An Assessment of Best Practices and the Efficacy of an Open Repository in the Construction Industry

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ABSTRACT
Effective collection and dissemination of project information including procedures and guidelines that help increase the likelihood of construction management success is vital to organizations. Inside the construction industry these pieces of project information are referred to as best practices. In a global economy, it is crucial to have successful practices standardized and accessible across organizations when needed. Best practices can help improve project performance, yet these practices are not universally implemented in the industry, due to the following: 1) not all practices are applicable to every project or organization, 2) knowledge lost in organizational turnover which leads to inconsistent collection and implementation of best practices and 3) the lack of standardized processes for best practice management in an organization. This study, sponsored by the National Academy of Construction, the Construction Industry Institute and Arizona State University, used structured interviews and a Delphi study to further examine the best practice management process, common pitfalls and the efficacy of an open repository of best practices repository. This paper presents the authors’ findings to date; specifically exploring the term “best practice”, its definition, elements that hinder implementation and the potential value of an open online repository for such practices in the AEC industry.

INTRODUCTION
In the architecture-engineering-construction (AEC) industry (building, industrial, infrastructure and manufacturing projects and all project participants), effective knowledge management systems are critical to successful collection and dissemination of information within organizations. Many times, this knowledge is critical to increasing the likelihood of project success for organizations and is also considered a competitive advantage. One subset of this knowledge base is best practices specific to the management of construction/capital projects.

NAC Best Practice Repository Feasibility Study
The National Academy of Construction (NAC) first considered the concept of an industry-wide open repository late 2011. The purpose of this effort is a desire by NAC to improve the industry as a whole. With sponsorship from the Construction Industry Institute (CII) and Arizona State University (ASU), beginning in the fall of
2012, the authors began the feasibility assessment of an open repository for best. A steering committee, made up of key industry executives and representatives from industry associations, was convened to provide guidance on both the content and form of the repository.

In this project, “repository” specifically refers to an online resource (i.e., website) that would house critical practices for project success. There would be global input from industry subject matter experts. Ultimately, if created, the repository could serve as a reference for those looking to learn about industry practices. An example of a well-known repository is Wikipedia.

Best practices are important and should be implemented; however, some organizations may not have the resources to effectively collect and disseminate these practices. Other organizations are so large, that dissemination across the width of the organization is difficult. An open source repository of best practices addresses these issues and could provide the industry with a set of proven practices. Further, this repository could support knowledge transfer despite personnel turnover, in turn allowing organizations to maintain or even improve their performance over time. Beyond the feasibility assessment of the repository, the research findings can also provide a knowledge management model for organizations, which can enable better collection and dissemination of internal information, facilitating successful knowledge transfer. Standardizing the collection of best practices can create an opportunity to systematically incorporate these practices within academic and industry organizations. If best practices are standardized and readily accessible in the construction industry, organizations can capitalize on opportunities for performance improvement, hopefully raising the performance of the industry as a whole.

The steps taken to better understand best practices and conduct the feasibility study were threefold. First, a review of relevant literature was conducted. Secondly, structured interviews were conducted to understand the management process of repositories within organizations. Finally, to gauge the interest of an open repository and create a strategy to create the resource, the authors gathered a group of industry experts to participate in a Delphi study.

The paper will first describe the state of best practices management in the AEC industry. An overview of knowledge management is given. Next the research methods (structured interviews and a Delphi study) used in this research study are described along with by the findings from these methods. Finally, important themes from the findings are discussed at the end of the paper.

**KNOWLEDGE MANAGEMENT AND INDUSTRY RESOURCES**

Knowledge management (KM) is defined as “the identification, optimization and active management of intellectual assets to create value, increase productivity and gain and sustain competitive advantage” (Webb, 1998). With the use of various resources and information and communication technology (ICT) tools organizations develop systems that can improve their business processes, leading to a competitive advantage. The goal of KM systems is to avoid “reinvention of the wheel, which is wasted activity and potentially weakens project performances” (Siemieniuch and Sinclair 1999).
Information housed in KM systems specific to the construction industry can be placed in three categories (Rezgui, 2001):

- **Domain** - information related to the construction industry. This information is not proprietary to any organization and can be thought of as common knowledge. For instance, state or city code regulations that are widely available.

- **Organizational** – information related to a specific organization. For instance, this information provides users insight on organizational procedures and policies.

