Charrettes as a Method for Engaging Industry in Best Practices Research

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Abstract: Gaining innovative and useful research findings concerning construction industry best practices requires an interaction and feedback mechanism between industry respondents and academia. Typical research methods such as surveys, source document reviews, and structured interviews will work, but suffer from barriers which can hamper results. Examples of these barriers include low response rates, asynchronous communication, time commitment of the researchers and respondents, access to project data, and travel costs. Structured workshops (research "charrettes") are a unique and useful method for facilitating data collection between industry respondents and academic researchers. They combine the best tenets of surveys, interviews, and focus groups in an accelerated time frame. This paper will explain how these workshops provide a critical avenue for industry interaction. Characteristics leading to successful charrettes will be outlined. The paper will conclude by describing the benefits of these workshops to researchers including lessons learned from successful workshops.

Introduction

For academic researchers to discover innovative and truly useful findings concerning construction industry best practices, an effective interaction and feedback mechanism between industry respondents and academia is needed. Typical research methods such as surveys, source document reviews, and structured interviews provide that mechanism, but suffer from barriers such as low response rate, long time for responses, asynchronous communication, time commitment of the researchers and respondents, access to project data, and travel costs which can hamper results. A unique and useful method for facilitating data collection between industry respondents and academic researchers is the use of structured workshops (research "charrettes"), which combine and integrate the best tenets of surveys, interviews and focus groups in an accelerated time frame.

This paper will discuss how research charrettes have been applied to several research projects over the past 14 years by the writers to investigate best project practices for the Construction Industry Institute (CII), Texas Department of Transportation (TxDOT) and others. Findings, practices, and tools developed as a result of these workshops are widely used in industry today. The paper will explain how these charrettes provide a critical avenue for gaining data and in determining the applicability and usefulness of newly created products or practices intended for industry use. It will illustrate how the interaction among industry professionals and academic researchers provides feedback and open forum discussion concerning critical investigation topics, while providing direction for future research efforts. The paper will also discuss how to conduct these workshops.

Special attention will be devoted to characteristics leading to successful workshop outcomes for both the industry participants and the researchers alike, including issues such as: who to invite, how to provide motivation for industry practitioners to attend, selection of location and venue of the charrette, optimum number of participants in attendance, sample size considerations, and so on. The paper will address when these types of workshops are best applied, as well as when they may not be as useful. The paper will conclude by describing the benefits of charrettes to researchers including lessons learned from successful workshops.

Background of Planning Charrettes

A planning charrette is a tool used by designers and facility planners to elicit ideas and leverage industry experience in an intense and targeted workshop format. Based upon the French word for "cart," charrette became part of the architectural vocabulary in the early 1900s at the Ecole des Beaux-Arts in Paris (Healey 1991). Nearing the end of a 12 or 24 h studio project, architectural students would frantically race to finish their work and place it on a collection cart as it was being wheeled along the aisles of drafting tables. It has been said that some students would actually walk

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along side the cart to make a few last-minute changes before the projects were collected by the instructors.

Currently, planning charrettes are being used for a variety of activities including facility programs, master plans, strategic operational plans, primary architectural designs, and more (Carter & Burgess, Inc. 2002; Gibson and Gebken 2003; Lindsey et al. 2003; Lennertz and Lutzenhiser 2006). Organizations as diverse as the Federal Highway Administration, the U.S. Department of Energy, the U.S. Green Building Council, the U.S. Army Corps of Engineers, and the American Institute of Architects espouse the benefits of these workshops in the planning environment. The value of these sessions is found in gathering the key stakeholders in a short, intense work session, gaining input and making decisions that will lead to better project planning, alignment toward project goals, and ultimately better outcomes.

Planning charrettes typically last one and one-half to four days or longer, with key project stakeholders captive during that time. The leader and a facilitator focus on project objectives, critical decisions, development of scope documents, and team alignment. These efforts are facilitated by the use of structured checklists, open brainstorming, diagramming methods, small group breakouts, multivoting, three-dimensional visualization and so on to help make effective use of the participant's time. At the end of the charrette, a path forward set of documents have been developed that facilitate completion of the scope and design of the facility or master plan.

