

STANDARDIZING CONTRACTUAL COMMUNICATION

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ABSTRACT

For almost a decade the authors have provided web-based services to exchange contractually required information between public project managers and their stakeholders. This paper evaluates the functionality provided by the authors' PROJect extraNET (ProjNetsm) service and identifies commonalities in business processes as either "interaction" or "enabling" patterns. Interaction patterns describe how contractors and owners interact with regard to specific contract requirements. Enabling patterns define application framework requirements for trusted interaction patterns. As an example of how these patterns have been applied, specific ProjNetsm applications are classified according to these patterns. Two types of costs savings can be achieved using these patterns. The first type of savings results from verifiable user attribution. The second type of saving results from the classification of specific items that are exchanged. These savings from the Design Review and Checking System (DrCheckssm) are provided as examples of the attribution and classification savings. ProjNetsm savings can be immediately identified by each user. Future requirements for the exchange of Building Information Models (BIMs) may not have an immediate benefit to the users providing BIM data. Demonstrating immediate benefits from the creation and use of BIM to those who will ultimately be required to provide it is critical if BIM is to become the future means of contractual information exchange between owners and business partners.

KEY WORDS

Information exchange, web-enabled, construction management, business process, design review, request for proposal, bidder inquiry, lessons learned, building information model, BIM.

INTRODUCTION

On public projects it is increasingly unlikely that the group of design, construction, and owner personnel on one project will work together on future projects. Regardless of the specifics of a given contract, without having worked together in the past there is no mutual understanding of individual team workflow expectations. Different expectations about the way work is to be accomplished may result in costly misunderstandings only discovered in later phases of the project life-cycle.

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Many project managers are turning to applications provided on the World Wide Web. A review of approaches to these tools identifies three ways that project managers are using the Web for information exchange. The first approach is for the project manager to create their own repository. This can be easily accomplished using a variety of tools such as File Transfer Protocol (FTP), LotusNotes, Groove, or SharePoint. While such an approach is the most flexible, and often initially the least expensive, each project manager must define the work-flow sequences needed to track issues and ensure resolution. Frequently, team members using such tools spend a significant amount of time sifting through large amounts of irrelevant data before finding information of interest.

Another approach that project managers have taken when selecting project information exchange platforms is that of commercial-off-the-shelf (COTS) tools. The benefit of COTS is that they provide a wide feature set that can meet the majority of information exchange requirements associated with the given product's target market. For example, some commercial systems are geared toward the exchange of information between subcontractors and prime contractors. Other systems are geared toward the management of design document versions. Thus, each commercial system has features sets that project managers must carefully evaluate. Within these tools there are either fixed or open ended applications. Fixed applications are those which require a specific set of steps needed to complete the process. Open-ended applications allow, for example, the free exchange issues to be resolved. The management of such open-ended applications is difficult since managers will need to know the overall state of all issues to resolve those in contention.

From an owner's point of view, are concerns with the use of commercial software provided by individual team members versus having the software be provided by the owner. The concern most often raised relates to the ultimate ownership of project records. While the majority of project records should be the property of the owner, depending on the use of the system there may be significant difficulties in removing proprietary information and transferring the information to the owner. Archiving information from multiple commercial systems into owner and facility manager databases has also proven difficult. Anecdotal evidence indicates that project records have been lost since access to such data requires continued access to the system after project completion. The potential for selective removal of project information may also be a concern of owners prior to a project's claims phase.

A third approach, taken by several federal and state public owners in the United States, is to create a consortium under which the specific standard business processes needed for owners can be addressed. This consortium was created in 2005 under the National Institute of Building Sciences (NIBS). The Government-to-Business (G2B) Process Committee's goal is to facilitate the standardization of information exchange business processes and where needed to define requirements that can be implemented in not-for-profit software. Through NIBS, the consortium is focused on the identification and support for contractually required information exchange. These data exchanges points are the basis for the business-process-based software in the PROJect extraNET (ProjNetsm) platform.

BUSINESS PROCESS PATTERNS

The majority of contractual information exchanges between designers, builders, and owners can be categorized in one of several standard methods of communication. In the discipline of software engineering, standard types of computer processing are called “patterns.” [Gamma 1995]. The application of patterns for general business applications are used to document, standardize, and streamline e-business communication. A leading force behind such standardization is the Organization for the Advancement of Structured Information Standards (OASIS) [OASIS 2006].