- **Project** – information related to a specific project within an organization. For instance, the labor and material typical required for a highway project.

Project specific information is the main focus of this study, specifically the best practices and similar information associated with construction projects.

In their study, Kamara et al. (2002) assessed the extent knowledge management had been implemented in the AEC industry. The researchers conducted 32 interviews and the study concluded the absence of a proactive KM strategy does not fully exploit the intellectual assets of AEC organizations, particularly in the capture and reuse of project knowledge, and in the integration of people and technology-based initiatives. The importance of information technology (IT) investment for successful KM systems is explored in research conducted by Anumba and Pulsifer (2010). The study concluded that KM systems should facilitate the “live” capture and reuse of knowledge and effective IT resources can improve this likelihood. The study also concluded that the continual investing in KM systems enables organizations to effectively and consistently use their knowledge to improve business (TFPL, 1999).

These studies illustrate the importance of capturing and reusing knowledge as a competitive advantage, portray a need for KM strategies for organizations and advocate the iterative process for knowledge capture.

A key element of this study is to identify best practices. This is a challenge because there is no common terminology regarding best practices or one standard list of industry practices. Also, the term “best practice” is difficult to define. A practice that is considered “best” to some organizations may not be considered a “best” for other organizations. Table 1 lists some industry associations and their respected best practice (or equivalent) resources. This short list demonstrates the fragmentation in the industry regarding practices. If an open repository is developed, the fragmentation of industry practices will need to be addressed. In addition to fragmentation, the resources are not freely accessible to the industry. The resources must be purchased and in some cases payment of a membership or consulting fee is required.
Table 1: List of Industry Repository for Best Practices

<table>
<thead>
<tr>
<th>Organizations</th>
<th>Industry Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Associated General Contractors of America (AGC), Associated Specialty Contractors (ASC) and American Subcontractors Associations (ASA)</td>
<td>Guidelines for a Successful Construction Project (AGC et al., 2008)</td>
</tr>
<tr>
<td>The American Institute or Architects (AIA)</td>
<td>Best Practices (AIA, 2013)</td>
</tr>
<tr>
<td>Construction Industry Institute (CII)</td>
<td>Best Practices (CII, 2013)</td>
</tr>
<tr>
<td>Construction Management Association of American (CMAA)</td>
<td>Standards of Practice (CMAA, 2010)</td>
</tr>
<tr>
<td>Independent Project Analysis (IPA)</td>
<td>Value Improving Practices (IPA, 2013)</td>
</tr>
<tr>
<td>Project Management Institute (PMI)</td>
<td>PMBOK and Library of PMI Global Standards (PMI, 2013)</td>
</tr>
</tbody>
</table>

Examining the literature and industry resources regarding best practices leads to a few conclusions. The first is the importance of a structured KM system that is supported by beneficial IT tools. Secondly, organizations that can avoid reinventing knowledge systems can use best practices more effectively which can lead to a competitive advantage. Finally, fragmentation and proprietary nature of industry repositories of best practice can hinder implementation. To have a positive impact on the industry, the proposed open repository will need to address these topics.

STRUCTURED INTERVIEWS

As previously mentioned, structured interviews were conducted to explore knowledge management systems (in respect to best practices), the required resources needed for management of a repository, and industry interest in the open repository. The structured interview approach allowed for in-depth questions, which did not restrict or limit participant’s responses. After questions are asked, each respondent is able to answer without being limited to a close-ended response.

In this study, the structured interviews were conducted over the course of seven months, from November 2012 to May 2013. In total, eight organizations (three owners and five contractors) participated (14 individuals) in the process. Each interview was roughly 60 minutes in length and all but one interview was conducted via telephone. The organizations that participated were from various industry sectors (e.g., pharmaceutical, chemical, commercial building, manufacturing and oil industry). Of the eight organizations, seven were CII members.

