

Approach for Easy Management of Bid Invitations in Construction: A Web Based Application

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Lack of communication between general contractors and subcontractors is often seen as one the major reasons for time delays and cost overruns in construction projects. This communication issue extends and is seen in the bidding process during pre-construction phase of a project as well. Often times, during bid days, contractors are seen struggling with the way in which they track bid invites and gather intentions of subcontractors regarding bidding. This leads to a lot of manual work, huge amount of time, and often strained relationships between general contractors and subcontractors. In the construction industry which is still slow in the adoption of advance technology, this paper attempts to provide a solution to limit the communication gap and encourage simplified flow of information during bidding process of a construction project. This paper presents the development and evaluation of a web-based computer application, which provides an easy platform for general contractors to send and manage their bid invitations. The paper also aims to encourage the industry personnel which is often reluctant to adopt the technology and thus, guides through the process of app development in detail which requires no manual coding and is accomplished using a simple database tool called Knack.

Keywords: Knack, Bid Invitation, General Contractors, Subcontractors, Bid Tracking

Introduction

The successful deployment of construction projects depends largely on the effective interaction among project participants. Often challenges in construction industry arise due to ineffective communication and are referred as communication problems (Emmerson 1962, Higgin and Jessop 1965, Latham 1994, DETR 1998, Loosemore and Lee 2012). A construction project includes several stages during which a large number of information is transmitted not only from one stage to another, but also among various participants within a stage. Due to its fragmented and dynamic characteristics, this industry forms a complex communication environment (Loosemore and Lee 2012). The information management and interaction of the project team remains further challenging as the participants come from wide variation of professional skills, educational background, expertise, working environment, and computer acquaintances.

With an industry being so diverse, communication also plays an important role in establishing relationship between different participants of a project (Loosemore and Lee 2012). Specific instance of one such relationship is between general contractors and subcontractors, which is considered as a key to success of any construction project. Interaction between these two parties begin right from the pre-construction phase till the owner occupancy, and remains active throughout the duration of a project. During pre-construction stage, an important and early interaction that a general contractor establishes with subcontractors is regarding invitation that they extend for bidding their project. These bid invitations can be sent through several ways such as, emails, phone calls, fax, in meetings, etc., but nowadays more emphasis is given to information technology tools. Several database software and internet technologies are available which provide substantial capabilities in this direction and allow transmission of vast volumes of information in no time (Chassiakos & Sakellaropoulos 2008). However, with the rapid adoption in technology and availability of numerous bid invitation tools such as, iSqft, BuildingConnected, CoConstruct, SmartBid, etc., the streamlining of existing practices is being deteriorating. Usage of varied software leads to unavailability of common platform to share information, thus inducing roadblocks to effective communication between general contractors and subcontractors. Also, withstanding the fact that construction is still not up in the list of technology friendly industries, complex tools

makes it even harder to carry out information management and its sharing efficiently. Thus, in order to surmount current deficiencies, more emphasis should be given to simpler methods and tools to disseminate crucial information at the required time.

This paper presents an attempt to develop a web based application which provides a simple platform on which bid invitations could be sent and managed easily. This is accomplished using a software called Knack, which eliminated the need of specialized knowledge in manual coding and programming to develop a computer application. This paper also provide detailed insights on how this application was developed using this platform, so that the workers in the non-computerized industry such as construction are even encouraged to adopt and. advance with the technology . Further, the background and motivation for this application, development methodology, evaluation, results, and its significance is discussed in the subsequent sections of the paper.

Background and Motivation

With thousands of information, in varied formats, being shared in an organization on a daily basis during a project, it becomes equally necessary to manage these valuable information effectively. To accomplish this, every industry including construction sector is must pace towards web technologies and information technology tools. The development of such tools, however, can be a challenging task. Developing a sophisticated database application may require expertise in number of areas including detailed knowledge of programming languages and framework such as, PHP, Python, Ruby, ASP.NET, etc. This doesn't give freedom to anyone other than the one with the background in computer programming, to develop such web applications. However, these days application development is made easy, as platforms such as, Zoho, Tremplin, Knack and several others are available for the users with no background in application development. This enables them to create applications that meets their own custom requirements and style of work without any manual coding.

