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CIB Volume 5, Issue 1
Table of Contents

Title	Author(s)	Pages
Organizational Implementation of Best Value Project Delivery: Impact of Value-Based Procurement, Preplanning, and Risk Management	Brian Lines Kenneth T. Sullivan Brian Stone	1-19
Post Construction Quality Evaluation - Manufacturer's Use of End User to Minimize Risk	Dhaval Gajjar Kenneth T. Sullivan Dean Kashiwagi	20-26
Optimizing Cost and Schedule Performance through Best Value Project Delivery: Application within a Design-Build Project	Brian Lines Kenneth T. Sullivan Anthony Perrenoud	27-40
Implementing Project Schedule Metrics to Identify the Impact of Delays Correlated with Contractors	Anthony J. Perrenoud Kenneth T. Sullivan	41-49
Utilization of a Best Value Structure on a City's Park Renewal and Upgrade Program	Jake B. Smithwick Kenneth T. Sullivan Dean T. Kashiwagi	50-58

Dear friends,

This issue of the Journal for the Advancement of Performance Information and Value marks the fifth volume and the first as a CIB Encouraged Journal, an honor that was bestowed in March of 2013. The journal has progressed over the past six years and the quality of its publications continue to provide tremendous worth to both academic and practitioner. This issue of the journal includes five papers, all involving application of performance information in the creation of value in the built environment. Within the purview of performance information research, the papers consider project delivery, material & manufacturer performance, organizational transformation, and policy adaptation. Each article uniquely furthers the body of knowledge of advanced business and project delivery approaches that employ Information Measurement Theory (IMT) as their core tenet, and though specific circumstances and methodologies exist, performance measurement, value, education, and dominant information are prevalent throughout. The journal is also a reflection of the continued evolution of the CIB Working Commission 117 and the Performance Based Studies Research Group (PBSRG), as the concepts of IMT, while maintaining their simplicity, are applied in ever more sophisticated modes, methods, and circumstances, as well as in diverse cultures and locations. Future issues of the JAPIV will undoubtedly highlight the research and testing of value-based concepts in Africa, Australia, Europe, the US, and Canada.

In the current issue, the first paper by Lines, Stone, and Sullivan explores organizational adaptation of performance information and value based concepts in project delivery and measurement. The paper considers change management principles and details the findings of a case study application of the Best Value model to a large university in western Canada. The second paper by Gajjar, Sullivan, and Kashiwagi shows the testing of performance information by a manufacturer of roofing products. The manufacturer has successfully developed a performance measurement platform and utilizes the information to minimize project and corporate risks. The third paper by Lines, Perrenoud, and Sullivan focuses on the project level, providing a case study analysis of Best Value application within a design-build and integrated project delivery project that entailed the design and construction of a \$30M+ (USD) Medical Isotope and Cyclotron Facility. The technically advanced and demanding scope of work proved to be an ideal environment for displaying and maximizing the positive impacts that IMT, performance information, and value based tools can achieve.

The fourth paper by Perrenoud and Sullivan presents the findings of a multi-year study that collected performance information of project schedules for over 250 capital projects at large university in the mid-western region of the United States. The study finds that, contrary to other literature, the majority of project performance issues arise not from contractor non-performance but from the client organization. This paper is rich in data and analysis and delves into detailed consideration of contractor delays and their causes. The fifth and final paper by Smithwick, Sullivan, and Kashiwagi presents the initial results of the adaptation of IMT and value-based concepts within a city government in the delivery of a parks renewal program. Policy, political, educational, and organizational challenges are identified and discussed, with a unique focus on the impact of non-project factors in the implementation of new organizational strategies.

The editors also wish to recognize the efforts of Kristen Barlish, Wim Bakens, and the PBSRG staff for their efforts in collecting and administering the publications contained in this issue. Moreover, we are grateful for the peer reviewers, who, from around the world, gave of their time and invaluable assistance to help ensure the necessary quality and rigor for this journal.

We look forward to your continued involvement in the Journal for the Advancement of Performance Information and Value (JAPIV) as a reader, subscriber, reviewer, sponsor, or author.

Warm regards,



Dean T. Kashiwagi



Kenneth T. Sullivan



Kristen C. Barlish

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Organizational Implementation of Best Value Project Delivery: Impact of Value-Based Procurement, Preplanning, and Risk Management

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Many buyer organizations have attempted to implement new project delivery methods to increase performance on their contracting processes. Yet implementing new business practices can be difficult to accomplish successfully. An action research methodology was utilized to present a longitudinal case study of the University of Alberta's implementation of the Best Value Business Model (BVBM). A key research objective was to document and present observations of the change management principles utilized during the implementation of organizational change at a large public organization. Other research objectives included quantification of project-level and organizational-level success indicators that reflect the progress of change implementation. Results are analyzed after more than two years of implementation of the BVBM on ten separate contracts. Direct cost savings on these projects as a result of the BVBM has been documented to be as much as \$16 million when considering savings below budget and conducting comparisons against traditional project delivery methodologies. Other success factors include low rates of vendor and contractor change orders and high satisfaction among owner project managers with regards to the performance of contracted service providers. Contributions of this research include documentation how theoretical change management principles have been applied within an action research setting as well as the identification and documentation of success indicators for project- and organizational-level implementation of new project delivery methods.

Keywords: best value, change management, preplanning, project delivery, risk management.

Introduction

Many large organizations, both public and private, rely upon frequent purchases of external services, whether in the architecture, construction, and engineering industries or in other general service areas. Yet as market conditions and growing competition continue to become more disruptive, buyer organizations have become increasingly interested in implementing advanced project delivery processes (Hallencreutz & Turner 2011). Within the context of this paper, the term "buyer organizations" refers to public organizations – such as city and state governments as well as public institutions that deliver higher education – that purchase some type of services, whether in the areas of design, architecture, construction, facilities, or business services. Buyer organizations are looking to improve performance in a variety of ways, typically by introducing new procurement methods, contract planning techniques, and risk management and performance measurement systems (Santema 2011). However, successful implementation of new business processes can be difficult for organizations to accomplish and literature sources suggest that more than half of all efforts to implement new business processes ultimately fail to accomplish

their original intended goal (Balogun & Hope Haley 2004; Maurer 1996; Pascale *et al.* 1997). This high rate of failure is a function of the fact that implementing new business practices within an organizational setting can be complex and presents a variety of challenges (Judson 1991). In light of this fact, successful change management practices are rapidly becoming a required project management skill (Todnem, 2005).

Implementing new project delivery processes into buyer organizations is a project-driven process and presents a key challenge. Organizations that attempt to implement new business processes must balance the dichotomy between the company-wide implementation effort and the specific application of the new process on individual projects. This becomes a challenge in a project-driven environment because each project group is responsible to independently apply the new process while dealing with their own unique set of project-specific objectives, constraints, and needs (Pheng and Teo 2004). In this environment, the implementation effort becomes split between strategic and tactical viewpoints. The organization level, program-wide viewpoint is more strategic, a long-term effort which typically aims to implement a business process as the organization's "new way of doing business," or at very least as a permanent tool within the organization's skill set. On the other hand, the project-level viewpoint is more tactical in that the separate project groups must implement the process within their day-to-day operations while also remaining conscious of the specific objectives and shorter time span of their individual project.

One method that buyer organizations are turning to in order to improve their procurement, pre-planning, and contract delivery processes is the Best Value Business Model (BVBM), which is a holistic project delivery methodology (Kashiwagi *et al.* 2012b, Sullivan *et al.* 2010; van Leeuwen 2011, Watanabe *et al.* 2012). Implementation of BVBM within owner organizations typically occurs on two levels – multiple individual projects and the overall organizational adoption effort – and both must be implemented successfully for the BVBM to be sustained long-term (Sullivan *et al.* 2011). In response to this problem, the researchers reviewed the existing literature regarding process models of organizational change, which suggest certain actions that can be taken to increase the probability of successful organizational adoption of new business practices. The research then presents a longitudinal case study of BVBM implementation at a large public organization, the University of Alberta, over a two year period. An action research approach was utilized to gather and document the process of organizational implementation of BVBM within the University of Alberta and relate observations regarding how the implementation effort was structured in alignment with literature theories. In order to address both the project- and organizational-levels of organizational change implementation, success indicators at both levels were identified to assist in quantifying the impacts of BVBM implementation. Data for these success indicators was collected via the action research process from the researchers' observation of project meetings and electronic communication as well as project archival documentation. This data contributes quantifiable metrics that can be measured by buyer organizations that are implementing new project delivery methods such as the Best Value Business Model.

Research Objective

The objectives of this research were threefold:

1. Present the process model of organizational change utilized by a large public Buyer Organization to implement a new project delivery method (the BVBM). The researchers document their observations of the process model implementation based upon their participation from an action research perspective. These observations provide application of theoretical organizational change concepts from the literature within the context of a longitudinal case study.
2. Quantify project-level success indicators resulting from implementation of the BVBM as a part of the overall organizational change effort.
3. Quantify organizational-level success indicators that reflect organizational implementation progress in adopting BVBM as a new project delivery method.

Literature: Process Models of Organizational Change

In order to promote successful implementation and long-term sustainability of project delivery processes, such as BVBM, it is important to first have an understanding of existing research in the area of organizational change implementation. In response to this, five process models of organizational change were reviewed to develop an understanding of the recommended change management principles that increase the probability of successful implementation. Process models of organizational change include specific change management principles that can be followed by organizations to increase their probability of successful implementation (Kinicki & Kreitner 2006). The importance of process models of organizational change was supported by Holt *et al.*'s (2003) comment that the extent to which organizations are able to achieve the benefits of new business practices is directly affected by the influence strategies used by organizational leaders to implement the change. The process models included in this paper were selected due to their prominence and comprehensive nature to gain a broader perspective into the existing knowledge within the field of organizational change research. The reviewed models included: Beer, Eisentat, and Spector 1990, Kanter *et al.* 1992, Kotter 1995, Armenakis *et al.* 1999, and Luecke 2003. Although these process models originated in the 1990's and early 2000's, these process models are still relevant to current research and are widely cited in the literature today (Kinicki and Kreitner 2006). Ates and Bititchi (2011) noted that organizations today still place heavy emphasis on implementation, although unfortunately the planning and preparation phases are sometimes less emphasized, which can lead to less success.

The key change management principles contained each within model were tabulated to develop an understanding of important practices and strategies to increase the success of organizational change efforts. Twelve leading change management principles were identified within the reviewed models and the frequency with which each change management principle appeared in the literature models was noted (see Table 1). Each of the change management principles is summarized in the following section.

Table 1

Change management principles identified in the literature

Change Management Principle	Beer, Eisenstat, Spector 1990	Kanter et al. 1992	Kotter 1995	Armenakis et al. 1999	Luecke 2003	Frequency of Citation
Create Motivation for Change	X	X	X		X	80%
Analyze Problems & Needs	X	X		X	X	80%
Identify Solutions & Vision	X	X	X	X	X	100%
Establish Core Team Leadership	X	X	X		X	80%
Secure Executive Support	X	X	X			60%
Strategic and Tactical Planning		X				20%
Educate the Change Message	X	X	X	X	X	100%
Overcome Resistance	X		X	X		60%
Implement on Test Basis		X		X	X	60%
Expand to Intended Scale	X		X	X	X	80%
Transition to Institutionalization	X	X	X	X	X	100%
Long-Term Measurement					X	20%

Create Motivation for Change. Change efforts require coordinated efforts by a multitude of people, and these people are more likely to be engaged when there is a sense of urgency to motivate them (Kotter, 1995). Luecke (2003) suggests a good rule of thumb is that the goals of the change cannot be achieved unless 75 percent of managers believe they must change from the status quo.

Analyze Problems and Needs. A broad review of the business is undertaken to come to a “joint diagnosis” of the roots of the current problems (Beer *et al.*, 1990). Kotter (1995) observed that successful changes generally start with frank discussions about unpleasant facts where multiple parties are engaged.

Identify Solutions and Vision. The vision is a “picture of a destination aspired to, an end state to be achieved via the change” (Kanter *et al.*, 1992). The vision is not necessarily a fully developed strategy, but is intended as the general purpose or goal for the movement; oftentimes, the details are worked out during implementation. Nanus (2003) stated that the vision for change must convey “a realistic, credible, attractive future for your organization.”

Establish Core Team Leadership. A visible leadership or Core Team must act as the leading change agents to implement the change. It is critical that these personnel have the operating know-how to accomplish the goals (Luecke, 2003). Armenakis *et al.* (1999) stated that the most important trait of Core Team leadership is credibility in the eyes of other organizational members.

Secure Executive Support. Executives often control resources needed by the Core Team implementers and their backing is crucial (Kanter *et al.*, 1992). Executive also supporters also wield the clout to further legitimize the change.

Strategic and Tactical Planning. The strategy is important to clarify high level goals, identify who is involved, and define roles and responsibilities of participants (Kanter *et al.* 1992). Tactical planning of specific projects or areas to change is important not only to help foster learning, but also to create short-term wins to maintain momentum and bring recognition (Kotter, 1995)

Educate the Change Message. The change message is critical to helping implementation and should answer five key questions: (1) Is the change really necessary? (2) Is the specific change being introduced appropriate? (3) Can I/we successfully implement the change? (4) Is there high level, long term support for the change? (5) What's in it for the change recipients? (Armenakis *et al.*, 1999).

Overcome Resistance. Resistance often crops up as employees feel shock, fear of the unknown, mistrust, fear of failure, loss of power, lack of perceived rewards (Armenakis *et al.*, 1990; Luecke, 2003). Education and communication to address these issues is an important responsibility of the Core Team change agents.