A key to planning charrette success is the efficiency with which the meeting time is planned and conducted, including having a defined agenda, structured and unstructured exercises, use of tools, and so on. Another key is the integrated involvement of project participants. The key players involved in planning charrettes include the project sponsor(s), the project engineer or architect, the key discipline leads, the technical representatives, the user representatives, key stakeholders, the design/builder or construction manager, and a facilitator. This all-encompassing participant list helps ensure the right voices are heard in the development of the project's scope definition, hopefully leading to less iteration in detailed design. Another key is the organization of the session and the facilitation and guidance by the person overseeing the effort (Gibson and Gebken 2003; Lennertz and Lutzenhiser 2006).

Research Charrettes

A research charrette is a derivative of the planning charrette. It is a unique marriage of the planning charrette with social data collection methods to elicit ideas and leverage industry experience in an intense and targeted workshop format. Its major advantages are the synergy gained by having a group of industry experts interacting in a structured manner, the ability to use multiple data collection strategies in a single setting, and the fact that when the workshop is over, the data have been collected and are available for analysis. It also has a secondary benefit of helping to get "buy-in" from industry participants to use or rely on the results of the charrette and to solicit follow-on involvement for validation or testing of any methods, findings, or "best practices tools" developed.

Research workshops (or charrettes) in construction or project research are not new. As an example, the National Research Council regularly convenes groups of experts and uses their collective knowledge and experience to determine findings and recommendations about specific issues in the construction industry [Board on Infrastructure and the Constructed Environment (BICE) 2003, 2006, 2007]. Research charrettes have been used to test software (Clayton et al. 1998). The term "charrette's" genesis was in teaching architecture and it is still used in that regard today (Walker and Seymour 2008). Charrettes can be used to develop a research agenda for a funding agency.

In the marketing and health care industries, these types of meetings are typically called focus groups and have been successfully used since the 1930s to determine opinions about manufactured goods, marketing campaigns, political concerns, and health care options prior to broader introduction (Stewart and Shamdasani 1990; Morgan 1997; Krueger and Casey 2000). Calder (1977) clarifies the relationship between qualitative research and focus groups, pointing out that in some circles qualitative research has become almost synonymous with the focus group interview. Kitzinger (1995) defines the purpose of a focus group as a group process that assists people to explore and clarify their views in ways that would be more difficult in a one to one interview. When done effectively, participants work alongside the researcher, often taking the research in new, unexpected directions. The usefulness of focus groups can be found in the study performed by Parasuraman et al. (1985) where the responses of participants in focus groups were consistent and allowed common themes to emerge.

The literature review found few published works referencing research charrettes or structured workshops as a social science data collection method in the construction and engineering arena; of those discovered, none provided guidance on how to plan and conduct a research charrette.

The typical research charrette combines several types of data collection methods into a four to six-hour-session to focus on a single thread of the investigation. The charrette is managed by the researcher or research team, and is very organized in its focus. At the end of the workshop, all data necessary to complete a research investigation phase has been collected.

The writers have been involved in conducting research charrettes over the past 14 years as outlined in Table 1. A total of 29 charrettes have been conducted with approximately 400 participants, representing over 100 organizations.

Types of Research Investigation Methods

Engagement of industry in "best practices" research requires social data collection and statistical evaluation methods. The data captured is typically a combination of both qualitative and quantitative input by respondents and observations of work practices or interaction of practitioners. Many times, these efforts are exploratory in nature, trying to determine the best methods, processes, and controls needed to gain a successful outcome to a defined problem. For instance, one may want to understand the best methods of planning an industrial project in order to favorably influence the success of the business venture, a subject with limited or conflicted past research studies. There are many variables and influences to the success of the effort, some under the control of the team and some not. How to study this area is a question that is difficult to answer. Typical issues to consider in choosing the investigation methods, along with how the research charrette method integrates into these issues are given below.

Collection Methods

Data collection strategies must be tailored to the research problem statement and are typically a combination of several methods

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Table 1. Sample of Recent Projects Employing Structured Research Charrettes

Research investigation	Number of research charrettes	Number of participants	Number of organizations
Project rating definition index for industrial projects (Dumont and Gibson 1996)	2	54	31
Alignment during front end planning (Griffith and Gibson 1997)	3	38	19
Project rating definition index for building projects (Cho et al. 1999)	7	69	35
Expediting highway construction while retaining quality tool (Simon et al. 2002)	6	62	6
International project risk assessment (Walewski et al. 2004)	4	44	25
Advance planning risk analysis (APRA) for transportation projects (Caldas et al. 2007)	3	62	12
Shutdown turnaround alignment review tool (Whittington et al. 2008)	4	67	39

(Gibson and Hamilton 1994; Yin 1989). Babbie's taxonomy (Babbie 1992) lists five modes of classifying the collection of social data:

1. Experimental research involves taking action and observing the consequences of that action and is usually associated with the physical sciences.
2. Survey research involves collecting data through asking people questions and is perhaps the most frequently used mode of observation in the social sciences.
3. Field research involves the direct observation of social phenomena in natural settings.
4. Unobtrusive research involves investigation without the researcher intruding into whatever is being studied. It can consist of content analysis, analysis of existing statistics, or historical/comparative analysis.
5. Evaluation research seeks to evaluate the impact of social intervention by using experimental and quasi-experimental methods.