The current study and development of web based application in this paper finds its motivation from such opportunities available. Despite the availability of several bid management software, industry is marred with number of communication issues during the bidding process. Great part of this issue is due in the fact that each company operates differently and has different preferred methods of exchanging information. Using Knack, creation of a simple web-based platform is aimed which can be used to send and manage the bid invitations in a simple and effective manner between general and subcontractors. Drawing its name from the nature of the work performed, the application developed in the current paper is called BidInvite.

Web application development and its working

The development of web application, BidInvite, required a set of data-driven web pages that were protected with the authorization and will allow the users to send bid invites and manage them. Knack, another database management application, which is used to develop this tool, provides its users with the powerful templates to build their own custom applications.

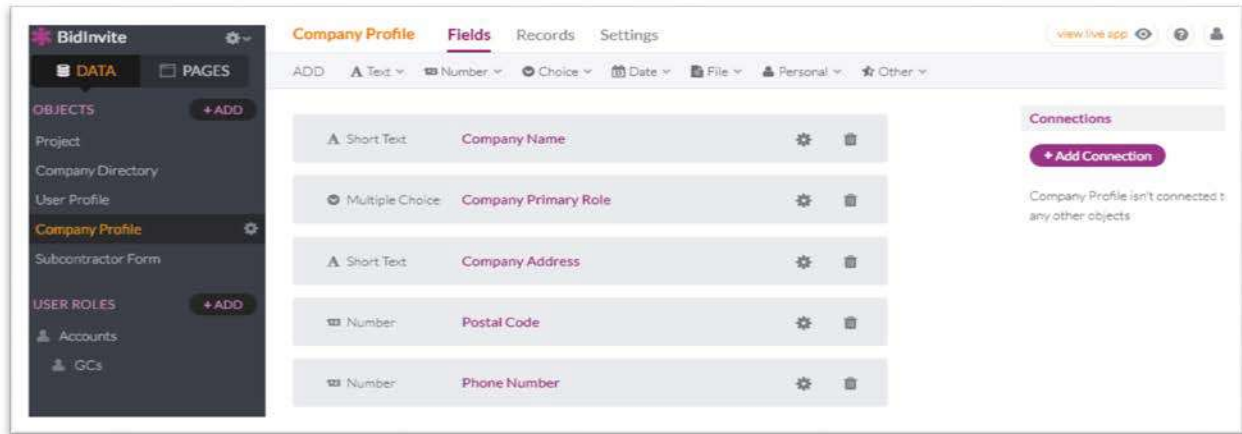


Figure 1: Application building page in Knack.

In Knack, each piece of information you want to store and manage in your application is called a field. As shown in Figure 1, all the rows such as, Company Name, Company Primary Role, Company Address, etc., are different fields which are grouped under one object called Company Profile. Similarly, different objects with several fields were first created and stored in Data. Knack gives the freedom to choose the type of field, which could be number, text, address, or multiple choice for storing data as required.

The Data which is stored in Knack database defines what kind of application can be built from it. Once the Data is defined, the records associated with it can be accessed and manipulated. After defining Data is the Pages section, using which flow of data, its records, and its connection can be defined to determine that how it will actually appear in the live application. As shown in Figure 2, the first page is set as a Home Login which will require the users to create their account and sign up to access the full application. Further, several pages are connected to it in a predefined flow as set by the creator.