Implement on Test Basis. Starting change on the periphery enables flexibility, experimentation, and improvement before impacting the whole organization (Luecke, 2003). Individual units or projects essentially become “developmental laboratories” for the change (Beer *et al.*, 1990).

Expand to Intended Scale. Building on initial implementation and short-term wins aids the diffusion process. Beer *et al.* (1990) recommend letting each department or expansion area “reinvent the wheel” to find the most optimal way to integrate the change into their environment.

Transition to Institutionalization. Institutionalization is the condition where the change becomes “the way we do things around here” (Armenakis *et al.*, 1999). The transition begins when the change has become more entrenched, the right people are in place, and the new team work setup is functioning (Beer *et al.*, 1990).

Long-Term Measurement. Kanter *et al.* (1992) stress the importance of sustaining the change by continuously providing feedback mechanisms to show organizational performance in terms of results metrics (showing we have “done it”) and process metrics (showing we are doing the right things to accomplish “it”).

Research Background

The research background is divided into two sections. The first section provides greater background detail concerning the characteristics of the Best Value Business Model, representative organizations that have implemented BVBM, and key organizational change that BVBM implementation necessitates. The second section provides a brief background on the University of Alberta and its goals for BVBM implementation.

Best Value Business Model (BVBM)

The Best Value Business Model is not a new process; rather, it has been tested on more than 900 individual procurements of construction and design services with a total value of more than \$2.7 billion (Kashiwagi *et al.* 2012a). The BVBM has been implemented by more than 80 organizations, generally representing large buyers of construction services in the public and private sectors, including the U.S. Army Medical Command, Arizona State University, State of Oklahoma, University of Alberta, State of Idaho, University of Minnesota, General Dynamics, Harvard University, and Rochester Public Schools (Sullivan 2011).

The Best Value Business Model includes a three-phased project delivery model, which is described below.

1. Selection Phase

The selection phase consists of a value-based evaluation process to procure a contract for the delivery of any type of good or service. Components of the value-based procurement include (Bos 2012, Van de Rijt and Santema 2012):

- Past Performance Information on key firms and individuals.
- Risk-based submittals that ask Proponent to identify, prioritize, and minimize risks they see in the service delivery.
- Value Added submittal wherein Proponents may propose alternatives to the prescribed scope of services.
- Interviews with the operations personnel who will deliver the good or service.

2. Pre-Award Clarification Period

Prior to awarding the contract, the highest rated Proponent from the Selection Phase participates in a brief, yet rigorous, pre-planning and risk management process. The highly flexible and unique approach includes traditional pre-planning activities augmented with a specific focus on risk, client concerns, alignment of expectations, and the selected Proponent's service delivery plan.

3. Performance Measurement

The third stage incorporates a performance measurement system for the duration of the contract terms. The selected Proponent tracks risks or other impacts that are encountered for the duration of the service delivery. Performance measurement data can be collected from individual contracts and combined into a single, program-level report.

When implementing the Best Value Business Model, organizations undergo several key changes in their procurement and project management processes: (1) a value component is added to the traditional procurement process wherein proposing AEC firms are asked to submit risks they identify to delivering a successful project and provide their proactive risk mitigation solutions; (2) a formal, risk-based pre-planning process is conducted with the highest-rated proposer in

order to clarify the plan for project delivery prior to entering into a contract; and (3) a performance measurement system is utilized to track risk against the original contract plan for the duration of project management and delivery.

Introduction of BVBM at the University of Alberta

The University of Alberta is located in Edmonton, Alberta and is the largest postsecondary institution in the province, as well as one of the largest in all of Canada. UA has a student enrollment of approximately 37,000 full time students and part time students with an academic support staff of approximately 11,700. The budget for UA is \$1.7 billion and has a \$500 million procurement spend, making it a large public organization that commands a large amount of buying power. The services that UA procures are wide ranging, from design and construction of capital projects in the range of \$150 thousand to more than \$150 million, along with many general services.

Methodology

The researchers utilized an action research approach to examine the project- and organization-level implementation of the Best Value Business Model at the University of Alberta for a period of more than two years. Action research is a methodology that provides the researcher with the opportunity to observe changes as they occur in “real time” (Coughlan and Coughlan), which provides researchers with a more holistic perspective regarding how change occurs within the organizational context (Gummesson 2000). There are three main benefits of action research conducted in this manner (Powell Jr. 2002). First, the research is based on actual conditions and not just preconceived or theoretical models. Due to this approach, the research presented in this paper contributes to organizational change literature by providing “real time” observations and success indicators of project delivery implementation in a large public organization. Second, action research enables high levels of collaboration between researchers and the participating members of the organization, which grants researchers greater access to critical information such as archival documentation, implementation issues, and project performance. Third, action research provides the adequate research flexibility to observe, analyze, and evaluate the constantly evolving aspects of organizational change endeavors. The action research team was composed of multiple investigators who, in accordance with research methodologies of Eisenhardt (1989), practiced an overlapping data collection and analysis process while in the field. Following the recommended practices of Ravenswood (2011), data collection was conducted using multiple methods including project archival documentation, contract performance data, and direct observations of project meetings as well as organizational-level strategic planning sessions.

Project-Level Implementation

Successful implementation of the BVBM on the project level was documented via multiple forms of performance data for each individual contract. The project performance data collected for project level implementation is summarized in Table 2 and described in detail below. The Contract Value for each project was recorded as the awarded contract

cost in millions of dollars. The Contract Duration was also documented as the number of months from the Notice to Proceed to substantial completion and project close out. Budget Savings were defined as the amount of dollars (in millions) that the Client organization saved on the selected vendor proposal price in reference to their budget. The percentage below budget was also calculated. Project Cost Savings were also tracked for as the total dollar value (in millions) that the Client organization estimated were saved via the risk minimization aspects of BVBM implementation when compared against their traditional project delivery methodologies. Project schedule savings were documented as the actual project duration (reported as number of months) compared against the original client-estimated schedule. Value Added was measured as the dollar value of vendor-generated contract alternates that were accepted by the client organization. Finally, Client satisfaction was measured on a 1 to 10 Likert-like scale by the Client project manager assigned to each project. The lead project manager for each contract provided satisfaction ratings specifically relating to the project delivery process used to select, contract with, and manage external vendor teams.

The data was gathered via direct research observation and participation in project meetings, including planning sessions and risk management meetings that occurred on a weekly basis for the duration of each contract. Project archival documentation included copies of the Request for Proposal, bid packages with risk and value proposals, scope documents, key performance indicators, service level agreements, change orders, and project email communications.

Table 2

Summary of collected data for project level implementation

Project Performance Data	Metric
Contract Value	\$ millions
Contract Duration	months
Budget Savings	\$ millions (percentage)
Project Cost Savings	\$ millions (percentage)
Project Schedule Savings	months (percentage)
Value Added	\$ hundred thousands
Client Satisfaction	1-10 Rating

Organization-Level Implementation

In addition to the project-level data, the researchers also emphasized the observation and analysis of success indicators to show more holistic progress of implementation on organizational level. Table 3 provides a summarized view of the data collected for organization-level implementation of the BVBM, which mainly consists of aggregated project data, project characteristics, and overall contract performance. For example, the number of BVBM implementations was tracked alongside the total dollar value of all associated contracts to identify the scale of organizational implementation. The number of unique project types was also tracked to show the flexibility of BVBM application to accommodate various scope packages. Unique project types were defined as the distinct industries or highly variable project sizes and objectives within a certain industry. As an

illustration of this classification, a large-scale new capital construction project was counted as a unique service when compared against smaller renovation projects that were limited to single laboratory or classroom spaces.

Table 3

Summary of collected data for organization level implementation

Project Performance Data	Metric
Number of Project Implementations	#
Total Contract Value of Projects	\$ millions
Unique Project Implementations	#
Percentage of Projects where Highest Rated Proponent was Lowest Cost	%
Total Cost Savings of BVBM Program	\$ millions
Overall Client Satisfaction	1-10 Rating
Vendor Change Order Rate	%
Vendor Schedule Delay Rate	%

The percentage of projects where the highest rated proposing Vendor during the Selection process was also the lowest proposal price were documented as an overall organizational metric. The researchers observed that buyer organizations may be hesitant to implement value-based procurement methodologies because of the perception that proposal prices will increase. In this metric, the highest rated Proponent was defined as the vendor team that received the highest rating from the Client’s evaluation committee. The researchers then tracked how frequently this occurred on across the entire organizational implementation of BVBM at the University of Alberta. Total Cost Savings were measured as the total value of contract award in comparison to budgeted dollars in addition to internal cost comparisons showing project execution savings compared against traditional process performance. Overall client satisfaction with the BVBM in terms of project delivery performance was measured as the average satisfaction ratings provided by all project managers on each BVBM project implementation. This rating thus represented the overall organizational satisfaction with project delivery performance under the BVBM. Organizational rates for change orders and schedule delays were aggregated for all BVBM project implementations. A modification of Wang and Gibson’s (2010) methodology was used to track change order and schedule delay rates, such that change orders were defined as $[(\text{final cost} - \text{award cost}) / \text{award cost}]$ and schedule delays were defined as $[(\text{final duration} - \text{award duration}) / \text{award duration}]$.

Results of the Process Model for Organizational Implementation

Organizational implementation of BVBM at the University of Alberta was conducted in accordance with the change management principles included in the process models from the existing literature. The researchers participated in the implementation process from an action research perspective and recorded their observations of the “real time” implementation effort in relation to the theoretical change management principles that were recommended in the literature. The observed actions and results from BVBM implementation at the University of Alberta are described in the following section according to each process step recommended in the literature.

Create Motivation for Change, Analyze Problems and Solutions

The University of Alberta was first introduced to the BVBM approximately five years prior to their decision to proceed with implementation. UA's first introduction to BVBM came when their Vice President (VP) of Finance and Administration and the VP of Facilities and Operations attended a presentation by Dr. Dean Kashiwagi. UA was motivated to consider BVBM implementation in order to adopt value-based procurement processes to increase the quality of outsourced service providers UA selected and to incorporate pre-planning and risk management practices to save costs, increase efficiency, and reduce change orders. After their initial introduction, UA conducted an extended internal review to analyze challenges and opportunities within their environment. Over the next few years, UA sought increased exposure to BVBM concepts by attending additional presentations. UA then waited for the right time to pursue initiation in a more direct manner.

Secure Executive Support

Since it was the VP of Finance and Administration and the VP of Facilities and Operations who were first motivated to enact the change, executive support for BVBM implementation was in place even before implementation efforts ever began. Once the decision was made to move forward with implementation, the VPs functioned as executive sponsors to the core team who would be responsible to drive the day-to-day implementation effort on both the tactical and strategic level. The UA core team was responsible to report to the executive sponsors on a regular basis to present BVBM implementation progress, future strategic direction, and identify any organizational barriers that may exist.

Establish Core Team Leadership

Once UA partnered with PBSRG, they quickly established a core team to plan and lead the actual implementation effort. The key leaders of the core team included the Director of Supply Management Services (SMS) and the Executive Director of Facilities (F&O) and Operations, who effectively formed an implementation partnership between their two departments. This was a natural partnership because SMS housed the contracting officers responsible for university procurement while F&O was one of the largest end users for which SMS procured these goods and services. F&O personnel included UA project management personnel responsible for delivering many of the contracts procured by SMS.

Strategic and Tactical Planning

UA's strategic vision for BVBM implementation was to improve organizational effectiveness via four objectives:

1. Become a measured organization that can demonstrate value on contracts.

2. Increase preplanning and risk management techniques on contracts.
3. Procure and contract with high performing vendors.
4. Add value-based selection methodologies to UA's procurement skill set.

In order to accomplish this strategic vision, a tactical plan was established to implement BVBM on a project by project basis. In this manner, project-level personnel would have the ability to participate directly in the implementation process and gain hands on experience in accomplishing day-to-day procurement and contract management tasks according to BVBM. Pilot project were identified and it was determined that different project personnel should actively participate in the delivery of each pilot. There would be some overlap of personnel between projects to increase their educational exposure to the new techniques.

Educate the Change Message & Overcome Resistance

The vision for strategic and tactical implementation of BVBM was communicated with UA organizational members via education touch points, planning meetings, and bi-weekly project planning meetings. These trainings were intended to reduce tactical concerns of UA project-level employees and increase their understanding of how BVBM would be executed on a project-by-project basis. Ongoing training and support was also provided to them by the PBSRG during project delivery.

Preliminary educational outreaches and pre-proposal meetings were conducted with external stakeholders to introduce UA's intent in adopting the BVBM on their upcoming procurements. The intent behind these outreaches was twofold: first, to reduce natural reactions of confusion and resistance that would inevitably be encountered when UA first began pilot testing the new process and second, to help create a common level of understanding about the new business approach, address questions and concerns, and orient external industry with respect to how to be successful in this new environment.

Implement on a Test Basis

Initial pilot projects were planned to function as "hands on" learning experiences for the core team and additional UA project-level personnel, including contracting officers and project managers. Tactical planning identified pilot projects that could implement the BVBM on a test basis, with the strategic benefit that each of the three pilot tests was planned to be within a different industry or type of service. The core team would be directly involved in the delivery of the first pilot project so they could gain familiarity with the techniques within the BVBM. Bi-weekly training sessions were held with PBSRG to ensure the core team had the necessary knowledge to successfully implement BVBM on the pilot project. Separate personnel were later chosen to deliver the subsequent pilot projects so UA could begin internal expansion of BVBM exposure.

