according to customer expectations.

Among firms in the construction industry, construction management is the overarching business process, with other processes such as procurement and contractor coordination subordinate to the construction management process [4]. The construction management process organizes the inputs from sources internal and external to the firm according to the practices and procedures developed by managers for sub-processes to provide an output in the form of a finished construction project to the customer. Larger firms in the construction industry, however, conduct global operations with decentralized business processes intended to support individual projects. Despite the potential applications of BPE for improving the business processes of construction firms, the approach has not been extensively used by the industry [5]. Construction firms often perceive BPE as a management fad not well suited for firms with a project orientation competing with each other using widely diverse practices and technologies [6]. Project management often requires

coordination of many contractors who use different business processes and operational procedures to produce the inputs necessary for completing a structure according to client specifications. In addition, the construction industry does not have the sufficient information technology (IT) tools available to effectively create an internal and external communications environment to achieve coordination between task functions and business processes [7]. Many firms have difficulty implementing standardized enterprise resource planning (ERP) software because of the perception that each construction project is unique [8]. Smaller construction firms often lack the resources necessary to customize an ERP system to fully coordinate internal and external activities.

The purpose of this paper is to identify the applications of the fundamental theoretical concepts of BPE in the construction industry. The underlying premise is based on the perspective articulated by Hammer and Champy [1] in which BPE involves the analysis of fundamental business process and the application of radical and dramatic changes to the processes to improve performance. Improving management performance in construction companies requires assessing the business processes in the firm influencing both the entire organization and individual projects. To accomplish this, construction firms must develop a construction management business process model capable of integrating the specific project processes with the general business processes used by the firm.

2. THEORIES OF BPE

An incremental approach to BPE can result in the process continuing to manifest inefficiencies because the discrete tasks in the business process remain are not fully integrated [9]. Radical change to the process can ensure it is closely aligned with the strategy and the conditions of the operating environment of the firm. The BPE philosophy also assumes all organizations consist of a primary strategic business process to produce goods and services for the customer, with many sub-processes interrelated to form a unified process [5]. At the same time, each sub-process is composed of discrete operational tasks requiring integration and coordination with the strategic business process of the firm [10].

2.1 Business Processes

The existing business processes in an organization have usually evolved based on the need of the firm to structure a set of activities necessary for operations [11]. Business processes can also become more complex through the addition of new steps and redundancies, which appear necessary at the time they are included in the process. If the business process remains static, it can become outmoded because of changing environmental conditions and no longer provide the firm with an operational advantage in reducing costs or providing a high quality output valued by the customer. One of the difficulties

many firms have when implementing BPE is the failure to distinguish between business processes and functional tasks. A business process is “typically cross-functional and involves the reciprocal or simultaneous flow of information between two or more functional areas, as well as among the functions within these areas” [12]. An example of a business process in the construction industry is logistics, which depends on functional tasks such as design, purchasing, and project scheduling. At the same time, there are cross-functional relationships between business processes in the firm, which create the strategic or overarching business process providing value to the customer [13]. In the construction industry, the strategic business process is construction management, which provides the customer with a finished building complying with specifications.

Business processes are extremely varied even within a single industry such as construction. Each firm develops business processes based on its available resources, competitive strategy, and historical pattern of firm growth. Bonfim, de Lima and da Costa [14] suggested there are five elements common to all business processes:

1. Value—the output of the business process meeting a customer need
2. Inputs—the tangible and intangible raw materials used by the business process
3. References—the rules of the business process established by the organization to control the methods and procedures used in the business process
4. Infrastructure—the human and physical capital used to transform the input to the value desired by the customer
5. Transition—the coordination of the tasks of the business process to ensure the transformation of the input produces the value desired by the customer

The generic elements of a process create a framework for the analysis of business processes necessary for BPE. The process can be understood as input resources transformed by activities defined by procedures and infrastructure to produce the value output [15]. In the construction industry, some of the common business processes are supply chain management and logistics to coordinate material inputs, sub-contractor relations to coordinate specialist transformation of the material input, and sales and marketing providing the interface with the customer.

The theories of BPE presume that firms develop their specific business processes in a haphazard fashion based on needs of the moment, with the process becoming entrenched in organization. In some situations, business processes develop based on organizational structure such as hierarchical and divisional structures fostering compartmentalization of functional tasks. In other situations, business processes are imposed from outside forces such as agreements with suppliers or contractors or changes in the needs and preferences of customers [10].