Any of these methods can be used in a standalone or combined manner. A research charrette will typically use more than one of the methods listed above, specifically Items 2: survey research, 3: field research, and 5: experimental Methods. Typically, the charrette will use one or more surveys (perhaps with the participants bringing a partially completed instrument to the event). Most charrettes include an interactive component. This component allows the researchers to observe the participants interact with each other and the research team in terms of specific problems or research questions, and to relay their observations about the research investigation to date. Finally, if multiple workshops are used with a mixture of demographic respondents, some inferences can be gained from the impact of the research investigation on the attitudes of the participants. Typical data collection methods that can be used in a research charrette are given in Table 2.

Drawbacks to Typical Data Collection Methods

Survey research methods are employed extensively to study construction industry best practices or other study variables, however surveys have several potential barriers that can cause concern. Response rates can range as low as the single digit percentages for national surveys (questionnaires); many times response rates as low as 15% are considered acceptable. Low response rates can be problematic from two perspectives. The first is the amount of resources needed to send out many questionnaires, only to receive a few responses; and, if the survey is attempting to be representative of a study population, uneven response can bias the results. The research charrette method has a captive audience (group of respondents) and, if handled properly, surveys will be received from all attendees by the end of the session, although not a random survey as explained later.

Another problem with questionnaires is the response time. In many situations, and especially with busy construction industry practitioners, it may take months to receive completed questionnaires, even with extensive follow-up correspondence. When the research charrette is complete, the survey instruments are in hand.

Finally, questionnaires must be well developed and tested beforehand in order to ensure that the intended meaning is transferred to the respondent. The communication is typically asynchronous from the respondent to the questionnaire. In a research charrette, the questionnaire can be explained by the researcher to the group and questions can be asked by respondents for clarification, ensuring that the right answers are given for the intent of the question. If several charrettes are performed using the same facilitator, consistency of response can be maintained across the data collection effort.

Another survey method is the structured or semistructured interview. This is an excellent method, but again, setting up an

Table 2. Examples of Data Collection Methods Used during or after Research Charrettes

Type of collection strategy	Examples
Surveys/questionnaires	Background information about the participants; opinions of relative importance of best practice strategies
Observation	Participant's interaction with peers in the charrette or their opinions about the subject matter
Structured interviews/facilitated discussion	Collective group or small group structured questions and responses
Focus groups	Collective or small charrette group response to research products or findings to date
Informal interviews	Interaction of the researchers with charrette participants during breaks or lunch
Result validation	Participants volunteering to test, use or employ research findings subsequent to the charrette

interview either in person or telephonically can take weeks or months. These interviews are typically performed one at a time and are very resource intensive. In a research charrette, structured questions can be asked in a collective setting or a small group, thus gaining the insight of quite a few practitioners in a short period of time.

Field research and evaluation research again are resource intensive. In the research charrette, small group deliberations and structured prioritization exercises can be used to determine the general opinion of the participants to particular proposed strategies or methods. The data gathered in these settings can provide keen insight into problems of interest and potential solutions to the research hypotheses.

Exploratory Research

Sedlack and Stanley (1992) discuss exploratory research as a situation in which a research investigator is exploring the basic dimensions or possibilities of a complex subject or where little has been previously recorded. They suggest that there are three basic questions under which exploratory research is conducted:

1. Are there any variable relationships that appear to exist?
2. What more detailed and systematic investigation is warranted?
3. What methods are most likely to generate profitable data?

If the hypothesis undergoing research has a lack of previous studies, unclear past results, or has many influences, they recommend using the data collection strategy of triangulation, which is "the process of comparing the measurement of the same variable from a variety of measuring instruments" (Sedlack and Stanley 1992). Triangulation is the combination of multiple methodologies in a study of the same subject area such that the multiple sources indicate key parameters that can be ascertained by study of all results.