Expand to Intended Scale

Expansion of BVBM implementation to a full organizational program commenced after 1.5 years of mainly focusing on pilot project efforts and increasing organizational

readiness. After 1.5 years, the expansion program was launched with an additional seven projects in addition to the original three pilot projects. When the expansion projects were launched, UA also began expanding their pool of participating project-level personnel in order to continue building a contingent of supporters with direct implementation experience.

Transition to Institutionalization and Implement Long-Term Measurement

The transition to institutionalization will continue to develop UA's self-sufficiency with implementation by maintaining project-level application of BVBM on new contract releases. The development of organizational-level measurements has begun in order to track real-time performance of the overall BVBM program. This measurement is intended to drive accountability that will sustain BVBM in the long-term, identify areas of weakness that can be augmented, and continuously quantify the benefits of BVBM implementation.

Project Implementation Results

Results of BVBM implementation at the University of Alberta are separated into three sections. First, project-level results of the three pilot projects are examined. Second, highlights and results of BVBM expansion phase are discussed to show the magnitude of the current BVBM program at the UA. Finally, overall successes on the organizational level are quantified to reveal the total impact experienced over the first two years and four months of BVBM implementation.

Pilot Projects

UA implemented three pilot projects as the initial testing grounds for BVBM implementation. The first pilot project was to procure custodial services for an initial three year term with options for three additional extension terms of three years, two years, and two years (a maximum of ten years). The value-based selection process resulted in clear differentiation among the bidding contractors: the selected firm was the lowest submittal price and also had the highest overall evaluation rating in the other selection categories of past performance information, risk submittals, value added submittals, and interviews (as described in the Research Background section). The submittal price resulted in a direct budget savings of \$0.5 million per year, and UA gained another indirect savings of approximately \$180 thousand per year in value added options that were exercised. The value added options leveraged the contractor's expertise in providing quality control services that enabled the internal reassignment of three internal full time employees at UA. After more than 1.5 years of service delivery, performance measurements have shown that the contractor is working at an equal or higher standard than established on campus. At the first year annual performance review, the contractor's performance was shown to be 5.5 percent higher than previous service levels that were shown to be satisfactory on campus. This information was documented by comparing the average performance level of custodial services on campus for the previous five years before the contract was awarded and then comparing against the

documented performance over the first year. The observed 5.5 percent performance increase has been viewed by the owner as a metric of improved contract value.

The second pilot project was for design-build delivery of a high tech research facility on campus. The project scope consisted of the repurpose of a cold storage facility to a specialized academic teaching, research, and production facility for radiopharmaceuticals utilized in cancer treatment research. This was a technically challenging and highly complex facility that included a 24MeV cyclotron particle accelerator. The value-based selection process resulted in the selection of a highly qualified, expert design-build team. During the pre-contract planning period, the design-build team identified multiple risks that were unknown and would have had a significant negative impact if not discovered until mobilization and construction. After extending the pre-contract planning period by nearly two weeks, the design-build team was able to present UA with solution strategies that minimized the cost and schedule impacts of the unforeseen risks. The solution strategies included an improved layout of mechanical equipment interstitial space and a foundation design that better met structural requirements while simultaneously achieving schedule acceleration. UA analysis showed that if the project were awarded and conducted according to traditional delivery methods, it would be estimated at a cost of \$44-48 million and a scheduled duration of 48 months. Substantial completion was reached in December 2012 with final project closeout planned in late spring of 2013, which placed the total project cost (after unforeseen risk impacts) at \$32 million and the delivery duration of 18 months.

A third industry was selected to participate in UA’s third pilot project: the design and engineering consultant community. This third project was for the design and redevelopment of an iconic building on campus. After a phased selection process, expert consultants were separately selected to provide consulting services in the three areas of (1) architectural, structural, and building envelop services, (2) mechanical engineering, and (3) electrical engineering. The selection was made below budget and \$190 thousand in additional value added services were accepted, which provided UA with enhanced three-dimensional modeling, weather mapping, and augmented reality components. The design process has completed design development. To date, the design team has delivered phase reports for conceptual design and schematic design on time and at a level of quality that has been highly satisfactory.

Table 4

Pilot project results

#	Project	Contract Value	Cost Savings	Schedule Impacts	Satisfaction/Performance
1	Custodial Services (Campus-Wide)	\$18M (3 year term)	\$1.5M (10%)	5.5% service improvement	10 (out of 10) Satisfaction
2	DB Construction (High-Tech Research Facility)	\$32M	\$14M (30%)	30 mo. reduction (63%)	9.7 (out of 10) satisfaction
3	Design Services (Iconic Building Redevelopment)	\$4M	\$500K (12%)	0% designer cost & schedule increases	\$190k in Value Added options

The results of these three pilot projects are summarized in Table 4. UA has quantified a direct total savings of more than \$16 million under budgeted levels and compared against traditional delivery processes. Across the three industries where BVBM was implemented – general services, construction, and design – results have shown a significant increase in service levels, drastic reduction in schedule time compared against traditional delivery methods, and a reduction in vendor-generated change orders.

Organizational Implementation Results

Results of the pilot and expansion projects can also be combined to examine the impact that BVBM implementation has had on UA’s organizational level over the past few years. Table 5 provides a summary of the organizational implementation of BVBM at the University of Alberta. Key success indicators include the total contract value and number of projects implemented according to BVBM techniques as well as the versatility of BVBM to add value in the delivery of six unique service types: custodial, construction, design, travel management, consulting, and large scale product supply. Internal program analysis conducted by UA has estimated the direct cost savings on BVBM projects to be at least \$16 million. Low vendor/contractor-generated change order and delay rates have been documented on BVBM projects. The lead UA project manager responsible for delivering each of these projects have rated their satisfaction with the performance and risk management capabilities of best value proponents as an average 9.8 out of 10. Another indicator of BVBM success is the fact that 50 percent of the selected vendors were also the lowest cost Proponent during the evaluation process. This is an important success metrics because it shows that value-based procurement practices do not necessarily function to increase prices; instead, half the time it has been observed that the highest performing Proponent is also the lowest cost. It may also be worth noting that of the four contracts where the highest performing Proponent was not the lowest cost, three were actually the second lowest cost option.

Table 5

Organizational impact of BVBM implementation

Project	Industry
Total Best Value Projects	10
Estimated Value of Best Value Projects	\$150+
Number of Unique Services	6
Percentage where Best Value Selection was also Lowest Cost	50%
Total Cost Savings (measured internally by UA)	\$16M
Average Client Satisfaction with Vendor Performance	9.8 (out of 10)
Vendor / Contractor Change Order Rate	1.2%
Vendor / Contractor Schedule Delay Rate	3.7%

Other organizational factors of success that have been accomplished include:

- Consistent identification and selection of high performing vendors. The positive results of the organizational-level success indicators appear to show that the BVBM has achieved the strategic objective of consistently awarding contracts to high performing external vendors, contractors, designers, and consultants.
- Each of the ten projects has utilized, or is planned to utilize, a formal pre-contract planning period and structured performance measurement system.
- UA has conducted multiple debriefs on BVBM implementation with their core group and internal staff to communicate successes and lessons learned in order to foster greater organizational knowledge in BVBM application.
- Debrief sessions with selected external vendors and consultants have also occurred to solicit feedback from industry participants in BVBM implementation at UA.
- UA core group members have organized and conducted multiple presentations on their BVBM efforts to other public buyer organizations, including various governmental agencies and numerous professional associations consisting of Canadian purchasing officers, university business officers, financial officers, resource planners, and supply managers.
- Increased ability to leverage industry expertise via Value Added options provided with the submittals on all ten BVBM projects as well as the first use of Vendor-Generated Solution submittals on the Travel Management Services contract.

The training requirements and general delivery efforts for the first three pilot projects consumed most of the organizational bandwidth for BVBM implementation over the first 1.5 years. Yet in summer of 2012, UA began to expand its implementation efforts into a full BVBM program by launching multiple projects in rapid succession. In the last eight months, UA has launched an additional seven contracts under the project delivery characteristics of the BVBM, more than tripling the size of the overall UA BVBM program. The seven contracts within this expansion phase include a wide array of industries, including three design and engineering services contracts, a construction management program with two preferred suppliers, travel management services, eProcurement consulting services, and the campus-wide supply and delivery of cleaning products small equipment. A summary-level view of these projects is provided in Table 6, along with their contract value and current status.

Table 6

Expansion program

#	Project	Industry	Contract Value	Status
4	Construction Management Program	Construction	\$8M	Awarded
5	Redevelopment of Universiade Pavillion	Design	\$7M	Awarded
6	Fire Alarm Upgrades	Design	\$5M	Awarded
7	Travel Management Services	Services	\$2M	Awarded
8	Founders Hall Redevelopment	Design	\$5M	Awarded
9	Consulting Services for eProcurement	Services	\$100K	In Procurement
10	Cleaning Products	Services	\$48M	In Procurement

The expansion of the BVBM program at UA has seen the addition of seven projects with a total contract value of at least \$65 million. Project highlights include a construction management (CM) program that has identified a preferred supplier list consisting of two suppliers of construction management services. This program will accommodate small construction, renovation, and maintenance projects on campus including classroom renovations, laboratory development, and office space upgrades up to a maximum \$2.5 million value per project. The CM program has been established to provide UA with a rapid contracting and project delivery structure to accommodate quick turnaround on these smaller projects. Since this program will include multiple projects, two separate construction manager firms, and multiple UA project managers, it is planned to be a leading candidate to establish its own program-level performance measurement system to track cost and schedule growth as well as closeout ratings on CM performance for each job (which in turn impacts competitiveness on future projects released under the program).

Conclusion

The research objective was to: (1) present observations of the process model of organizational change used to implement the Best Value Business Model at the University of Alberta, (2) quantify project-level success indicators of BVBM implementation, and (3) quantify organization-level success indicators of BVBM implementation. An action research approach was used to observe, document, and analyze the implementation process at UA in relation to the change management principles recommended by the literature. The researchers acted as direct participants in the implementation effort to provide training support to UA's core team leadership and project-level personnel.

After more than two years of implementation, the documented success indicators have shown that BVBM implementation at UA has had a positive impact on both project and organization performance. To date, BVBM has been implemented on ten separate projects in six unique service sectors, including custodial, construction, design, travel management, information technology consulting, and large scale product supply. The direct cost savings on these projects has been documented to be as high as \$16 million when considering savings below budgets and conducting comparisons against traditional project delivery methodologies. Other success factors include low rates of vendor and contractor change orders and high satisfaction among UA project managers with regards to the performance of contracted service providers.

As the third year of implementation unfolds, UA objectives consist of fostering greater self-sufficiency with pre-contract planning enforcement, creation and establishment of program-wide measurement tools, and increased training for evaluation committees. UA plans to continue its rate of project-level application of BVBM techniques, including the integration of BVBM pre-contract planning and performance measurement techniques on non-value-based procurement contracts. Additional objectives include hosting internal review sessions to provide a forum to gain feedback from external vendors who

participated in BVBM project and also to promote formal discussion of lessons learned amongst UA personnel.

Contributions of this research include documentation how theoretical change management principles have been applied within an action research setting. This contributed to the literature by demonstrating that implementation of new project delivery processes can follow the theoretical constructions presented in the literature to achieve success on both the project and organizational levels. Additional contributions include identification and documentation of success indicators on the project level and for organization-wide implementation of new project delivery methods.

The researchers have additional objectives for future research to continue refining the process model for organizational change management. To support these objectives, the researchers recommend further development of training resources and strategies, followed by application and analysis in action research settings across a multi-organization data sample.

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Post Construction Quality Evaluation – A Manufacturer’s Use of the End User to Minimize Risk

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A roofing manufacturer is motivated to increase accountability, minimize risk and differentiate themselves from other manufacturers to increase their sales. In order to achieve this, the manufacturer approached the research group to implement a warranty program that measures the performance information of their systems and applicators. The manufacturer submits a list of warranted jobs to the researchers, researchers perform a satisfaction check by calling the end users and report back to the manufacturer. Concepts utilized by the manufacturer include the use of warranty to ensure performance decreases risk, transparency is the best way to mitigate risk and risk can be mitigated before it happens. The research revealed that warranty program minimizes the risk for manufacturer and clients and helps differentiates the manufacturer by identifying end users that are not satisfied, applicators that are low performing, jobs that are leaking, customer retention rate and having a running log of satisfaction rating for every warranted job.

Keywords: end user, manufacturer, performance information, risk, warranty

Introduction

The last couple of decades have revealed a poor documentation of performance information in the construction industry (Cahill and Puybaraud, 1994; CFMA, 2006; Davis et. al., 2009, Egan, 1998, Flores & Chase, 2005). Due to poor documentation of performance, roofing manufacturers and contractors are unable to differentiate themselves from other competitors and are enticing buyers to purchase their services based on low price and long term warranty durations. The manufacturers and contractors that provide high quality materials have a tough time competing in this price-based market riddled with false promises through the use of warranties (Kashiwagi, 2012). The warranty does not protect the buyer since it is an offer of protection provided by the manufacturer to the buyer (Agrawal *et. al.* 1996). The warranty is written by a roofing manufacturer and its legal representatives that contain certain exclusions, if encountered, will void the warranty (Christozov *et al.*, 2009). Hence, the long term warranties have no proven correlation with the performance and the life cycle of a roofing product (Kashiwagi, 2011).