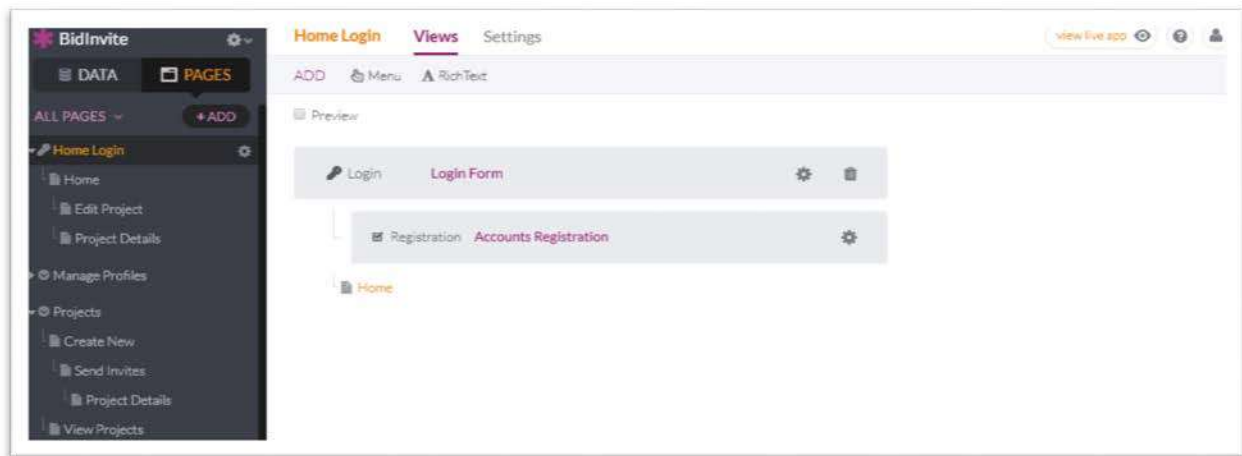


Figure 2: Pages defined in Knack using the data stored.

Once the Data and Pages are defined in the Knack, the live application can be used. The home page of BidInvite application shows the calendar which gave the general contractors an overview of their project bid dates.

General Contractor as a User

Looking at the calendar in Figure 3, the general contractor gets an immediate idea of the upcoming projects and their bid dates. On the calendar, projects highlighted red have their bid date in the past and are no longer active. Projects

with a green highlight are upcoming within the next week and are active. Whereas, projects with a blue highlight represent projects not in the immediate future.

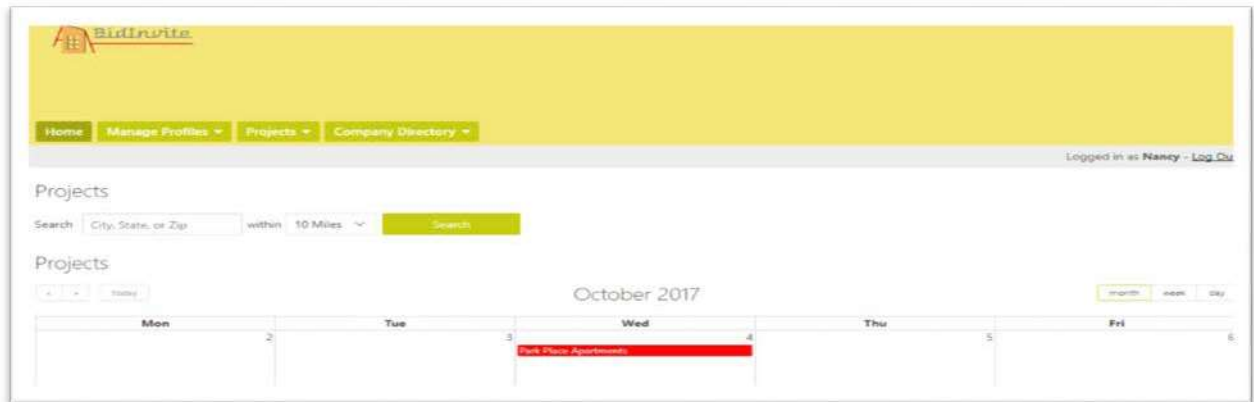


Figure 3: Home page in BidInvite as seen by General Contractor.

Further, BidInvite, gives the general contractor the ability to create new projects. By providing information regarding the project in the form of its location, bid date, preconstruction meeting and documents related to the project, the general contractor can easily create a new project as seen in Figure 4. Once a project has been set up by general contractor, the app gives an option to send invitation to multiple contacts through send invites. In send invites, the general contractor can select multiple subcontractors at a time and send them invitation directly in their emails. Company Directory tab (see Figure 4.) allows general contractors to create their directory and add contacts of their subcontractors.

Figure 4: Setting a new project in application and sending invites.

Subcontractor as a User

Upon sending invites to subcontractors, the subcontractors receive an email as seen in Figure 5. The email contains details regarding the project and its location. The email further gives access to a link, whereby subcontractors can obtain project's detailed information which was set up by the general contractor and the related documents required for bidding.