The efficiency of the sub-processes and the methods used to integrate the sub-processes into a unified strategic business process can affect the efficiency of the overall business process of the firm. Because of the complexity of operations for larger firms, there can be difficulties distinguishing a task from a business process. Chatha, Weston and Monfared [16] suggest that a task can be viewed as a self-contained activity triggered by an event such as the receipt of inputs necessary for transformation to an output for another task. In contrast, a business process consists of both an event triggering an activity and a call for ongoing support for the activity from some other task performed by the organization in the organization. From this perspective, a business process requires coordination among two or more functional tasks.

3. BPE TO THE CONSTRUCTION INDUSTRY

The construction industry is characterized by the formation of temporary project organizations with a major firm contracting with the client for the delivery of a finished structure and coordinating the activities of designers, contractors and other professionals [17]. The temporary project organization can be viewed as a virtual team composed of organizations with varying cultures, operational methods and expectations. In the traditional temporary project approach to construction, there is often an adversarial relationship between the major firm contracting with the client and with the professionals from other firms providing services necessary for the project. The adversity within the project is the outcome of industry practices encouraging contractors to make low bids to obtain business and to use the contractual arrangements to obtain additional payment and increase profitability. Because of these practices of the construction industry, a firm engaged in BPE to provide value for the customer must examine and redesign both the internal business processes necessary for project management and the external business processes necessary to establish and maintain more cooperative relationships with contractors.

In construction, BPE involves rearranging processes for the design and construction of a structure to increase efficiency and reduce costs [6]. Many firms in the industry, however, focus on continued use of the business processes developed from traditional practices rather than seeking and adopting processes representing the best practices in the industry. The resistance to adopting BPE in the construction industry partially stems from the project orientation of firms. Because BPE is a top-down initiative attempting to identify and implement optimal business processes, it increases standardization of processes and practices throughout the organization [10]. Construction firms, however, often perceive each project as presenting unique scheduling and resource management challenges requiring redundancies in systems and processes to ensure on-time completion at or

below budget [4]. In addition, managers have a functional focus and remained primarily concerned with ensuring the firm's processes function effectively for supporting the tasks necessary for project completion. A study conducted by Soares and Anderson [18] determined the majority of the business processes used by construction firms are project-level processes, with the few company-level processes related to administrative functional tasks. This finding suggests there is a fundamental dichotomy in the business processes of the construction industry, with technical and functional processes producing the output while company-level processes providing support services. The perspective implies construction firms have difficulties with envisioning an overarching business process composed of multiple interrelated and coordinated sub-processes.

Another barrier to BPE for construction firms is the fragmentation in the industry, with a small number of large construction firms using the services of many smaller specialist contractors. When the large firm attempts to alter a business process, it may also have to change some of the traditional local practices and procedures of the contractors to conform to the new business process [19]. Because BPE requires the coordination of both internal and external inputs related to construction management, implementation requires cooperation of designers and contractors responsible for project functional tasks.

Despite the organizational inertia in the construction industry resisting change to existing business processes, there are crisis circumstances in which construction firms are willing to adopt new and radically different business processes [20]. The crises often involve demands by customers for rapid completion of a project or an emergency rebuild due to specification changes or the discovery of material variance. In these situations, the firm's usual business processes containing redundancies and non-essential procedures inhibit the ability to meet customer requirements. The alternatives for the construction firm are to allow competitors to obtain the business or alter business processes at least temporarily to meet the customer demands. When a construction firm undertakes an exceptional project, it provides an opportunity to evaluate the effectiveness of changes to business processes in practical situations. If the outcome of the change is beneficial for improving construction speed or reducing costs, the firm should consider a permanent change to its business processes.

The caveat for construction firms when implementing BPE is to ensure the organization has initially developed a strategic vision to provide general guidance for the outcome of the BPE process [21]. Construction firms have typically focused on operational effectiveness rather than strategy, which can create difficulties with understanding the nature of the overarching business processes of the organization. Developing a strategy requires the firm to create a connection between the

organization and its external environment for effective competitive positioning [21]. The strategy creates a framework for the coordination of resources and the processes used to provide value for customers and for differentiating the firm from competitors. Strategic fit occurs when the organization's resources and business processes are configured to effectively manage the forces in the external environment, which can include customer requirements and contractor relationships [22]. In contrast, an operational orientation focuses solely on creating greater efficiency in an operational process, which may not contribute to creating customer value or positioning of the firm.