Interview Findings

A questionnaire was developed before the interviews started in November 2012. The questions created were grouped into four overarching themes below:

1. Management of Best Practice Repository
2. Definition and Granularity of Best Practices
3. Potential Value of Open Repository

**Management of Best Practice Repository**

Organizations were asked to describe their knowledge management system, specifically the methods of collecting, populating and disseminating information. Organizations also detailed the resources (technology, time, and human capital) used to manage the system. Below are the key findings for this theme:

- All organizations interviewed had a structured knowledge system in place. These systems not only held best practices but also domain and organization specific knowledge. Organizations had already developed or were in the process of developing “one stop” systems, which made finding resources and learning about best practices (knowledge dissemination) more convenient for users.
- Organizations used both internal and external tools and techniques to implement best practices.
- Collection of project knowledge ideally occurred during a project or shortly thereafter. Each organization had a plan in place and an individual or a committee charged with updating the knowledge within the system.
- In many organizations knowledge management responsibilities were handled in addition to job roles. Therefore a structure documented process and dedicated champions were mentioned as elements needed for a successful management process.
- Larger organizations had more resources (financial and human capital) dedicated to the management of knowledge. One of the organizations (owner) mentioned it had a group dedicated solely to improving resources for best practices (roughly 65 highly skilled/educated individuals).

**Definition and Granularity of Best Practices**

The definition of the term “best practice” and the identification of specific best practices was an important interview topic. Understanding the method in which organizations identify best practices could serve as a model for best practice identification for the open repository. Organizations were specifically asked about their internal definition of the term “best practice” and to give insight on their approach to granularity of information. In the interview, granularity refers to the breadth and depth of knowledge that organizations found important to collect.

Listed below are findings from the interviews regarding the definition and identification of best practices:

- None of the organizations had a proprietary definition of the term “best practice” or a similar term. However, a few individuals said “we know it when we see it”. A few of the organization mentioned that they defer to the
definition and best practices structure of various associations. For instance industry groups mentioned earlier in this paper (CII and IPA).

- Regarding granularity, the breadth of best practice spanned the project lifecycle (project planning, risk, safety, etc.) There were industry segment project specific best practices as well, for instance pipeline versus water treatment projects. When needed there were instances where best practices were very detailed. However, organizations found that with greater detail, users become overwhelmed with the information and there is a probability the information or resource is not used.

**Potential Value of Open Repository**

During the interview, individuals were asked to give their opinion of the potential value of an open repository for industry best practices. The findings from the interviews on the potential of the repository are listed below:

- All organizations said that there would be value in an industry repository for best practices. Some organizations mentioned that it could be a valuable resource if there are global contributions in the repository.
- Many cautioned that it might be difficult to get significant industry participation. The organizations interviewed mentioned that it was a struggle to get its employees to use internal best practice and lesson learned systems. The human factor is key to successful use of such systems.

To conclude, the purpose of the structured interviews was to explore the term “best practice” identify elements that hinder implementation and assess the potential value of an open repository. From the interview findings, organizations used the term “best practice” or a similar term and deferred to industry organizations for its definition and best practice identification process structure. To overcome hindrances to successful implementation, a structured process, management team and iterative knowledge collection process were key. Finally from the structure interviews, organizations stated that an open repository would be valuable but there was concern regarding the potential use in the industry.

**DELPHI STUDY**

A Delphi study is used to “structure a group communication so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem” (Linstone and Turoff 1975). The origins of the Delphi method dates back to research conducted by the RAND Corporation in the 1950s and 1960s. The Delphi is characterized by four important elements: anonymity, iteration, controlled feedback, and statistical aggregation (Dalkey et al. 1969; Rowe and Wright 1999). Specific to this study, the Delphi method is being used to further explore the topics identified from the structured interviews.

The first round of the Delphi study is completed. A second round is scheduled with a possible third round to follow. In the first round of the study, participants were asked to answer questions focused on the definition and identification of best practices; their interest in an open repository, the ideal management strategy for the
repository; and potential barriers to success if the repository were created. Participants were asked to rate multiple statements and answer open-ended questions. Rating was on a Likert scale from one to seven. On the scale, one represented “Strongly Disagree” and seven “Strongly Agree”.

**Findings**

The following subsection shares findings from the first round. Thirty-five individuals from industry organizations (CII and non-CII member organizations) and academia have agreed to participate in the Delphi study. To date, 21 individuals have completed the first round questionnaire.