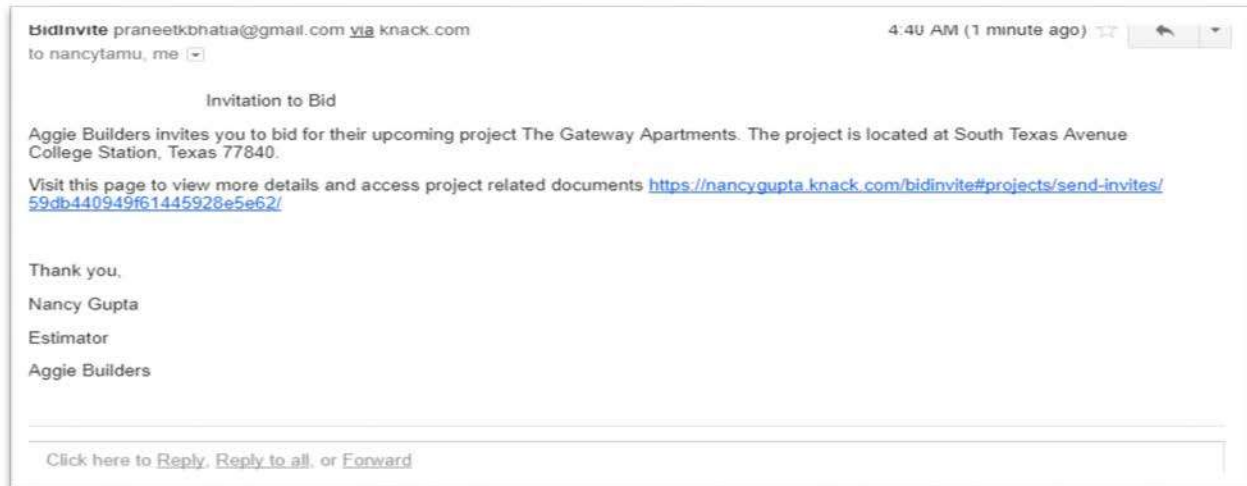


Figure 5: Receiving of a bid invitation in subcontractors email.

The screenshot shows a web form titled "Add Subcontractor Form". The form has a navigation bar with "Home", "Manage Profiles", "Projects", and "Company Directory". Below the navigation bar are links for "Create New" and "Send Invites". The form fields are: "Company Name" (text input), "Name" (split into "First" and "Last" text inputs), "Phone" (text input), "Subcontractor Email" (text input), and "Project Name" (dropdown menu with "Select" as the current option). A yellow "Submit" button is located at the bottom of the form.

Figure 6: Information form to be filled by subcontractor on clicking the invitation link.

Upon entering the link, the subcontractors are requested to fill out information regarding themselves, which will better help general contractors in tracking the subcontractors who have actually accessed the project documentation. Upon filling out the project information, the subcontractors can access the documents. The general contractor can then look at the subcontractor list, as shown in Figure 7, to find out which subcontractors have opened the invitation and downloaded documents. This will help the general contractor in not only tracking the interested subcontractors for their project but also send them reminders when bid day approaches.

Subcontractor Forms

search by keyword search

Project Name	Company Name	Name	Phone	Subcontractor Email	Project Active?	Edit	Subcontractor Form Details
Medical City Dallas Hospital	Bluebird Developers	Steve Madison	(756) 981-9190	steve.madison@gmail.com	Yes	edit	view
Medical City Dallas Hospital	Fortune Builders Inc.	Saurin Kakkad	(385) 657-2123	saurinkakkad@gmail.com	Yes	edit	view
Plains Capital Bank	Green Landscapes	Kiran Choudhry	(987) 987-9879	kirancha@gmail.com	Yes	edit	view
The Gateway Apartments	Texas Painters	Joe Harness	(454) 365-6556	joeh@gmail.com	Yes	edit	view
Medical City Dallas Hospital	Waco Builders	Mike Polo	(839) 393-9292	mikepolo@wacobuilders.com	Yes	edit	view

Figure 7: Subcontractor information report as seen by general contractor.

BidInvite, also gives the general contractor the ability to look at all his projects at once. This feature helps, general contractors in having a clearer picture of the projects and their upcoming bid dates. Further, BidInvite also provides the ability to edit projects and its details in the report itself.

Home Manage Profiles Projects Company Directory

Projects

search by keyword search

Showing 1-6 of 6 [Add Files](#)

Project Name	Project Description	Project Address	Bid Date	Pre-construction meeting 1	Pre-construction meeting 2	Edit Project	Project Details
Medical City Dallas Hospital	Medical Centre	7777 Forest Ln Dallas, TX 75230	11/01/2017	10/15/2017	10/22/2017	edit	view
Park Place Apartments	Luxury student living apartments	1505 Park Pl College Station, Texas 77840	10/04/2017	10/11/2017	10/25/2017	edit	view
Plains Capital Bank	Commercial Bank	3840 Far West Blvd Austin, Texas 78731	10/11/2017	10/24/2017	10/31/2017	edit	view
Scandia Apartments	Luxury living for students in College Station	401 Anderson St., Scandia Apartments College Station, Texas 77840	10/16/2017	10/20/2017	10/31/2017	edit	view
The District on Luther	Student Living Apartments	601 Luther Street West College Station, Texas 77840	10/12/2017	10/25/2017	11/09/2017	edit	view
The University of Texas School of Dentistry at Houston	Dental School in Houston	7500 Cambridge St Houston, TX 77054	12/05/2017	12/13/2017	12/20/2017	edit	view

Figure 8: Detailed report of all the general contractor's projects.