The subject manufacturer realized that in order to survive in the competitive market saturated with low price and false promises, they need to differentiate themselves from other manufacturers in a dominant way that will minimize the risk of the manufacturer and the client creating a “win-win” environment. The subject manufacturer approached the researchers in March 2011 to solve this issue. The, researchers proposed a Post Occupancy Evaluation (POE) method that tracks the satisfaction rating of the buyers through the use of performance information of all the warranties issued by the manufacturer known as client satisfaction warranty program. The Post Occupancy Evaluation (POE) method, where a finished product is

evaluated to measure the quality for continuous improvement on future products, is currently being implemented in the industry (Wicks and Roethlein, 2009). Buyer satisfaction questionnaires have been distributed after each project to impact future projects positively through corrective behavior modifications (Forbes 2002; Gajjar et. al. 2012).

Methodology

The manufacturer initiates the client satisfaction warranty program by sending a list of all the warranted jobs to the researchers as illustrated in Fig. 1. After receiving the list of jobs, researchers contact the end users for satisfaction ratings and direct feedback regarding the job. The researchers report back the information to the manufacturer with satisfaction ratings, problems and issues identified by the buyer that is compiled into a performance information matrix.

The questionnaires for the warranty process were developed jointly by the researchers and manufacturer. The subject manufacturer showed an immense interest to have the measurement for an end user buyer satisfaction rating for their product, contractors installing the product, their representative present on the job site, leaks on the job site and customer retention rate. The researchers agreed that these are the critical elements for a successful roofing job and this would help the manufacturer to clearly identify the unsatisfied end users and mitigate the problems proactively. Keeping these objectives in focus, the following questions were developed:

1. Satisfaction rating of the roofing system (1 lowest – 10 highest)
2. Would you purchase the manufacturer's product again? (Yes or No)
3. Is the roof currently leaking? (Yes or No)
4. Satisfaction rating of the contractor (1 – 10)
5. Would you hire the contractor again? (Yes or No)
6. Satisfaction rating of the manufacturer's representative (1 – 10)
7. Satisfaction rating of the value relative to the overall roofing project cost (1 – 10)
8. Overall satisfaction rating of the roofing project (1 – 10)
9. Have you used manufacturer's product more than once? (Yes or No)

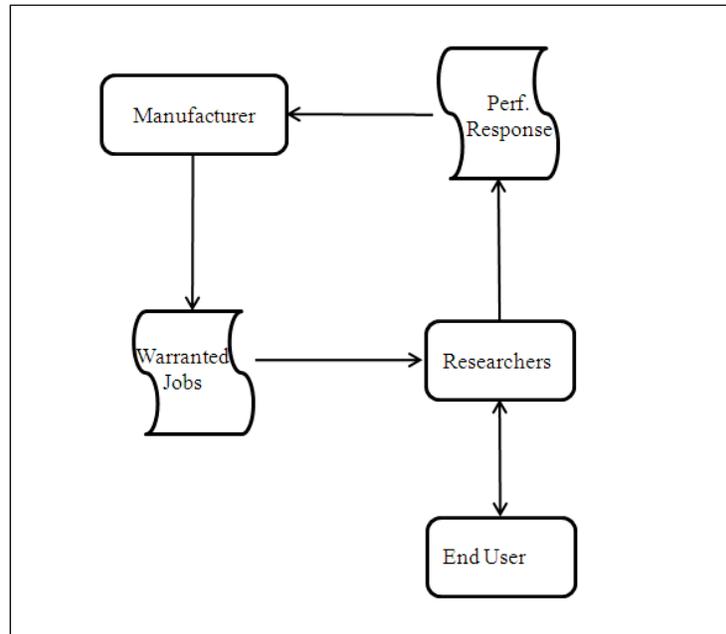


Figure 1: Warranty process

Upon completion of the satisfaction check, the performance response (performance information) is then reported back to the manufacturer. This proactive risk minimization system enables the manufacturer to identify and resolve problems upfront, rather than becoming reactive to them as they materialize in the future.

Pilot Projects

Before advancing any further, researchers recommended the manufacturer to conduct three pilot tests in order to test the ability of the warranty process to accomplish the desired goal of differentiating subject manufacturer from other competitors and minimize the risk:

- Pilot 1 - Warranty process on largest and oldest fifty projects
- Pilot 2 - Warranty process on randomized one hundred and fifty projects
- Pilot 3 - Warranty process on fifty different end user projects

Table 1 shows the performance information of three pilot tests. The data reveals that the overall satisfaction rating of the manufacturer is 9.2 out of 10. The customer satisfaction rating of the roofing system is 9.1 out of 10 and 98% of the customers would purchase the manufacturers product again. There are 99% of the projects with no leaks. However, the customer satisfaction rating of the applicator is below 9.0 indicating it is essential to identify low performing applicators i.e. contractors to minimize manufacturer's and end user's risk.

Table 1

Performance information for pilot tests

No	Criteria	Unit	Overall	Pilot 1	Pilot 2	Pilot 3
1	Overall customer satisfaction	(1-10)	9.2	8.9	9.1	9.4
2	Oldest job surveyed	Years	3	3	2	2
3	Average age of jobs surveyed	Years	1	1	1	1
4	Customer Satisfaction - Roofing System	(1-10)	9.1	8.9	9.1	9.3
5	Percent of customers that would purchase the system again	%	98%	100%	97%	100%
6	Percent of roofs with no current leaks	%	99%	98%	99%	100%
7	Customer Satisfaction – Contractor	(1-10)	8.8	8.7	8.9	8.7
8	Percent of customers that would hire same Contractor again	%	95%	98%	97%	100%
9	Customer Satisfaction – Manufacturers Representative	(1-10)	9.5	9.2	9.6	9.5
10	Customer Satisfaction - Value relative to project cost	(1-10)	8.9	8.7	8.9	8.9
11	Percent of repeat customers (surveyed)	%	N/A	N/A	N/A	77%
12	Total job area (of job surveyed)	SF	4,942,175	3,202,636	1,125,333	614,206
13	Total number of jobs surveyed	#	127	31	76	20
14	Total number of surveys	#	250	50	150	50

Table 2 shows the percentage of end users that can be contacted and the reason if the researchers were unable to contact the end user. The research revealed that only 52% of the end users could be contacted.

Table 2

Survey responses

No	Criteria	Unit	Overall	50 Projects	150 Projects	50 Diff Projects
1	Bad/Missing Information (No contact info, wrong #, etc.)	%	28.4%	34.0%	26.0%	30.0%
2	Refusal to Complete	%	2.0%	2.0%	0.7%	6.0%
3	Jobs cannot be contacted	%	15.4%	2.0%	22.6%	24.0%
4	Surveys Returned	%	51.8%	62.0%	50.6%	40.0%

Since end users play a critical role in the warranty process, it is essential that the response rate of the end users be increased. Manufacturers and the researchers agreed that the warranty process needed a twitch in order to meet its purpose to increase the response rate of the end users.

New Warranty Process

Upon addressing this issue to the manufacturer, it was revealed that the contact information was provided by the regional managers in the field and that they did not realize the importance of accurate contact information in the warranty process. In order to ensure the smooth functioning of the warranty process system it was identified that following is important:

1. Education within the organization

2. Warranted jobs to be submitted monthly to minimize the time between job completion and satisfaction check
3. Send a list of jobs that cannot be contacted to the regional managers and request the accurate contact information

Figure 2 illustrates the updated warranty process. The difference compared to the previous process is that if the end user cannot be contacted, the regional manager is responsible for providing the accurate contact information. After the accurate contact information is received, the end user is contacted again for the performance response.

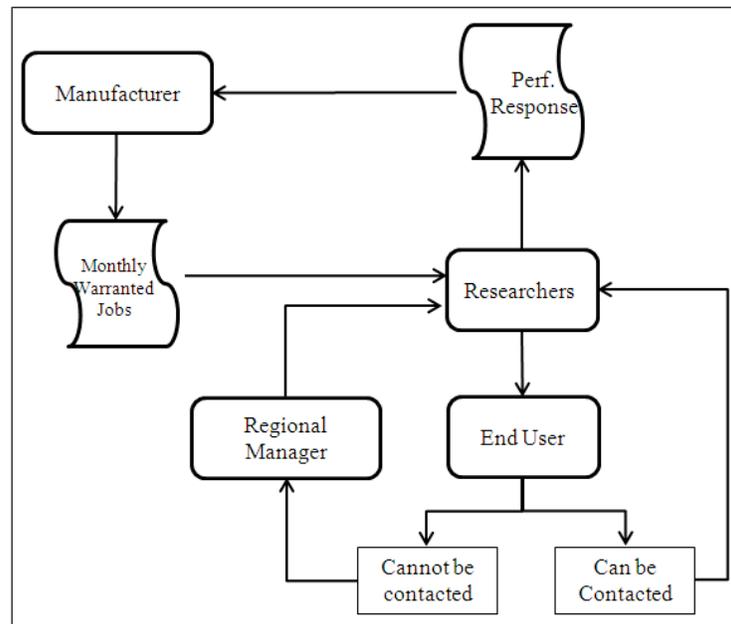


Figure 2: Updated warranty process

The new warranty process is being implemented approximately for one year. Table 3 reveals the overall performance information after the introduction of new warranty process for nine months. The data is consistent with the pilot tests where the applicator has the lowest satisfaction rating (9.0 out of 10). Satisfaction of the roofing system is 9.2 out of 10 and percentage of customers that would use the manufacturer's product again is 98%. The overall customer satisfaction rating is 9.2 out of 10 and it was identified that fifteen of the roofs (3%) are leaking. The customer retention rate and percent of customers that would purchase manufacturers product again was high with 88% and 97% respectively.

Table 3

Overall performance information

No	Criteria	Unit	Overall
1	Overall customer satisfaction	(1-10)	9.2
2	Oldest job surveyed	Years	10
3	Average age of jobs surveyed	Years	0.8
4	Customer Satisfaction - Roofing System	(1-10)	9.2
5	Percent of customers that would purchase the system again	%	98%
6	Percent of roofs with no leaks	%	97%
7	Customer Satisfaction - Applicators	(1-10)	9.0
8	Purchase of customers that would hire same Applicator again	%	96%
9	Customer Satisfaction - Representative	(1-10)	9.5
10	Customer Satisfaction - Value relative to project cost	(1-10)	9.0
11	Percent of repeat customers	%	88%
12	Total job area (of job surveyed)	SF	9,426,705
13	Total number of jobs surveyed	#	564
14	Total number of different customers to be surveyed	#	846
15	Total number of Surveys	#	1,282

Table 4 shows that almost half of the clients are non-responsive due to incorrect contact information. The lists of jobs that do not have accurate contact information are being sent to the regional managers. Moreover, the regional managers have been educated on the warranty process and the importance of contact information. Upon receipt of the updated list, the end users will be contacted again for higher response rate.

Table 4

Overall survey responses

No	Criteria	Unit	Overall
1	Bad/Missing Information (No contact info, wrong #, etc.)	%	19.4%
2	Refusal to Complete	%	2.5%
3	Cannot be Contacted	%	29.8%
4	Surveys Returned	%	44.7%

Conclusion

The manufacturer was successfully able to implement the warranty program and measure the performance information of their systems and applicators as recommended by the researchers. Having a proof of documented performance of their systems differentiates the subject manufacturer from other competitors through performance measurement. The warranty program also benefited the manufacturer to minimize the risk not only for the manufacturer, but also for the end users by identifying

- End users that are not satisfied
- Applicators that are low performing
- Jobs that have current leaks
- Having a running log of satisfaction rating for every warranted job

The manufacturer was able to mitigate the risk proactively by identifying the unsatisfied end users and leaking jobs in the warranty process. The manufacturers are able to report these jobs to their respective managers that are responsible for their region within two weeks of notification.

The research also revealed that the product of the manufacturer is a high performing product with 98% of the clients purchasing the product again and an overall satisfaction rating of 9.2 out of 10.

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Optimizing Cost and Schedule Performance through Best Value Project Delivery: Application within a Design-Build Project

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Performance in the construction industry is wrought with challenges and owners often are victim to cost and schedule overruns, particularly on high profile projects that are large, complex, and risky. Alternative project delivery methods and techniques are continually being developed and implemented by buyers of construction services to address these problems. The Best Value Business Model (BVBM) has been rigorously tested and shown to improve project performance via its three-phased approach to project delivery. BVBM increases performance throughout the construction project lifecycle by utilizing value-based selection processes, pre-contract planning methodologies, and performance measurement systems. The objective of this research is to provide a detailed case study of BVBM application on a design-build project to deliver a highly complex research facility with tight schedule and budget thresholds. The implementation process is discussed in detail and project results are provided and analyzed to demonstrate the ability of BVBM to improve project performance. Special attention is paid to the ability of BVBM to optimize project cost and schedule performance through the application of a value-based selection methodology, a pre-contract preplanning period, and a weekly risk management system.

Keywords: construction, design build, planning, project delivery, risk management.

Introduction

The construction industry is often faced with low performance in the form of projects completed late or over budget (Post 1998, Shortages 2005, Georgey *et al.* 2005). Research has shown that large or complex project face difficulty in delivering quality, with cost and schedule overruns of 40 to 200 percent (Condon and Hartman 2004). Buyers of construction services have turned to various solution strategies, typically in the form of implementing alternative project delivery methods such as design-build (Gransberg *et al.* 2003). One approach, known as the Best Value Business Model (BVBM), holds the potential to overlay on top of these project delivery methods to further alleviate poor performance in construction (Santema 2011). BVBM aims to improve project performance through value-based evaluation of Proponent proposals during procurement, pre-contract planning to clarify the highest-rated Proponent's project delivery plan and risk management approaches, and a performance measurement system to regularly track cost and schedule impacts for the duration of the project.