**Definition and Identification of Practices Critical for Success**

The authors quickly found the term used to describe best practices varied across companies and sectors. Thus to potential benefit industry, it was proposed a new term be developed that encompasses “best practice” and similar terms. With input from the steering committee the term “Practices for Excellence” (PFE) was created. Delphi participants were asked to evaluate the term and identify practices critical for project success. Below is the term and definition that participants were asked to evaluate.

| Practices for Excellence (PFE) are specific processes and actions, with proven benefits (from research or past performance), that when repeated and documented, result in an increased probability of management or operational improvement throughout the construction/capital project lifecycle. |

From the first round Delphi results, key findings on the term “PFE” and the identification of practices are listed below:

- Seven respondents strongly disagreed, disagreed and conditionally disagreed; six respondents were neutral; and eight respondents conditionally agreed, agreed and strongly agreed that the term “Practices for Excellence” would add value to the industry.
- Two respondents disagreed and conditionally disagreed; five respondents were neutral; and 14 respondents conditionally agreed, agreed and strongly agreed that the definition encompasses “best practices” and similar terms.
- Participants were asked to identify seven project practices that are most critical to increasing the probability of project success. The Delphi participants identify the top best practices as the following: Front end planning (Gibson Jr et al., 2006), Constructability (Goodrum, Hancher, and Yasin, 2003), Alignment (Griffith and Gibson Jr., 2001), and Risk Management (Walewski and Gibson, 2003).

Regarding the value of the term “Practices for Excellence”, 13 of the 21 respondent disagreed or were neutral that the term added valued. One reason for the disagreement is that the term “Best Practice” is currently widely used within and out the AEC industry. Respondents mentioned that it would be difficult to implement the
new term “Practices for Excellence” without buy-in from the industry. The term “Practices for Excellence” would need to be widely adopted in order to add value. Practices critical to project success identified by respondents were heavily focused on the management of projects. The top practices are widely recognized and used by CII member organizations.

Industry Interest and Management of the Open Repository

Participants addressed the potential “traction” of an open repository in the industry and the management strategy for the repository. Participants were also asked to identify the potential users of the early release of the repository.

Below are key findings from the results:

- Respondents agreed that there is an opportunity for the repository to gain “traction” in the industry. Sixteen of 21 respondents conditionally agreed, agreed or strong agreed. The remaining respondents conditionally disagreed and disagreed.
- Respondents replied that project engineers, senior project/construction managers and owners should be the groups initially targeted in the early release stage of the repository.
- Nine respondents replied the creation and management of the repository should be connected with an established industry association. Seven replied that repository should be created and managed as a stand-alone entity and four replied that repository should be connected with an academic institution.

Potential Challenges of Open Repository

In the final section participants were asked to identify the primary barrier to the creation, implementation and sustainment of the repository.

- Respondents indicated that the lack resources (money and time) and lack of industry commitment/involvement would be the primary barriers to the creation of the open repository.

The purpose of the Delphi study was to help the researchers further explore topics from the structured interviews and identify keys elements in the early release stage of the repository. From the first round Delphi results, the term “PFE” would not add value or help the fragmentation in the industry. Also from the results, Front End Planning, Alignment, Constructability and Risk Management are practices that should be included in the repository. In the early phase of the project engineers, senior project/construction managers and owners should be initially target. Yet again, the Delphi results indicated there is interest in an open repository; however, the lack of resources and industry commitment are the primary barriers to success.

CONCLUSION

This study on the feasibility of an open repository of best practices for the AEC industry is still in progress. However based in the current findings a few
conclusions can be made. Firstly, there is fragmentation in the industry regarding the term “best practice” and its definition. Secondly, there is industry interest in an open repository of best practices. Thirdly, lack of industry support and resources (money and time) for the open repository of best practices are the primary barriers to implementation.

Defining the term “best practice” and identifying best practices are important steps if the open repository is developed. To help with this step, with the input of the steering committee the term, “Practices for Excellence” was developed. However, from research findings, the creation of the new term in not immediately needed. This finding is important because in the early release phase of the repository effort should be spent on the identification and collection of practices (e.g., Front End Planning, Constructability, Alignment, etc.).

There is interest in the idea of an open repository; however, the business case will need to be further explored. The business case will explore difficult topics such as startup funding, revenue streams to fund the repository and technology needed to create a robust repository. The exploration of these topics is critical to develop methods to increase industry support and “buy-in” for the repository. Further exploration by way of the second Delphi round and focus groups will provide more clarity to the business case. In the end, even if the feasibility of creating the open repository is not found, organizations looking to strengthen their process can find value in the results found from this study.

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