Indeed, the capability to implement a strategy of triangulation means that evaluators must include in their research plan the ability to use qualitative methods (Patton 1989). Patton's support of the use of multiple and proven research methods in the exploration of new areas of research has the apparent aim of minimizing the chance of researchers making the common mistake of oversimplification and overgeneralization.

Research charrettes are typically very effective in exploratory studies. Combining the different methods used in the charrette with other data collection strategies outside of the charrette provides a ready method to accomplish the triangulation needed to conduct one of these studies. This can be accomplished by perhaps using specific case studies, structured interviews, statistical database analysis, and so on in addition to the charrette method.

Sample Selection

One of the first steps in designing a research project is to define the population to be studied. The unit of analysis in construction studies can be the project team, a group of individuals, a process step, a project, or a database of existing data. The entire population of construction data in most cases would be too large and diverse to study, producing questionable results. Conclusions reached by a study of such a wide mix of project types would provide overly general information that would not prove useful to any specific subset of the population of project teams. As a result, the sample is generally narrowed to a subset, such as "project

teams involved in the planning and execution of industrial capital facility projects," so that the results can be applied specifically to the investigation domain of interest.

Once the population has been defined, the question of taking a sample must be addressed. There are basically two methods of selecting a sample from a defined population; probabilistic and nonprobabilistic. With a probability sample, each element has a known nonzero chance of being included in the sample (Kalton 1983). In order to select a sample by a probability mechanism, a sample frame is required. A sample frame is essentially a list of all members of the study population and a sample is selected from this list using some form of a random selection procedure.

Purposive nonprobability sampling is characterized by a selection process that does not result in every member of the population having a chance of being selected. Examples of nonprobability sampling include (Kalton 1983; Griffith and Gibson 1997):

- Volunteer subjects for studies;
- Time and motion studies of workers or equipment on a few construction sites;
- The clients of a given contractor;
- The employees of one firm;
- Interviews conducted on a specific job site;
- Respondents to a pull-out questionnaire included in a trade magazine; and
- Persons calling in response to an e-mail solicitation requesting opinions.

Probability sampling permits the use of statistical theory to develop estimators of little or no bias and to evaluate sample error. Nonprobability sampling methods do not permit the application of sampling statistics. These types of samples can only be assessed by subjective evaluation (Kalton 1983).

However, some populations do not permit probability sampling due to the lack of a sample frame. The study population within the construction industry is typically such a case. There are few lists of capital facility projects from which a random sample can be taken. In some cases, respondents want to remain secretive for proprietary reasons. The construction industry is fragmented, with many smaller companies versus a few large companies, making it more difficult to find representative companies and projects. Some projects are completed in-house and are never publicized. Other projects are completed through negotiated contracts which are not advertised for bids and not part of the local permitting process. There are some commercial databases available that attempt to identify current construction contracts which could be used as a sample frame. However, these databases are expensive to use and still are biased because they are missing many in-house and negotiated contracts. Despite the obvious drawbacks in nonprobability sampling, the study population requires its use for almost all construction best practices studies.

The research charrette uses the nonprobability sampling method focused on volunteer experts. Participants in the charrette (some of which may have traveled long distances to attend) are generally invited based on past contacts with the researcher, recommendations from the research sponsor or oversight team, or are actively involved in an organization such as a department of transportation or a research consortium or trade group and respond to an advertisement. Generally, the charrette will have certain parameters that are applied to screen the participants based on qualifications related to the study. For instance, the number of years experience that a person has been in industry, the types of

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projects that he or she has been involved with, educational background and so on which allow the researcher to focus in the proper area of assessment for the study.

If the population of potential respondents is known, a random sample could be chosen to participate in the charrette. This situation is unlikely for the construction industry, but could happen within very defined subsets.

The participants need to be able to focus not only on their own organization's short-term goals but also the overarching improvements to the construction industry as a whole. This separation of short-term views from long term issues needs to be addressed in the make-up of the data collection instruments.

Several charrettes may need to be conducted at different geographic areas to improve participation and participant diversity. This dispersion will typically allow a more robust response set, but geographic differences cannot be inferred based on the locations.

The fact that the research charrette uses a nonprobability sample limits the ability of the researcher to infer broad claims beyond the sample surveyed. It also means that research charrettes should typically be used as one component of a research framework.