The objective of this article is to demonstrate that the principles of BVBM can be effectively utilized in the delivery of extremely complex, risky, and high profile construction projects in the design-build arena. A detailed account of how BVBM was utilized in a representative design-build project is provided along with the resultant

project performance results. One aspect of the Best Value Business Model is highlighted in particular – its unique pre-contract planning methodology – to demonstrate the significantly beneficial impact it can have in the area of risk management, minimization of cost and schedule growth, and facility optimization. A case study approach was utilized to implement BVBM in the design-build delivery of a high tech research facility, wherein the pre-contract planning methodology had a direct and drastic impact to improve project performance.

Research Context

This research presents a case study application of the Best Value Business Model (BVBM) in a design-build project to construct a highly complex and high profile research facility at the University of Alberta (UA). The context of this research is discussed in three sections. First, a summary of BVBM is given. Second, an organizational background on UA is provided as well as their involvement in BVBM application. Third, the scope of the case study Cyclotron Project is discussed.

Best Value Business Model (BVBM)

The Best Value Business Model is an approach to project delivery and management that consists of techniques to improve efficiency and value in all aspects of the lifecycle for project delivery. BVBM is divided into three major phases. The first phase is Selection, which encompasses a value-based approach to procuring goods and services and consists of unique expertise-based evaluation criteria. The second phase is a pre-contract planning process that occurs with the single highest rated Proponent from Selection. This pre-planning methodology is unique to BVBM and is called the Pre-Award Clarification Period. The third phase is Performance Measurement for the lifetime of the contract, where a formal reporting system is utilized to track cost and schedule growth while simultaneously providing a structured change management communication process.

The Best Value Business Model is not a new process; rather, it has been tested and refined by the Performance Based Studies Research Group (PBSRG) from Arizona State University (ASU) on more than 900 individual procurements of construction and design services with a total value of more than \$2.7 billion (Kashiwagi *et al.* 2012a, Kashiwagi *et al.* 2012b, Sullivan *et al.* 2012a). BVBM has been implemented by more than 80 organizations, generally representing large buyers of construction and general services in the public and private sectors, including the U.S. Army Medical Command, Arizona State University, State of Oklahoma, University of Alberta, State of Idaho, University of Minnesota, General Dynamics, Harvard University, and Rochester Public Schools (Sullivan 2011). Other groups that have utilized BVBM include the Hanze University of Applied Sciences, City of Peoria, Tata Steel, and the government of the Netherlands (Bos 2012, Sullivan *et al.* 2010, van der Rijt and van den Hoogen 2012, van de Rijt & Santema 2012).

University of Alberta Application of BVBM

The University of Alberta is located in Edmonton, Alberta and is the largest postsecondary institution in the province, as well as one of the largest in Canada. UA has a student enrollment of approximately 37,000 full time students and part time student with an academic support staff of approximately 11,700. UA has a \$500 million procurement budget, making it a large public organization that commands a large amount of buying power. UA partnered with PBSRG in fall of 2010 to begin implementation of BVBM within their organization, and immediately began their first pilot test on their campus-wide custodial services contract. Their second implementation of BVBM was the design-build development of the Medical Isotope and Cyclotron Facility (MICF) on campus, which began development in the summer of 2011.

Medical Isotope and Cyclotron Facility Scope

The Medical Isotope and Cyclotron Facility was planned to be a stand-alone, medium energy cyclotron facility with an integrated radiopharmacy located on the South Campus at the University of Alberta (Construction Projects 2013). The project scope consisted of the repurpose of a cold storage facility to a specialized academic teaching, research, and production facility for radiopharmaceuticals utilized in cancer treatment research. This was a technically challenging and highly complex facility that included a 24MeV cyclotron particle accelerator. This project was a partnership between University of Alberta, Alberta Health Services, Alberta Advanced Education and Technology, Alberta Health and Wellness, Natural Resources Canada, and Advanced Cyclotron Systems (MICF 2013). Both the University of Alberta and Alberta Health Services were planned to house research teams at the completed facility to conduct research and production of medical isotopes that could be used to diagnose and treat patients with cancer, cardiac, and neurological disease. The project was under intense budget and schedule pressure to be complete in time to begin the production of radioisotopes. Procurement and delivery of the project was accomplished via a value-based design-build process. The Request for Proposal included bridging documents at approximately 80 percent design to assist Proponents with their bid and costing.

Research Objective

The objective of this research was threefold:

1. Demonstrate how the implementation of value-based procurement, pre-contract planning, and a continuous performance measurement system works well in a design-build environment for highly complex projects.
2. Share a case study of the Best Value Business Model's use in a high profile, extremely complex and risky project with considerable budget and schedule constraints. The details of how BVBM was implemented in this instance are revealed.
3. Demonstrate the value of the second phase of the BVBM, known as the Pre-Award Clarification Period, which is essentially a pre-contract planning process

between the selected design-builder and the owner organization and can have a significant beneficial impact towards risk management.

Research Methodology

The research background is divided into three sections to describe the three-phased project delivery method that is utilized by the Best Value Business Model. The first section describes the value-based Selection phase. The second section provides information regarding the Pre-Award Clarification Period. The third section discusses the performance measurement system used within BVBM.

Selection Phase

The BVBM selection phase consists of a value-based procurement process to deliver a wide range of goods or services. Components of the value-based procurement include (Bos 2012, Sullivan and Savicky 2010):

- Past Performance Information on key firms and individuals. Information is collected regarding from past clients that have used the Proponent firm or individual on previous projects. The past clients provide information regarding the Proponent's capabilities in management, meeting schedule deadlines, risk assessment, planning, and adhering to rules and regulations as well as their overall satisfaction with the Proponent's performance.
- Risk-based submittals that require Proponents to identify, prioritize, and minimize risks they see in the service delivery. The first submittal looks at technical risks to the project, which refers to potential risks that are directly within the Proponent's control and therefore can be minimized at the outset of the project due to the Proponent's expertise in delivering the project. The second submittal focuses exclusively on risks the Proponent does not control, such as regulatory approvals, third party interactions, or owner-provided deliverables.
- A Value Added submittal wherein Proponents may propose alternatives to the prescribed scope of services. These alternatives should be outside the owner-specified scope of services, which enables Proponents to utilize their expertise to determine the best service delivery options. All cost and schedule impacts associated with these options are also included on the Value Added submittal.
- Interviews are conducted with the operations personnel who will deliver the good or service. Each individual is interviewed independently from all other project team members. Interview questions center on how the operations personnel plan to deliver the project, risks they see to the plan, potential impacts of these risks, strategies to minimize the risks, and any support they may require from the owner organization.

Evaluations are conducted individually by each member of the Evaluation Committee on a 1 to 10 rating scale. Once complete, individual evaluations are returned to the project's contracting officer for compilation. Table 1 provides a listing of the specific components collected in the Medical Isotope Cyclotron Facility project as well as their associated evaluation weights.

Table 1

<i>Selection criteria</i>		
No.	Criteria	Weight
1	Cost	35
2	Technical Capability	10
3	Risk Assessment	15
4	Value Added	05
5	Interviews	40
6	Past Performance Information	10
Total Points Possible		115

Pre-Award Clarification Period

The highest rated Proponent from the Selection phase is notified of their Selection, provided that their cost is within a justifiable range. This highest rated Proponent is then moved forward into a brief, yet rigorous preplanning and risk management process known as the Pre-Award Clarification Period. This period features a highly flexible and unique approach, including traditional preplanning activities augmented with a specific focus on risk, client concerns, alignment of expectations, and the selected Proponent’s service delivery plan (Sullivan *et al.* 2012a). Key deliverables of this period include:

- Thorough pre planning and proposal review by the Proponent and owner.
- Detailed project plan developed and presented by the Proponent.
- Uncontrolled risks are identified, prioritized, minimized, and documented by the Proponent.
- Project milestone schedule is developed.
- Performance system implementation is planned for Phase 3.

The specific steps within the Pre-Award Clarification Period are as follows:

- Step 1: Process Education. The owner and related consultants provide educational resources for the selected contractor regarding the philosophy of the process, expected deliverables, and agenda of the initial kickoff meeting
- Step 2: Kickoff Meeting. The contractor directs the meeting by presenting an overview of their project plan, discusses major risks and solutions, and sets the schedule of activities for the preconstruction planning period.
- Step 3: Plan & Coordinate Deliverables. All required coordination activities are conducted to determine details of the project plan. This step has the longest duration, and consists of meetings with specific owner stakeholders to provide needed information and requirements to the contractor’s project team.
- Step 4: Insert Deliverables into Contract. The final functional plan is written in a formal manner and included in the contract documents. The plan includes the project scope (centered on interaction points between project participants), risk management plan, milestone schedule, financial agreement, and performance metrics.

- Step 5: Summary Meeting. This meeting serves as a formal, final check that all parties agree to the plan before signing the contract.
- Step 6: Contract Signed. Once all parties agree to the plan presented in the Summary Meeting, the contract documents are finalized, compiled, and signed.

Performance Measurement

The third phase of the Best Value Business Model is the incorporation of a performance measurement system for the lifetime of the project, which serves as a tool for the owner to analyze performance on each individual contract they procure. The main component of the Performance Measurement phase is a Weekly Risk Report (WRR) process. The WRR is an Excel spreadsheet that is submitted by the contractor prior to or at the date when Notice to Proceed is given all the way through substantial completion and project closeout. Within this spreadsheet, all risks that occur during the project are documented along with their associated cost or schedule impacts.

Submission of the Weekly Risk Report becomes a real-time performance measurement system because the WRR is submitted each week with any relevant updates. Weekly submission is typically accompanied by a risk review meeting with key stakeholders from the contractor and owner teams, which essentially becomes a formalized change management process to communicate any alterations in project approach. The information captured in the Weekly Risk Report includes:

- Contact information for key members of the owner and contractor project team.
- A brief, written description of each risk that impacted the project. This description is updated weekly with any relevant updates until the risk in question is resolved and closed out.
- Projected resolution dates for open risks.
- Cost and schedule impacts of each documented risk, as well as an associated summary of any change orders approved by the owner.
- A milestone schedule with up-to-date information on percent completion.
- An owner satisfaction rating with the contractor's actions to mitigate each risk that occurred during project delivery.

Results and Discussion

Results of BVBM implementation at the University of Alberta are separated into four sections. First, the value-based selection process and evaluation results are shown in detail. Second, the hugely beneficial impact of risk management ability in the Pre-Award Clarification Period is closely examined. Third, the performance measurement system utilizing the Weekly Risk Report is discussed. Fourth, overall project impacts and savings as a result of BVBM application are discussed.

Value-Based Selection

Four Proponents submitted proposals for the Medical Isotope and Cyclotron Facility. An Evaluation Committee of five individuals was formed, where participants had background in procurement and supply management services or facility and operations project management. The Evaluation Committee was responsible for evaluating the written portion of the Proponents’ proposals, which consisted of the two risk submittals (Technical Capability and Risk Assessment) along with the Value Added options. The Evaluation Committee’s scores were averaged and combined with the Proponent’s Cost proposal and Past Performance Information and converted to a weighted score, as seen in Table 2. At this stage, the contracting officer performed the short list determination which ultimately removed Proponent B from moving forward in the Selection process due to their low total points. The remaining three Proponents were invited to participate in the Interviews as the final evaluation portion.

Table 2

Weighted scores for short list – prior to interviews

No.	Criteria	Weight (%)	Proponent A	Proponent B	Proponent C	Proponent D
1	Cost	35	33.2	26.3	34.8	35.0
2	Technical Capability	10	10.0	3.3	5.5	6.5
3	Risk Assessment	15	15.0	3.9	15.0	11.1
4	Value Added	05	5.0	2.2	2.8	4.3
5	Interviews	40	-	-	-	-
6	Past Performance Information	10	9.0	9.3	9.3	9.0
Total Points		115	72.2	45.0	67.4	65.9

Individual interviews were conducted with four key members of each Proponent’s design-build team: the Builder’s Project Manager, the Builder’s Site Superintendent, the Design Architect, and the Design Mechanical Consultant. Each of these key team members was interviewed on an individual basis and Evaluation Committee members provided their separate scores, which were then averaged to arrive at the final Selection weighting shown in Table 3. After inputting the Interview evaluations, Proponent A received 109.4 of the total 115 points possible and was the highest rated Proponent. Proponent D and Proponent C were the second and third highest rated Proponents with total evaluation scores of 90.9 points and 86.5 points, respectively. Based upon the final evaluations, Proponent A was notified of their selection and moved forward into the second phase of the BVBM.

Table 3

Weighted scores for selection – including interviews

No.	Criteria	Weight (%)	Proponent A	Proponent C	Proponent D
1	Cost	35	33.2	34.8	35.0
2	Technical Capability	10	10.0	5.5	6.5
3	Risk Assessment	15	15.0	15.0	11.1
4	Value Added	05	5.0	2.8	4.3
5	Interviews	40	37.1	18.8	25.0
6	Past Performance Information	10	9.0	9.3	9.0
Total Points		115	109.4	86.5	90.9

Pre-Award Clarification Period

As a part of their due diligence during the Pre-Award Clarification Period that was scheduled to last three weeks, the selected design-builder conducted extensive site reviews that ultimately identified significant risks that were previously unknown and unforeseen on the project. Three major unforeseen risks were brought forward as a result of the Pre-Award process:

1. During a site review, the design builder found the existing building to be roughly 15 feet wider in the North-South direction, with added more than 1,800 square feet over the building dimensions originally shown in the bridging documents.
2. The Cyclotron Vault Design developed by the bridging consultant did not contain details regarding the acceptable wall thickness or materials, which necessitated updated calculations to be determined by the design-builder. The deep pile foundation system shown in the bridging documents made it difficult to maintain schedule.
3. A field review by the structural engineer revealed cracking on the perimeter concrete beams.