As work on the ProjNetsm suite has evolved, the authors have identified several patterns in contractually required exchanges of information among and between project stakeholders that have been built into ProjNetsm. What changes between patterns is the designation of users’ roles. Business processes in ProjNetsm can be described by two types of patterns. The first are interactions that require exchange among and between authorized business partners, or “Interaction” patterns. The second are interactions required between users and the systems that implement the Interaction patterns. This second type of pattern is called an “Enabling” pattern.

INTERACTION PATTERNS

Issue Identification and Resolution

The typical pattern of communication between contractors and owners is one in which issues are identified, evaluated, resolved, and verified. During this process different types of users perform different roles depending upon their contractual obligations. For example, in a design review, building operators and occupants identify issues that must be evaluated by designers. In a bidder inquiry process, prospective bidders ask questions that are evaluated by the owner’s technical experts. Bidder inquiries are answered by authorized representatives of the contracting officer. During the request for information stage, awarded construction contractors request information to clarify designs. Requests are again evaluated by the owner’s experts and replies provided by the contracting officer, or representative. Construction submittals are also a process that can be described by the issue identification and resolution pattern.

Information Exchange

The information exchange pattern allows a group of known users to exchange information with one another. There are times when this exchange is a one-way transmission, such as a deliverable. There are other times when this exchange is an interactive exchange of partially completed files exchanged between companies using interoperable software systems. A web-based exchange platform is useful when local area network connections are not available. Since the scope of the ProjNetsm service is information exchange, not collaboration for document production, direct mark-up or check-in and check-out capabilities are not provided in ProjNetsm.

Information Broadcast

While the issue identification and exchange patterns apply to specific projects, the information broadcast pattern applies across entire programs of projects. In the broadcast pattern, design guidance and standards developed and maintained by the owner's subject matter experts are provided to the owner's business partners. Application of the broadcast pattern ensures that the owner's business partners will have a single point of access to the latest standards. The owner is able to provide the standards at a lower cost resulting from decreased reproduction cost. A side benefit of the Information Broadcast pattern is that subject matter experts can update their documents real-time without restrictions imposed by information management staff.

Mediated Broadcast

In the information broadcast pattern information flows from experts to all stakeholders. In the mediated broadcast stakeholders provide information to subject matter experts. Before broadcasting the submitter's information, the subject matter expert reviews and approves the release of this information. The identification and evaluation of repetitive deficiencies, customer criteria, location criteria, or lessons learned are all processes that require a mediated broadcast pattern.

ENABLING PATTERNS

User Attribution

To use information exchange tools, particularly in contractual settings, users must have confidence that the information attributed to each person was actually created by that individual. Without a 100% guarantee of attribution, trust in non-face-to-face communication breaks down. While the protection of proprietary communication or data, is often the stated goal of the security requirements imposed on information technology such as the National Information Assurance Certification and Accreditation Process [NSTISSC 2000], from the authors' perspective, such requirements simply provide a framework within which user attribution can be 100% certified. Rather than a hindrance to the rapid creation of software systems security requirements engender the trust required to establish web-based software tools.

Effective user attribution is contingent upon four key requirements. The first is encryption of transmitted information. Encryption ensures that someone does not intercept and modify information being exchanged. The need for encryption eliminates the two most commonly used information exchange protocols, File Transfer Protocol (FTP) and Simple Mail Transfer Protocol (SMTP), from consideration if contractually valid information exchanges are needed.

The next two components of the attribution pattern require that users are each provided with their own individual account and that these accounts are provided with access rights to modify system data commensurate with the user's job duties. Often this is called "user authentication" by security specialists. Finally, exercise the user's set of approved functionality they must be "authorized" for access to individual projects, or classes of projects.

Team Provisioning

Providing customer accounts to information systems is a very difficult and widely discussed problem. For example, many universities now have specific “Identity Management” offices as part of their computer services or security offices. Such services may provide authentication devices such as identification cards as well as accounts to needed automation systems and networks. Until such time as a national authentication authority issues standard electronic passports, each system (or group of related systems) must provide their own user authentication. While civil libertarians bemoan the centralization of identity management, the requirement that each of us carry passwords for many different systems is, from the authors’ point of view, untenable.