Types of Analyses

As with any type of social data study, the types of analysis employed based on data received during research charrette would include:

- Statistical descriptive data summarizing averages, medians, modes and frequencies of the participant's demographic information;
- Pattern matching on written verbiage responses;
- Compilation and analysis of comments and suggestions;
- ANOVA on stratified subsample results;
- Regression analysis of dependent variables based on independent variable input; and
- Frequency analysis on ranges of response.

When to Use Research Charrettes

Research charrettes are an effective method of gaining industry input and insight in studies focused on determining best practices or understanding key parameters affecting project performance by tapping the extensive expertise of volunteers. They are particularly effective when the researchers are working with oversight committees from the research sponsor. These committees are important in helping conduct the charrettes and also in developing the background research hypotheses data collection strategies for the charrette.

A major benefit of the research charrette method is the ability to overcome time constraints around delivery of results. Research charrettes can typically be developed, organized, held, and analyzed within a few months, if necessary.

Research charrettes should be part of the data collection process for the research investigation, not the entire collection effort. It is important to combine the data collected in the charrette with other methods such as case studies, follow-on validation of charrette findings or theories, source document reviews or databases. Combined together, the different collection strategies allow the researchers to triangulate on overarching critical findings.

The research charrette is also an effective method to provide input at the beginning of an exploratory investigation. The relatively rapid manner that the charrette can be conducted, and the bisynchronous manner in which the researcher can gain insight into the problem are unique.

The research charrette is not as effective in situations where a rich data set is available for review, a national study is required (although it could be used to test the questionnaire), or where observation of methods or field procedures are dictated by the study parameters. As previously discussed, the charrette should always be combined with other data collection strategies, such as field observation, database assessments, or case studies to ensure study triangulation.

Past Research Charrettes

As indicated in Table 1, the research charrette method espoused in this paper has been used on several research investigations. A brief discussion of each of these studies is given in this section to illustrate the method's flexibility, and its evolution; however extensive evaluation of the specific data sets collected and actual statistical analysis conducted is beyond the scope of this paper. One example data collection effort will be provide later in the paper. Additional information and more detailed data analysis for each charrette are located in the cited references.

The first use of the research charrette method by the writers was during a study funded by CII in 1994. The research problem was to gain insight into planning applications in industrial construction projects. Based on data from a previous research effort (Gibson and Hamilton 1994), and input from a research team composed of 17 industry representatives, a detailed draft checklist for scope definition call the project definition rating index (PDRI) was developed. Two research charrettes were used during the effort to refine the checklist and obtain feedback from 54 participants concerning the relative importance of the elements in the checklist. This activity used the respondent's experience and insight based on their current projects. The respondents were a purposive volunteer, expert sample. The developed tool and method, which included relative values of the scope definition elements established in the charrettes, was subsequently tested on 40 projects, with some of the charrette participants providing test cases (Dumont et al. 1997; Dumont and Gibson 1996; CII 1997). This tool has been used globally by many organizations for planning industrial projects.

A second series of research charrettes were used in an exploratory study investigating project team alignment. Three charrettes were held to narrow a list of 54 key alignment strategies which had been identified by an industry oversight committee. Multivoting and small group breakouts were used to refine and narrow the list to the top issues affecting project team alignment during front end planning. These issues and refinements were used in a subsequent series of project case studies and structured interviews with company executives (Griffith and Gibson 1997, 2001).

In 1999, the method was applied again on a project sponsored by CII to develop a PDRI for building projects. Seven research charrettes were used in this development effort, employing a very similar methodology to the first study cited above. Again, the tool was refined and developed with input from industry participants, with the charrettes being widely dispersed around the United States. The developed tool and method were subsequently tested on several dozen real projects as another source of data (Cho et al. 1999; CII 1999; Cho and Gibson 2001). This developed tool has been widely adopted by organizations in industry.

In 2001, the research charrette was used for a slightly different purpose. TxDOT was concerned with the speed with which its projects were being delivered. A list of likely strategies were developed by the research team and then a series of charrettes were held to refine this list, identifying whether these methods were feasible for TxDOT to pursue, and through a series of multivoting exercises to recommend strategies that could be pursued immediately and others that required additional research. These six charrettes involved 62 practitioners from six organizations (and included 24 of the 25 regional construction management districts in Texas), and showed the flexibility of the charrette method (Haas et al. 2003; Simon et al. 2002). This effort lead to several additional funded research efforts focused on scheduling, right-of-way acquisition, utility adjustment, and benchmarking.