3.1 Business Process Modeling in Construction

The current state of business process modeling in the construction industry retains a strong project function orientation, often ignoring the process relationships explored in an EM. The project approach to modeling identifies the organizational processes influencing construction operations, with a product model and information model creating the boundaries for the project processes [23]. In this modeling approach, the processes transform the resource inputs in accordance with the product specifications subject to constraints established by the physical conditions associated with the project and the policies and procedures of the firm. The product model interacts with the business process model to define the value of the outcomes for the customer. The modeling approach in construction is often based on scheduling models, which use a critical path concept based on task, sequencing and dependencies [24]. The model is conceptually bounded by the project requirements, with business processes outside the model viewed as support services for the project. In addition, construction firms often develop a new process model for each project based on the assumption that projects are unique. In effect, the firm develops business process models focusing on the life cycle of individual projects, which limits the understanding of the interrelationship between the general business processes of the organization.

The modeling process ideally develops an as-is view of the business processes used by the firm including time constraints and priorities derived from a strategic vision for the integration of organization and project processes [25]. For the firm to realize profitability while providing the customer with expected value, the business processes must operate efficiently enough to create a differential between costs and the price charged to the customer. The information model establishes the data exchange environment to support operational functions. The shortcoming of this modeling approach is the segregation of functional tasks as separate business processes. While the information model allows data to flow between functional activities, the business processes remain discrete stages leading to a specific project outcome. The modeling approach assumes that the IT system will

inherently coordinate activities, increasing efficiency despite constraints or deficiencies in a functional activity.

Some approaches to business process modeling in the construction industry uses a functional task database, with each task identified as an object [7]. The task objects become part of a task library, with the objects extracted from the library to develop a workflow diagram. The objects are reusable and can be components of several workflow diagrams or placed in different locations in the same diagram. The model is based on the assumption that the tasks required for projects are repetitive and are similar regardless of the specific nature of the project [26]. The model provides the ability to simulate the effect of changes to individual variables as well as changes to the relationships among the variables controlled by the business process. The use of task objects, however, continues to focus on the functional task activities associated with individual projects and does not fully depict the full range of the business processes of the firm that interact with the specific project tasks.

Olson, Malone and Smith [27] have developed an extension of the virtual design team (VDT) approach to EM for application in the construction industry. The model is based on the assumption that a construction project requires inputs from a variety of specialists external to the firm responsible for specific functional tasks, with the construction firm responsible for coordinating the project activities [17]. The VDT approach combines qualitative pattern matching of business processes with event simulation to provide a model of the current state of business processes and the effect of changes on the processes. The approach assumes that organizational structures are fundamentally intended to facilitate information flow between the individuals responsible for accomplishing specific tasks [28]. The VDT model uses clearly defined measures such as critical path duration of the sum of all activity durations to assess efficiency. The specific measures are flexible and can be related to the industry or business activities of the firm, and focus on determining the effectiveness of communications in controlling activities. The assumed dependencies in the model are sequential, which is a critical path perspective, informational, which measures the communications between actors engaged in interdependent activities, and failure, which determines the impact of a task failure on the overall business process.

The generic VDT model presumes the work is routine, with the employees employing a standardized business process. In the construction industry, however, many projects involve non-routine tasks because the individual construction projects are subject to influences from external factors such as environmental conditions and behaviors of contractors and suppliers. As a result, the construction project can be unpredictable, which creates difficulty in forecasting the effects of changes to business processes. The VDT enterprise model effectively depicts

the dependencies within each project and the dependencies among the projects from organizational and inter-organizational processes. The model links the organizational chart with both the project and firm-wide activities showing the reciprocal information dependencies and the failure dependencies in the business process. The VDT is considered a computational model because it can be used to establish mathematical relationships between tasks, actors, organizational structure and information flows. An alteration in one or more of the factors can produce a change in the numerical output of the model, providing a forecasting tool for the effect of changes to the business processes. The model can also adjust for variable complexity in a project or business process with a notation for the number of dependencies an actor must keep in mind when executing a task [29].

4. CONCLUSIONS

Although construction firms have a project orientation, they can implement BPE by initially creating an EM of the processes used by the organization. The model should be based on the language-action perspective to distinguish functional tasks from cross-functional processes. The model should also identify the strategic business processes common to all projects, including the relationship of the firm with external contractors and service providers. After developing the model, the business processes can be evaluated or justified, which involves assessing whether the business process provides value to the customer in its current configuration. Justification requires a careful examination of the key business processes used by the firm to identify systemic shortcomings in the process and to create a new business process to produce greater efficiency. At the same time, the firm should examine the feasibility of automating as many business processes as possible through the use of ERP. There is no formal methodology or criteria for determining whether a business process is effective for a construction firm in its current configuration. The use of performance measures such as costs, task duration times or other metrics can be useful in evaluating the effectiveness of an existing business process and for modeling the possible outcome of a fundamental and radical change to the process. Examining the outcomes of BPE in the construction industry is an area requiring further research to identify the most effective performance measures and best BPE practices.

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