After uncovering these unforeseen risks and communicating them to UA, the design-builder requested that a 1.5 week extension of the Pre-Award be granted because they felt it was important to bring all the risks forward and be able to properly mitigate them before jumping into contract. Solutions to these three risks were developed and enacted prior to the end of the Pre-Award Clarification Period. The risk resolution strategies are summarized below:

1. The design team accommodated the extra space by incorporating additional corridors, which ultimately resulted in a more efficient facility layout. Once the new floor plan was developed and approved, the design-builder provided UA with any interior and exterior cost implications to enable budgeting.
2. The design-builder designed a raft foundation alternative which drastically reduced schedule time (by as much as five weeks). The cost of general conditions and other overages that would have been incurred over that period nearly offset the entirety of the additional cost of the newly proposed foundation design.

3. The design-builder developed a solution that would add perimeter struts during the roof deck replacement portion of the construction phase. The design-builder also recommended treating existing cracks with epoxy injection as well as a reinforcement of the deck diaphragm with permanent bracing.

These three major unforeseen risks did result in cost impacts to the project. However, the fact that these risks were identified prior to signing the contract and mobilizing for construction was beneficial because it enabled effective optimization of the facility and expedited the required regulatory approvals to accommodate the changes. This demonstrates the huge benefit gained by incorporating the Pre-Award Clarification Period as espoused by BVBM. If UA and the design-builder would have gone directly to contract after Selection, these unforeseen risks would have become changes after the fact, driven other changes, and likely delay the completion of the facility. Instead, utilization of the Pre-Award Clarification Period enabled UA and the design-builder to manage these risks – and their associated impacts – ahead of time. In this manner, the pre-contract planning methodology of BVBM does result in risk management and risk control related to the project before the award, which serves to minimize the any issues that may be encountered after the fact.

Another benefit of the Pre-Award Clarification Period was that UA was able to review the Value Added options proposed by the selected design-builder. After review and clarification, UA elected to utilize multiple Value Added options, which is an example of how BVBM enables owners to leverage industry expertise to delivery greater value on their projects. These items were identified and included directly within the design-builder's initial proposal to the University, which would not have been typical in a traditional selection process. The Value Added items proposed by the design-builder included the following:

- Replace Wood Decking – existing wood has been exposed to moisture for a considerable time and replacing it with steel decking prior to re-roofing maximize life cycle cost.
- Upsize the Emergency Generator – the originally-specified generator was smaller than the required power sizing for the building's needs. The selected design-builder identified this design error directly within their proposal and provided the associated costing required to upgrade the generator to an appropriate sizing.
- Variable Air Volume System with Reheat – the original design drawings showed a dual duct system. The design-builder proposed an alternative design that met the owner's intent while also saving \$158,000 and creating interstitial space for improved maintenance access.
- Addition of Boron Carbide Additive to Vault Concrete – the radioactive shielding requirements were not specified in the owner's Request for Proposal. The design-builder included a potential solution within their proposal based upon their expertise delivering previous projects of similar scope. This solution was analyzed in the Pre-Award phased and ultimately deemed to be an appropriate solution.

- Replace Drywall and Epoxy Paint with Arcoplast – the original bridging documents showed a drywall, tape, mud, sand and paint method to be used for interior finishes, which is time consuming to install. The design-builder proposed utilizing an arcoplast product to reduce the schedule impact of the drywall trade by fifty percent. This solution also provided greater ability to maintain the high levels of cleanliness required within the building interior spaces.

Performance Measurement System

Once the contract was signed, a performance measurement system was incorporated for the duration of the project. In accordance with BVBM practices, the design-builder's construction project manager updated and distributed a Weekly Risk Report on every Thursday in preparation for a regularly scheduled Friday morning risk review meeting. All cost and schedule impacts to the project were tracked and categorized. The vast majority of cost impacts, listed in order of magnitude, stemmed from owner-driven scope additions to improve the facility, design discrepancies from the original bridging document consultant, and approved value added items to increase the facility's functionality. In this respect, cost impacts were not due to poor performance, but rather were a result of risk minimization strategies and opportunities to improve this important research and medical treatment facility for many years to come.

As a result of the WRR system's communication process, the owner project manager was enabled to "clear the path" for the design-builder, essentially eliminating bottlenecks caused by the greater owner organization of other third party groups the owner was involved with on the project. This resulted in a much more streamlined project delivery process and provided a regular forum to document and communicate risk impacts that may necessitate change management actions. As a part of the WRR system, the UA project manager from the Facilities and Operations department provided a 97 percent satisfaction rating with how the design-builder managed each risk impact throughout the project, another indicator of high performance.

Discussion of Project Savings

The Medical Isotope and Cyclotron Facility reached substantial completion on December 21, 2012, closing the eighteen month project duration with an on-schedule delivery of the operational facility. The final project cost, including all cost impacts resulting from scope additions, bridging document design discrepancies, and value added decisions by UA was \$32 million. The Executive Director of Facilities and Operations at UA performed an analysis of total cost and schedule durations that would be estimated for representative projects of similar complexity to provide a benchmark performance comparison. The conclusion drawn from this analysis was that this project, if conducted via a traditional project delivery methodology, would be estimated to cost \$44-48 million and have a scheduled duration of approximately 48 months. From this analysis, it was determined that UA's implementation of BVBM resulted in nearly \$14 million (30 percent) in cost savings due to increased efficiency and as much as 30 months in schedule reduction (63 percent). These dominant performance results are summarized in Table 4.

Table 4

Cyclotron project BIBM results

Project	Contract Value	Cost Savings	Schedule Impacts	Satisfaction/Performance
DB Construction (High-Tech Research Facility)	\$32M	\$14M (30%)	30 mo. reduction (63%)	9.7 (out of 10) satisfaction

Figures 1, 2 and 3 provide photographic representations of the substantially complete MICF on University of Alberta’s South Campus. Figure 1 shows different views of the MICF’s exterior appearance and envelop as well as the front entry canopy. Figure 2 provides views of the various components present within the laboratory spaces. The upper left picture shows a hallway with windows into numerous laboratory rooms while the lower left picture gives an interior view of one laboratory. The upper right picture shows some of the processing equipment available to researchers while the lower right depicts a controlled pass-through between rooms for sensitive material. Figure 3 provides views to the complex mechanical equipment array that is located above the interior roofing in the laboratory space. Pass ways were included to enable easy access points for maintenance future maintenance work.



Figure 1: Exterior views of the MICF



Figure 2: Various components of interior laboratory spaces within the MICF



Figure 3: Mechanical equipment design for radiopharmaceutical production

Conclusion

The research objective was to (1) demonstrate how the implementation of value-based procurement, pre-contract planning, and performance measurement is beneficial in a design-build environment with an extremely complex and high profile project, (2) provide detailed case study information regarding the application of the Best Value Business Model within this setting, and (3) emphasize the impact pre-contract planning

can have in the construction industry to promote more effective risk management practices. These objectives were accomplished via a case study approach to document the impact of BVBM on the design and construction of the Medical Isotope and Cyclotron Facility built for the University of Alberta in Edmonton, Alberta.

Estimated total cost savings were found to be in the range of 30 percent with a 63 percent schedule reduction due to the application of the Best Value Business Model over more traditional project delivery approaches. Although all three major phases of BVBM provided a positive contribution towards these performance results, the pre-contract planning methodology of the Best Value Pre-Award Clarification Period had the largest impact on the MICF project. The design-builder utilized this process to uncover significant unforeseen risks to the project, and then extended the Pre-Award duration in order to address the risks prior to jumping into contract. The resultant benefits were numerous: it minimized changes after the fact, minimized cost and schedule impacts of the risks, allowed the owner to acquire proper budgeting for the facility, and expedited regulatory approvals.

Future research is planned to continue implementation of BVBM at the University of Alberta on contracts of all sizes and types. Different industries will be tested, including design and consulting, design-bid-build construction, construction management fast tracking, and other general services such as travel management, information technology consulting, and others. University stakeholders will be surveyed periodically to assess their perspective of the benefits gained via BVBM application. The intent also exists to apply the pre-contract planning methodology in concern with the performance measurement system on contracts that are procured via more traditional, non-value-based selection processes and track the resulting impacts to project performance across the organization.

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Implementing Project Schedule Metrics to Identify the Impact of Delays Correlated with Contractors

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Schedule management reduces schedule delays while optimizing positive opportunities to the project timeline. The built industry continues to struggle to capture project metrics that will improve supply chain management. The lack of performance metrics on construction projects filters the actual project performance of the project stakeholders. Contractors can easily be blamed for schedule delays because of the nature of construction projects. A large university capital improvement organization recognizes their lack of performance information and begins implementing a performance measurement system in 2005. The university measurements focus on project impacts to cost, schedule, and quality in hopes that additional information will improve risk management processes. This article reviews the schedule impacts that contractors create within projects. Data was collected directly from both contractor and client project managers of 254 construction projects. Actual delays from contractors were found to be a small percentage of the overall project schedule delays. More than half of the delays that contractors produced were found to be correlated to the material suppliers.

Keywords: Risk Management, Contractor Delays, Performance Metrics, Schedule Management

Introduction

Construction organizations have historically struggled to capture performance metrics over an extended period of time (Egan 1998). Due to the high variance between projects, construction organizations have not been able to benefit from long term measurements as they have focused uniquely on short term project data (Love & Holt, 2000). The common short term data of on-time or on-budget percentages provide little assistance to gauge how the company will perform on their next project (Chapman *et al*, 1991). Short term data also provides little assistance for improving processes within an organization (Kaigioglou *et al*, 2001). Long term measurements need to track qualitative measurements, such as: quality, project impacts, social impacts, and human factors (Love & Skitmore, 1996).

Construction companies closely manage project schedules to ensure projects are completed on time. Understanding the organization's ability to manage project schedules is a key metric, both for individual project success and overall organization success. Successful projects that are delivered on time will ensure the profit in which the contractor originally estimated and will allow the owner to effectively utilize the completed facility as planned. Measuring the reasons for delays on projects and the parties responsible for the delays will provide transparency of the common delays that organizations experience on construction projects.

In 2005, a capital program at one of the largest universities in the United States found itself without metrics related to schedule management on their campus projects. The lack of performance information created confusion on what the common project delays were. The performance of the contractors working on university projects was questioned. This perception of poor contractor performance is common within the build industry (NEDO,1983; HMSO, 1995). During the next several years the university implemented performance metrics on their projects to increase their ability to manage risk with the project schedules. The newly implemented metrics created transparency to delays on the university projects. This article reviews the implementation of the schedule metrics and analyzes the specific delays correlated to the contractor's performance.

Performance Measurement

Performance measurements in the built environment are described as “a quantifiable, simple, and understandable measure that can be used to compare and improve performance” (Pitcher, 2010). Pitt and Tucker (2008) explained the three reasons for measurements as: 1) to ensure the achievement of goals and objectives; 2) to evaluate, control, and improve procedures and processes; and 3) to compare and review the performance of different organizations, teams, and individuals. Metrics have also been found to assist with providing organizations customer ratings, reviews and suggestions (Love & Holt, 2000).

Two limitations are often seen with performance metrics: first, metrics are retrospective, with markets frequently changing, continuous performance metrics are necessary for it to be meaningful to the current climate, as past data might only reflect past markets (Halachmi, 2005; Busco *et al*, 2006); and second, comparable benchmarks are often unavailable to measure company performance, reluctance to release proprietary information forces organizations to place benchmarks from their past metrics or individual goals (Kaplan and Norton, 1992). Because of the nature of construction projects these difficulties were seen with the implementation of the performance metrics on schedule management.

Schedule Management

Project schedule management has been heavily researched and is understood to be highly correlated to successful project management (Globerson and Zwikael, 2002). The effort required from contractors and owners to ensure that projects are completed on schedule is often described as schedule management (PMBOK, 2008). Ineffective time management leads to overruns of the project schedule, known as delays. Schedule delays can become very costly to both owners and contractors. To the owners, delays mean the loss of revenue from the loss of productivity of the facility being constructed. Contractors see financial loss through the extended use of the company's resources on the construction project. Creating greater efficiency with schedule management is beneficial for both the owners and the contractors.

Researchers have placed a great amount of effort into creating greater schedule management efficiency. A large area of time management research focuses on the causation of project delays (Bordoli & Baldwin, 1998). To understand project delays many different methodologies have been used to collect project information. In a review of the past research with schedule delays

Doloi *et al.* (2011) found that most studies quantified and identified project schedule delays by gathering schedule data from the project stakeholders. This methodology of research was used in this article to capture the contractor delays.

Contractor Delays

The variety found within construction project scopes account for the difficulties of identifying and eliminating the defects from the supply chain. Unlike manufacturing, construction workers seldom, if ever, replicate identical products more than once. However, common characteristics are found on construction projects and past research has identified many of the common schedule delays seen on construction projects (Kumaraswamy & Chan, 1998). Common schedule delays on projects include: owner interference, delayed decisions, project financials, ineffective planning, subcontractor delays, labor productivity, and inadequate contractor performance. Although owner interference greatly impacts construction schedules, owners expect contractors to perform at high levels and to minimize any contractor related delay. The common practices found with liquidated damages on construction projects demonstrate the low tolerance owners have with contractor delays. Because of this high expectation, contractors focus on minimizing the risk in which they might impact the schedule. Researchers have identified the main reasons that contractors delay project schedules (Doloi *et al.*, 2011, Kumaraswamy & Chan, 1998), they include:

- Contractors finance difficulties
- Conflicts with subcontractors schedules
- Construction errors causing rework
- Other parties creating conflict with the contractor
- Poor site management
- Poor communication and coordination
- Ineffective planning and scheduling
- Improper construction methods
- Delays from subcontractors
- Frequent changes with subcontractors

A 2002 study found that the different stakeholders involved with construction projects often disagree with which party creates the greatest risk to the schedule; owners and consultants blame the contractors and contractors blame the consultants and owners (Odeh & Battaineh, 2002). Without project metrics, finger pointing will always result from the non transparency, this is the situation that the organization included in this research was in.