Testing and Evaluation

The application operability has been tested employing both artificial and real data from construction projects. Artificial data were used to check the workability of the application during its development to remove possible malfunctions. Real data were afterwards employed by the construction industry professionals when the application was sent for its validation. To carry out the evaluation process with the company personnel, which is considered as a human research subject, Institutional Review Board (IRB) authorization was first obtained, and the IRB ID for this study is IRB2017-0695M.

An anonymous online survey using Qualtrics tool was carried out to gather feedback on this application. This was done in two parts. First, the application was introduced to the construction students and their feedback through survey was collected on the general working feasibility of this application and ease in its usability. Secondly, the application was sent to industry professionals, mainly pre-construction personnel, to test and validate it with the real industry data. Further, they were requested to take the survey and reflect their views on this new tool. The survey questionnaire included questions asking if they liked the application, what features were useful, and their suggestions to improve it.

Results: Application in practice & its Limitations

The development of the BidInvite application has aimed at achieving an acceptable level of simplicity, generality, and flexibility. As derived from the feedback gathered in two phases, the application is considered successful in terms of proper functioning of the tool and user friendliness. The application displayed no problems during the user-interaction and while performing tasks as designed. The feedback also suggested that application is simple to use since limiting the type of end users, which is general contractor for this app. Also the feasibility of sending invitations in emails increases the communication reliability and makes it less complex than the existing software and tools.

Despite its positive characteristics, the tool's acceptance and applicability in industry practice may be hindered by a number of limitations. First, the application content and functions up to this point is quite basic and holds capability of sending bid invitations in emails directly. Unlike other software available for this purpose, this tool is designed for only one user, i.e. general contractors. It does not in its current state, give the opportunity of interaction between general and subcontractors through application itself. This could be beneficial and preferred for some, whereas, other companies may find it as a drawback. Secondly, designed for the simple process this application may find its usability more in small to mid-size companies where gathering and tracking bid proposals is important. The tracking of bidders may not be a part of operation in larger companies where they are in no shortage of subcontractors as bidders, however, they can still use this application to send invites to their preferred subcontractors in emails directly. Another reason that could impede the adoption of this application is the reluctance of the construction industry to try new technology and change its way of operation.

The development of a full scale application would require substantial time and effort. BidInvite tool, as it sees in its current state, is still in the evolution process. Knack, as its major strength, provides a simple solution to add new fields, establish connections, and make the development adequately flexible and extensible. Using the suggestions obtained during survey, this application is still being modified to meet the industry needs and increase its applicability. Considering the diversity of construction companies and its operational functions, the wide-spread adoption of this application by construction companies is a challenge. However, this new tool can find its usefulness for some companies which are looking for a simple platform to share information and manage bid invitations.

Conclusion

Construction is one of the most information-dependent industries, mainly due to its extended fragmentation (Chassiakos & Sakellariopoulos 2008). Construction process are complex and consist of several stages to successfully accomplish a project. The amount of information generated and exchanged during each stage is enormous, which could lead to ineffective or miscommunication. The discrepancies in information exchange during bidding process of pre-construction phase often times result into a lot of manual work, whereby on the general contractor's side it is required to manually contact subcontractors in order to discuss their intent to bid.

However, with the growing influence of technology in construction, this problem was addressed using a simple application called BidInvite, which was built using the Knack platform. BidInvite gives general contractors the ability to set up a new project in application and send them to multiple subcontractors at a time. Further, it also help general contractors in tracking the subcontractors who are actually interested in the project. It does this by generating a report automatically which contains all the subcontractor's information who accessed the invitation and downloaded the document. The relative ease of use of this application was pointed as the number one advantage for using BidInvite by industry professionals. However, it did lack in certain inabilities which was seen as a point of improvement and furthering the application. With growing technology and flexible development offered by Knack, more useful features suited to industry needs can be added to BidInvite, to make it a one stop show for Bid Management activities.

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