For ProjNetsm the customer access pattern allows existing users to request accounts for access to project-specific information. The designation of project-specific access must remain with the project managers, or designated representative, responsible for each project. Some business processes require “public” access so that contracting or standards-related information may be exchanged. These sub-patterns must also be accounted for to ensure compliance with the Attribution pattern.

User Assistance

Given the frequency of technology change, users cannot be expected to know the details of information systems used on an infrequent basis. A critical pattern of any complex tool is that of customer support. From the authors’ point of view this requires human interaction. While the primary function of Call Center staff is to provide first line support for password and access issues, the ultimate function of the Call Center is to promulgate best practice standards. As a result, Call Centers must be staffed two types of personnel. First are those with a general knowledge of computer technology such as could be achieved with associate’s degrees. Call Centers must also include experienced personnel capable of assisting project managers and team members on a wide range of projects and contractual arrangements. These experienced Call Center personnel capture and feedback best-practices in the use of information exchange technologies.

Technology Distribution

The pattern of technology distribution provided for a given application suite may driven by the need to provide a “rich” end-user interaction or by the need to include the widest possible set of partners. Given that higher-level user interactions require the installation of software clients such as CADD systems, the marginal cost to provide CADD tools, even viewers, becomes quite high for infrequent users. In some instances, corporate policy restricts the installation of individual application software to reduce the total cost of computer ownership. In other cases Internet Service Providers terms of service also limit the types of interactions that can occur across their connections.

For project environments where access for all contracting tiers, across all projects is essential, the only effective means of technology distribution is through a web browser and server-based software. The original ProjNetsm distribution model was to provide a turnkey web server and software to each agency. This pattern of distribution was soundly rejected by

our customers. Agencies project management and engineering staff continue to resist the use of internal information management personnel and infrastructure whose goal is to restrict access to “scarce” corporate information resources.

PROJNETSM SERVICES

To support these interaction patterns the ProjNetsm provides a suite of software services that all utilize the same framework of enabling services. In this section, the major ProjNetsm services are described matched with their associated contractually-based information exchange patterns.

ISSUE IDENTIFICATION AND RESOLUTION SERVICES

DrCheckssm supports the identification and resolution of design and other document reviews [Soibelman 2003]. Identification of contentious issues and status summaries allow managers to quickly reach resolution while reducing meeting and travel costs [East 2004].

ProjNet-Bidsm supports the bidder-inquiry process through which prospective bidders questions are answered by appropriate contracting office staff. Agency technical experts assist contracting office staff in reaching a technical resolution of each item.

ProjNet-RFIsm supports the request for information process by which awarded contractors request clarifications to contract documents. These questions are answered by contracting office staff based on feedback from agency technical experts.

INFORMATION EXCHANGE SERVICES

ProjNet-Filersm allows project team members, including tiered consultant, sub-contractors, and suppliers to securely exchange documents. Audited electronic transmission eliminates mailing delays and identifies file access history. Documents provided through ProjNet-Filersm may also be used to begin Issue Resolution patterns.

ProjNet-Plansm allows contracting officers to publish bid documents and requests for proposals. Tools for referencing standard documents shared among all request for proposals and features supporting publication of amendments are also provided.

Information Broadcast

ProjNetsm's Design Standards Portal allows managers of design standards to maintain a single point of distribution for all authorized business partners.

Mediated Broadcast

CMS, short for the Criteria Management System, allows agencies to coordinate the management and content of agency-specific and government-wide specifications such as the Unified Facilities Guide Specifications (UFGS). Agencies also manage their internal regulations and guidelines using CMS.

CCR, short for the Criteria Change Request tool, allows members of the public to request changes to government criteria, requirements, regulations, and guidelines.

Design Quality Lessons Learned (DQLLsm) provides the capability for owners to capture, evaluate, re-use, and resolve repetitive deficiencies, location criteria, and customer-specific requirements. Lessons learned identified as potential criteria changes are forward through the CCR to ensure prompt inclusion in future criteria updates.