Methodology

In 2005, the capital program at the University of Minnesota had no system in place to track and document challenges they were facing in cost and schedule growth within their capital construction projects, which also prevented the identification of opportunities to improve performance in these areas. Capital Planning and Project Management (CPPM) is the department responsible for all construction projects on the two main universities campuses. CPPM consists of a director, senior project managers, project managers, and support level staff that are

responsible to ensure that all construction projects are delivered effectively. Without a comprehensive metric system, the quality of the organizations performance was created by perception and opinion alone, this consequentially left management skeptical of contractor's performance. CPPM looked for ways in which they could begin capturing project time management metrics to better understand performance and minimize project delays. During 2005, CPPM implemented metrics on the performance of construction projects on its campus. The implementation of metrics is described extensively in past research (Sullivan *et al*, 2007).

To capture the individual project metrics CPPM introduced the "Weekly Risk Report" (WRR). CPPM required that contractor project managers maintained the weekly report to capture any event that delayed their project. The contractor managed the WRR and captured any risk on the project that delayed the project schedule, each delay was categorized in the WRR to identify who and what caused the issue. The development of the WRR has been described in further detail in past research (Sullivan *et al*, 2006) but, the main purposes of the WRR are to:

1. Provide basic project information;
2. Track the projects schedule;
3. Track all project risks on the project and how they are managed;
4. Track deviations to the schedule and cost;
5. Track who and what caused deviations;
6. Assign a level of project severity from the projects impacts for executives;
7. Capture the client's satisfaction ratings of contractor's ability to manage risk.

The WRR captured any deviation to the vendors planned schedule. The desire of the report was for the contractor to identify potential risks and provide solutions to minimize the risks. If a risk wasn't minimized and the project schedule was impacted than it was recorded with an explanation of the schedule delay. Each delay that occurred on the project was labeled with the party responsible for the delay, these project stakeholders included:

1. Client – department within the university
2. CPPM – client project management representative
3. Contractor - vendor selected to construct project
4. Design – consultant for design and engineer of the project
5. Unforeseen – any delay that was not foreseeable and could not be assigned to a stakeholder

The client project representative evaluated and confirmed the data collected on the WRR each week. On completion of the project the WRR summarized the risks that impacted the project schedule and identified the amount, the severity, the causation, and who was responsible for the project delay. The data captured project delays whether the actual completion date was completed on time or not. The university started implementing the WRR on select construction projects in 2005. The number of WRRs used on construction projects increased annually, until 2008 when the university required that a WRR was used on all construction projects. By the year 2012, 254 weekly risk reports had been implemented on construction projects at the university (Perrenoud & Sullivan, 2012).

Research Analysis

The results of the metrics captured in the WRR were gathered and analyzed for trends and common occurrences at the University of Minnesota. Information relating specifically to project schedule delays is analyzed in this section including an in depth analysis of the delays that contractors created.

Overall Schedule Delays

Weekly Risk Reports were collected on 254 projects at the university from 2005 to 2012. The 254 projects included both new construction and renovation projects on the university campuses. The total awarded cost for these projects was \$222,964,090 and the total number of days scheduled for these projects was 26,183 days. Each project captured the number of days in the planned schedule and the number of day the planned schedule was delayed. Sixty nine percent of the projects experienced a delay in the project schedule, in total 174 projects had delays. Overall the projects were delayed by 8,567 days, a 32.7% delay rate. A breakdown of the project delays categorized by project stakeholders can be seen in Table 1.

Table 1

Overall schedule delay rate

	Original Schedule Delay Rate	Number of Projects that had a Delay	Percent of Projects that had a Delay
Overall	32.7%	174	69%
Client	11.6%	93	37%
CPPM	9.9%	80	31%
Contractor	3.0%	41	16%
Designer	3.2%	39	15%
Unforeseen	5.0%	54	21%

As Table 1 points out the majority of the delays came from the client and the client project management team. Frequent scope changes and delayed action tasks accounted for a large portion of the delays that impacted the construction projects. The greatest risk to the contractor completing the project on the planned schedule was the client themselves. As the contractors on these projects were not included with the planning and designing of the project, there was very little the contractor could do to minimize the majority of the delays. Table 2 breaks down the number of days delayed by each stake holder. In total the contractor delays accounted for 788 days, 9 percent of the days delayed. The next section will analyze these 788 delays to find the major causes of the contractor delays.

Table 2

<i>Stakeholders delays</i>		
Stakeholder Schedule Delays	Days	Percent of Days Delayed
Client Delays	3047	35.6%
CPPM Delays	2603	30.4%
Contractor Delays	788	9.2%
Design Delays	825	9.6%
Unforeseen Delays	1304	15.2%
Total Schedule Delays	8567	100%

Contractor Schedule Delays

Of the 788 days that the contractor delayed project schedules, the researcher found that more than half of the delays were due to the manufacturers and the suppliers responsible to produce and deliver the construction materials. Manufacturers accounted for 56 percent of the delays that were reported on the WRR for the contractors. Table 3 is a complete breakdown of the contractor delays.

Table 3

<i>Contractor delay breakdown</i>					
Contractor Delay Attributes	Delays	Days Delayed	Delay %	Delay %	Delay %
<u>Contractor delay source</u>	26	344	44%		
Construction documents oversight	7	70		20%	
Equipment ordered late	4	78		23%	
Work related errors	15	196		57%	
Scheduling conflicts	4	42			21%
Installed incorrectly	6	102			52%
Soil not compacted	1	5			3%
Damages occurred in construction	3	16			8%
Forgot to install equipment	1	31			16%
<u>Manufacturer delay source</u>	18	444	56%		
Shortage of materials	2	92		20%	
Delivery of materials delayed	11	215		49%	
The manufacture was delayed	2	37			17%
Manufacture delivered late	9	179			83%
Incorrect material delivered	6	137		31%	
Delivery lost	1	36			26%
Missing pieces	2	10			10%
Incorrect size delivered	1	15			15%
Wrong equipment delivered	2	49			49%
Total	44	772	100%		

Actual delays created by the contractors were broken down into three subcategories: construction document oversight, equipment ordered late, and work related errors. Project management errors accounted for the majority of the contractor errors. Work related errors occurred when the construction processes broke down and the delay was specifically the contractors fault. Ordering equipment late also resulted in several delays to construction. These types of management errors are risks that contractors should have the ability to minimize.

Manufacturers and suppliers created the biggest impact to the projects when they either delivered supplies late or they delivered incorrect materials. With 56 percent of construction delays coming from the manufacturers, it is important that contractors work with effective and proven companies that will be able to deliver their product on time and correctly. Although the manufacturers delays only occurred 18 times compared to the 26 contractor related delays, the 18 delays had a larger impact on the schedule, highlighting the severity of the manufacturer delays. Manufacturer delays might be less likely to occur, but the severity of their impact was the greatest. The most severe manufacturer delays occurred when deliveries were lost, wrong equipment was delivered, incorrect sizes were delivered, or when the delivery was delayed.

Conclusion

In conclusion, the University of Minnesota was able to establish and collect performance measurements on 254 of its construction projects by gathering Weekly Risk Reports. The WRR is a simple tool managed by the contractor to assist risk management communication, produce accountability to the project teams, and provide performance metrics to the client. The university gained the ability to understand the needs of their projects with regards to managing the schedule. They have used these metrics to improve annually and to assist individual project managers to alleviate common delays they might experience on projects.

The researcher analyzed the performance of the project schedules from the data collected in the 254 WRRs and presented the findings in this paper. Against the common perception that contractors create large project delays, contractors were found to only have a slight impact on schedule performance, only accounted for 3.0 percent of the delay rate. The majority of the delays came from within the university and their project management group. The contractor has very little ability to manage and minimize these delays from the clients, such as: scope changes, delayed decisions, and lack of planning. But, the delays that the contractors should have minimized were presented in Table 3. Within these contractor delays the manufacturer and suppliers accounted for the largest portion of their delays. Because of the risk that suppliers create to the project schedule it is critical that contractors work with effective suppliers to ensure that they don't hinder the contractors' performance. In the end, the metrics provided transparency of the project delays and created accountability of the different stakeholders to ensure they minimize project delays.

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Utilization of a Best Value Structure on a City's Park Renewal and Upgrade Program

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The City of Roseville is utilizing a best value selection and contract management process for the delivery of their \$19M park renewal and upgrade program. The best value process minimizes decision of the client, and requires pre-planning from the vendors. This paper analyzes the impact external factors can have on a successful implementation of best value business model. The City is using the model after a highly successful initial pilot project, and in response to tremendous political pressure to deliver a high quality, high performance renewal program.

Keywords: performance information, public works, non-governmental organizations, risk management

Introduction

Best value procurement is a supplier selection process that considers both price and performance evaluation criteria (Sullivan, 2011). This differs from the traditional low-bid approach, where price is the only selection criteria. Therefore, by definition, anything purchased on the basis of price alone is a “commodity” and all other factors are perceived to be equal (Rayburn, 2010; Reimann, Schilke, & Thomas, 2010). However, a buyer incurs increased risk if non-price factors do in fact make a significant difference in determining potential performance of a supplier (Gransberg, 1996; Kashiwagi & Savicky, 2003).

In 2005, the University of Minnesota (UMN) Capital Planning and Project Management group tested a best value approach called the Performance Information Procurement System (PIPS) (Kashiwagi, 2012). A key component of PIPS is that buyers are trained to release control to the suppliers they are hiring. For government officials, the process is particularly appealing because it aims to leverage the expertise of the non-governmental organization / contractor. After very high performance at UMN and widespread support from the supplier community, the industry labor unions lobbied for the passage of best value legislation, which was signed into law in 2007 (Minn. Gen. Laws. ch. 16C, § 28, 2007). The significance of this law was that it permitted municipalities (cities and school districts) to utilize best value on their construction projects.

The subject City of Roseville, Minnesota (MN) is a small community of 34,000 in the Minneapolis metropolitan area. After observing the success at UMN and with the legal backing of the best value law, the City piloted the best value system on a complex geothermal system in 2008. The project was completed with no change orders, and City staff rated the contractor 9.8 out of 10. Four years later, in 2012, the City requested the authors' assistance to use the best

value structure to deliver their \$19M Parks and Recreation Renewal Program (PRRP). However, the renewal program itself (not best value) was highly contested amongst a small group of citizens who filed suit against the City.

Much of Roseville's parks and equipment is 30 years old, or more, and is in need of repairs and upgrade (City of Roseville, 2010). The renewal program (as a result of the City's 2010 Master Plan) is the City's response to address these issues. The Master Plan integrates the public's goals with a strategic approach to maintain the City's assets. One of major components of the renewal program is a physical-geographical organizational concept of sectors and constellations. The entire City is divided into four sectors, and each sector is made up of several constellations. These constellations allow the design team to better meet the local desires of citizens, and also deliver the upgrades in a logical approach. Table 1 describes each of the major renovations, scope, cost, and construction completion date and Figure 1 provides an overview of the sectors and constellations.

Table 1

City Park upgrades

Park	Summary	Cost	Finish Date
Acorn Park	irrigation	\$ 25,000	Fall 2016
Acorn Park	disk golf	\$ 100,000	Spring 2016
Acorn Park	rink	\$ 150,000	Summer 2015
Autumn Grove Park	shelter building	\$ 500,000	Spring 2014
Autumn Grove Park	park improvements, rink	\$ 600,000	Spring 2015
Bruce Russell Park	court	\$ 150,000	Summer 2014
Central Park	Parks Foundation shelter	\$ 300,000	Spring 2015
Central Park Lexington	irrigation	\$ 35,000	Fall 2014
Central Park Lexington	restroom, drop-off, plaza, lighting	\$ 1,450,000	Spring 2016
Central Park Victoria	ballfields	\$ 300,000	Summer 2014-2016
Central Park Victoria Ballfields	ballfield shelter	\$ 300,000	Spring 2014
Dale Street Athletic Fields	FOR Parks shelter	\$ 300,000	Spring 2015
Evergreen Park	court	\$ 150,000	Summer 2014
Evergreen Park	ballfield	\$ 200,000	Summer 2015
Evergreen Park	ballfields	\$ 200,000	Summer 2016
Harriet Alexander Nature Center	building improvements	\$ 250,000	Spring 2014
Harriet Alexander Nature Center	boardwalk	\$ 500,000	Summer 2013
Howard Johnson Park	court	\$ 150,000	Fall 2014
Langton Lake Park	irrigation	\$ 35,000	Fall 2014
Legion Field	ballfield	\$ 300,000	Spring 2016
Lexington Park	shelter building, rink, irrigation	\$ 750,000	Spring 2014
Oasis Park	shelter building, improvements	\$ 550,000	Spring 2015
Owasso Park	irrigation	\$ 25,000	Spring 2016
Pocahontas Park	court, park improvements	\$ 225,000	Spring 2016
Rosebrook Park	shelter building, improvements	\$ 855,000	Spring 2015
Roseville Skating Center	paint	\$ 150,000	Spring 2014
Sandcastle Park	park improvements	\$ 575,000	Spring 2015
Southwest Roseville		\$ 500,000	Fall 2016
Villa Park	rink, shelter building	\$ 450,000	Spring 2014
Villa Park (upper)	ballfield	\$ 150,000	Spring 2016