IMPACT OF CURRENT ePAPER EXCHANGE

Given the exchange of information based on current contracts and specifications, the patterns of interactions identified above are, to a great degree, independent of the media used to exchange the information. The current media of exchange within ProjNetsm is “ePaper.” ePaper refers to typed or stand-alone diagrammatic media. For example, the four ways to enter comments in DrCheckssm are by typing comments through a web form as a full participant in the design review process, by typing comments into a Microsoft Word file template, by typing comments into a legacy system client application, or by typing comments as a one-time user of DrCheckssm QuickAdd functionality using a review specific key and web form. These electronic methods and forms simply replace the paper-based forms previously used to capture review comments.

The impact of the replacement of paper-based forms with electronic forms is that information is automatically attributed and organized. The attribution results from tracking each user’s identity through enabling patterns. The organization results from the consistent use of agency or industry standard meta-data identified with the exchange each atomic exchange packages, such as an individual review comment.

Simply by having automated attribution immediate benefit result. Issue resolution is simplified since the names and contact information for all parties involved in a given issue are easily identified. Attribution during file exchange is also critical since team members need to know who provided specific information and when such information was retrieved. Having this attribution results a documented, direct savings to the project due to a reduction in the number and duration of meetings. A minimum savings of \$30K (U.S. dollars) in the cost of project management services can be traced to reductions in meetings[East 2004].

The automated classification of issues provides immediate benefits as well. At the most basic level, the automated classification of issues frees the project manager from having to collate issues prior to meetings. While savings associated with collating have not been formally documented, one can realistically estimate that 40 hours per project could be saved as a result of the automatic categorization of ePaper-based information. Information related to the distribution of items across classification schemes has also been used by agencies to reduce costs. The allocation of criteria update funds in one agency were, for example, redirected based on data mined from DrCheckssm. The result of this redirection continues to be of benefit to all subsequent agency projects. Data mining techniques have also been demonstrated to support the automated identification and evaluation of repetitive design deficiencies [East 1996].

Data classification by design discipline also streamlines efforts of the entire project team. This is possible since those items related to users’ areas of interest can be directly accessed as needed. Additional subsets of information can be identified based on the stage of issue

resolution or various user defined 'warning' flags that are part of the issue identification and resolution pattern. Classification of comments according to user attribution also provides an important, but unquantified benefit. By comparing the set of possible participants with those who actually did participate, project managers are now able to identify and prompt those individuals or firms that did not perform as expected.

THE CHALLENGE OF BUILDING MODEL EXCHANGE

The simple application of automated user attribution and classification provide the lower bound of benefits to be achieved by the standard exchange of contractually required information. As the industry transforms from ePaper to Building Information Models (BIMs), additional benefits have been projected. Some of these benefits will, however, not accrue to those performing the information exchange but only to those downstream in the facility life-cycle process. For example, the Ifc-mBomb project's goal was to demonstrate the exchange of information between design, construction and operations [IFC 2004]. The electronic capture of submittal information during construction does not, at this time, appear to directly support the construction manager, contractor, subcontractor, or supplier. The goal of the United States General Services Administration's (GSA) efforts to document architectural programming decisions for the purpose of providing more tractable project cost estimates to guide later conceptual and final design stages. GSA's efforts do not appear to directly provide benefit to those during architectural programming responsible to create this information.

Acceptance of the information exchange tools provided in ProjNetsm has been successful because the benefits of using the exchange tools reduce costs associated with the daily activities of those using these tools. Since the first benefits from the exchange of BIM will accrue to those in different project phases, the challenge to researchers, the BIM-community, and software providers will be to explain how the patterns of BIM-enabled exchanges can directly reduce the costs of those required to produce the BIM.

CONCLUSION

Through ProjNetsm, U.S. federal and state governments are standardizing and streamlining their information exchange processes. The not-for-profit approach taken by U.S. government agencies provides the value of commercial software solutions in a framework that emphasizes increases in use of software versus seats sold. Business-process applications on ProjNetsm have flexibility to respond to different contract requirement patterns. Best-practice guidelines assist project managers to adopt standard practices across all government agencies. Currently savings resulting from the use of ProjNetsm are due to automated attribution and collation using standard classification schemes. To be successful, the upcoming transformation to BIM, must address not only value to those upstream and downstream in the building life-cycle but also the value to those who are required by contract to create the BIM.

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