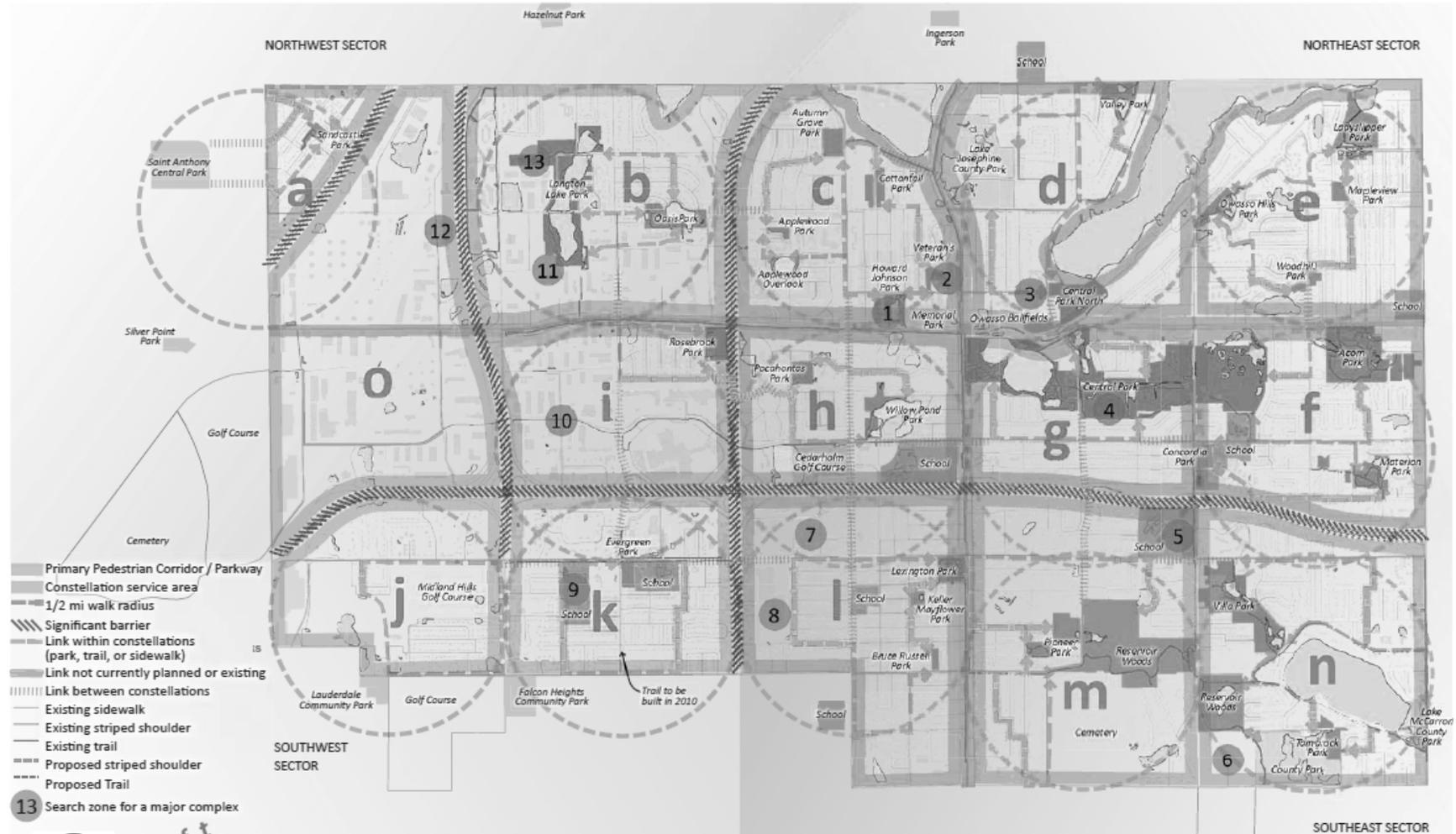


Figure 1: Master Plan Overview: Sectors and Constellatio

This paper has three objectives. The first is to document and potentially explain the citizens' resistance to the renewal program. The paper then analyzes the best value approach as a model to identify experts, and increase the performance of City-provided services. Finally, the paper closes with a discussion of challenges the City has faced under the best value implementation. The City's project performance is shown to be on par with other best value projects within Minnesota. The authors' case study research methodology consisted of an initial pilot project with the city (project results, surveys, and client interview), and a follow-on approach to expand and further refine the City's application of best value.

Citizens' Resistance to Renewal Program

The City of Roseville's budget policy states that any funding program exceeding \$3M must be put to voter referendum for approval (Carlson, 2011). Funds obligated under Port Authority, however, do not require voter approval. The park renewal program has an estimated cost of \$19M, so the City Council moved to use its Port Authority to issue bonds that would fund the program. In response, a group of eight Roseville citizens (Responsible Governance for Roseville, or RGR) filed a lawsuit to stop the issuance of bonds (Carlson, 2011). Their primary contention was that the public was not permitted to vote on the bonds and that the use of Port Authority was inappropriate. Fundamentally, RGR felt that any park renewal program funded by taxes would be wasteful. This contrasts with a June 2011 random public survey which found that 69% of 760 respondents "would vote" or "might vote" for a tax increase supporting the park improvements (Anonymous, 2011).

Clearly, the City was faced with predicament. A vocal group of critics felt that the City was not being a good steward of taxpayer money, while a large majority of citizens dominantly favored paying for the improvements. These opposing views are an example of the struggle government faces in defining what the public interest actually is (Kettl, 2012). Either scenario could lead the perception that the government is complacent and unresponsive to the needs of its constituents (Kaufman, 1969).

The two ideas of how the City should proceed are also reflective of the conservative and liberal perspectives (Cayer, 2010). The authors surmise that the RGR group may be more conservative as they want to reduce the scope of government involvement by limiting tax dollars spent on 'non-essential' public projects. The RGR legal approach through the court system was their attempt to get the City to recognize the individual rights of people to vote (Rosenbloom, 1983). The general population of citizens who support the park renewal may generally viewed as liberal, as evidenced by their willingness to pay more taxes and receive more government services. Of course, these are vast generalizations of the two groups, but it helps to gain a better understanding of the potential underlying motivations of each group.

After a series of court hearings and appeals, the Minnesota Supreme Court refused to hear the RGR's case and thus the park renewal program moved ahead (Olson, 2012). The City then started development and implementation of the best value contracting and organization change structure.

Best Value Structure: A Model for Contracting with NGOs

Though the legal challenges were cleared, the Parks and Recreation department management was still under intense pressure to deliver a high quality park renewal program. The City's initial test of best value in 2008 resulted in a project that met their time, cost, and quality expectations. The City of Roseville has also acknowledged that they are not technical experts in park renewal programs (citywide park design, integration of neighborhood feedback into planning documents, or construction project management). Therefore, they sought the services of multiple non-government entities to provide the expertise the City lacked, and used the best value system to deliver the services.

The best value process contains three phases (see Figure 2) (Kashiwagi, 2012). The Selection Phase solicits proposals from interested vendors and consultants. Once all responsive proposals are evaluated, one 'potential best value' firm is identified and invited to the Clarification Phase. At this time, the firm will clarify their entire plan and address any concerns that the owner may have. Once all parties are comfortable and the owner accepts the firm's offer, a contract is signed and the Project Management phase begins. The best value firm will track any deviations to the project's baseline expectation on a weekly risk report. At the conclusion of the project, the owner will complete a closeout survey rating the firm's performance. These performance ratings may be used on future best value projects.



Figure 2: Phases of the Best Value Process.

The best value structure offers several components to minimize some of the challenges in partnering with NGOs (Kettl, 2007; Sullivan, 2011):

- Performance information available on suppliers, projects, and city staff (increases transparency)
- Evaluation of risk, capability, interview, and past performance (identifies expertise of suppliers)
- Clarification phase between all critical trades, city personnel, and citizens before a contract is awarded (enhances coordination)
- Supplier submission of weekly summary reports on project status, cost increases, and schedule delays (increases accountability of suppliers)

The use of these tools by the park renewal program administrator is in response to the City Council's policy directive to upgrade the parks. The various complexities of the program and associated risk explain why the administrators pursued new tools to manage the program (White, 2012).

In some ways, the best value model melds certain facets of the conservative and liberal ideologies in order to deliver a product or service (the park renewal program, in the case of this paper) that most parties can accept, even those that hold opposing political views (See Figure 3). The model aligns government personnel to release control to the expert vendors who will then direct the project, which results in fewer change orders (minimize government direction; conserves resources). Additionally, the structure is a mechanism that allows the government to be a more efficient service provider, which could potentially increase the demand for government services (increased government involvement in the day to day lives of people).

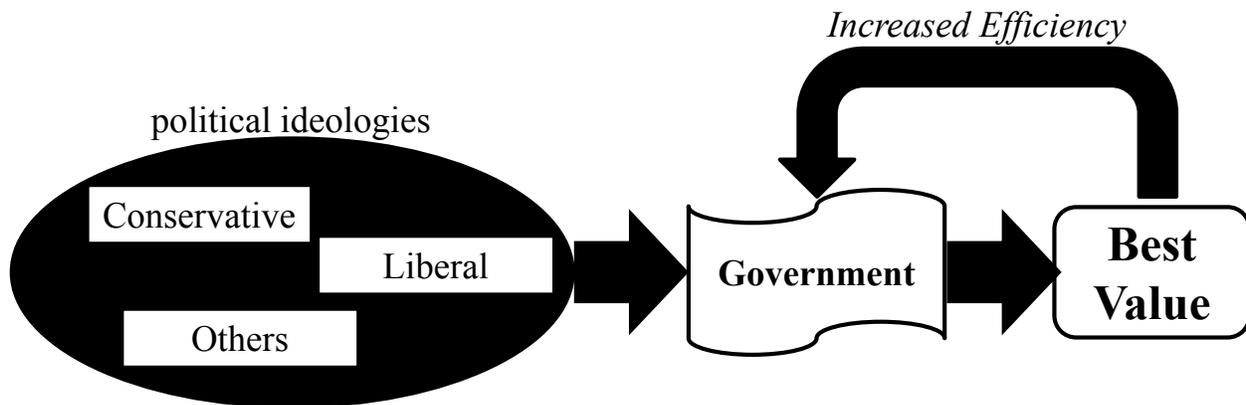


Figure 3: Best value helps to increase efficiency of government services.

Challenges Experienced by the City

The City has faced two main challenges in the implementation of the best value structure: educating government personnel and ensuring continuity of the program in the midst of staff turnover. Most of the challenges faced under the best value structure have been in changing the culture of the government personnel, and the supplier industry. First, government is designed to change slowly (Appleby, 2012; Cayer, 2010; Rosenbloom, 1983). As a result, educating government personnel to release control to the expert is time consuming and perceived as counterintuitive. The suppliers, on the other hand, are not used to leading and managing government personnel. The primary reason for the resistance is that the City's administrators are attempting to change the organizational culture of both the City and the industry. In short, the underlying assumptions (or shared beliefs) of the government and suppliers are not in alignment (Martin, 2002; Schein, 2010).

A second challenge is the possibility of staff turnover in key supporting positions (Allison, 1983). The senior parks director is appointed by the City Manager whose tenure is controlled by the City Council; this could create some instability in the leadership. However, the key

champion of the parks renewal program is actually a staff supervisor, whose position is somewhat protected from politics. Because of this person's unique position, they are able to ensure the program continues through completion. Additionally, the foreseeable legal hurdles and citizenry resistance have been minimized in order to avoid delays.

Table 1 summarizes best value construction performance at the City. They have completed one project, awarded one project, and are in procurement for two other projects. The overall change contractor and designer change order rate is 0%, with customer satisfaction rated at 9.8 out of 10. The actual best value selection process has been rated 10 out of 10. Though based on a very limited sample, the performance of Roseville's best value projects has been on par with the performance of other best value projects in Minnesota.

Table 1

Summary of performance

General overview	Overall	Project 1	Project 2	MN Other Projects
Total number of proposers	5	3	6	4
Total awarded cost (\$M)	\$2.4	\$2.2	\$0.2	\$453
Cost increases				
Overall change order rate	0%	0%	0%	8%
<i>Client</i>	0%	0%	0%	7%
<i>Designer</i>	0%	0%	0%	0.6%
<i>Contractor</i>	0%	0%	0%	0%
<i>Unforeseen</i>	0%	0%	0%	0.5%
Schedule increases				
Overall delay rate	7.1%	0%	10.4%	35.7%
<i>Client</i>	7.1%	0%	10.4%	26%
<i>Designer</i>	0%	0%	0%	3.6%
<i>Contractor</i>	0%	0%	0%	2%
<i>Unforeseen</i>	0%	0%	0%	4.1%
Satisfaction ratings				
<i>Vendor</i>	9.8	9.8	n/a	9.5
<i>Selection process</i>	10	10	n/a	9.6

Summary

City staff recognized that they, as a whole, do not have the expertise to deliver \$19M of park upgrades in the most cost- and time-effect manner. As such, they used a best value model to minimize the challenges typically encountered in working with third party, non-governmental organizations. Though the City is just getting started with the renewal program, the projects' performance is line with other best value projects in Minnesota. The best value model provides the City with performance measurements, coordination and planning education, and project management tools. The City's biggest challenge has been in understanding its own organizational culture and that of the supplier's industry. The process has helped improve the working relationship between the City and non-governmental organizations.

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