Three additional studies have used the research charrette method effectively in developing approaches to solving specific industry problems. In 2003, four research charrettes were used to develop a risk management tool for international projects (CII 2003; Walewski et al. 2006, 2004). In 2006, three charrettes were used to develop a risk management tool for highway projects (Caldas et al. 2007; Le et al. 2009). Each of these used similar methods as outlined previously. The final study was recently completed and focused on developing an alignment and risk assessment tool for shutdowns, turnarounds, and outages in the industrial sector and is outlined in the next section.

Research Charrette Example

In the fall of 2007 and spring of 2008, the writers used research charrettes in order to prioritize and test the shutdown turnaround alignment review (STAR) tool, a new planning tool for use in shutdowns, turnarounds, and outages (STO) sponsored by CII.

An initial survey was conducted of all CII members in 2006 concerning the extent of renovations projects within their project portfolio, including high level discussion of management concerns and risks for these types of projects. One identified area of importance and concern was the area of shutdown-turnaround-outages of industrial projects. Evaluation of these results led to the realization that these types of projects should be studied more closely from a front end planning perspective as well as providing a starting list of issues of concern (Whittington et al. 2008).

Along with the writers, the STAR Tool was initially drafted by 10 research team members (industry practitioners) who specialize in the planning and implementation of STOs on an industrial site. Nine summary categories (given later in Table 4) and 94 element descriptions (not shown in this paper) were refined; these categories and subservient descriptions can be used for a joint assessment of the multiple projects that typically converge during the STO.

Once the initial tool was drafted, a series of four research charrettes were held to prioritize the tool as well as to provide input and suggestions for refinement. The agenda from one research charrettes conducted in this study is given in Fig. 1. The charrettes allowed interaction between the industry professionals while also improving the STO planning tool. The workshops included an overview of the research effort, prioritization of the critical elements in the tool under development, and written feedback. The charrettes also included a detailed vetting of the individual elements within the STAR Tool as well as assessment of tool appearance, ease of use, and overall usefulness. At the conclusion of each charrette, the researchers were able to present real-time prioritization results to the participants by performing

Continental Breakfast and Informal Networking	8:00 am – 8:30 am
Introduction • Introduce participants • Research Project background • Objectives and STAR Tool format • Prioritization and scoring methodology	8:30 am – 9:00 am
Review of STAR Tool and Category Prioritization	9:00 am – 9:45 am
Break	9:45 am – 10:00 am
STAR Tool Category Prioritizations – Breakout Session • Category Reviews 1-9 • Element Reviews	10:00 am – 11:30 am
Break	11:30 am – 11:45 am
Breakout Session Reports	11:45 am – 12:00 pm
Lunch and Open Forum Discussion	12:00 pm – 12:45 pm
Prioritization Results	12:45 pm – 12:50 pm
Conclusion and Wrap-up	12:50 pm – 1:00 pm

Fig. 1. Example of research charrette agenda

on-site analysis of the collected data, including comparison to results from previous charrettes.

Each participant was asked to fill out a background datasheet at the start of each workshop. The datasheet included contact information, experience levels, and questions related to their impressions of how their company handles renovation and revamp (R&R) and STO projects. In addition, each participant was asked to provide information on a recent STO they had conducted to be used as their reference project for prioritizing the STAR Tool. Table 3 shows information on the participant background data. One of the participants used a $1.6 billion STO, a major refinery upgrade, as their basis for evaluating the STAR Tool. While the average project size listed is greater than $80 million, this number was skewed by the one extremely large project. The median project value for all 67 projects within the sample was $30 million and the nominated projects totaled approximately $5.5 billion in total installed costs.

Each of the respondents was then asked to indicate the relative importance (priority) of each of the nine categories to the planning process for STO projects (on a scale of 1 to 100, with 100 total priority points assigned) at a point just prior to beginning of detailed design/construction. The respondents used their nominated projects as a basis for these prioritizations. The details of the method used to develop the prioritizations are fully described by Whittington et al. (2008).

The nine STO categories are listed in Table 4 along with relevant statistical results from the four workshops. Each respondent was asked to give a relative value to the nine categories on a zero to 100 point scale, based on their career experience and their nominated STO sample project. Given input from the 67 respondents, the priorities of each category are listed along with the standard deviation of each. The table includes the total number of respondent outliers from each category.

Table 3. Workshop Participant Information

Results N=67	Years of PM experience	Years of R&R experience	Percentage of work in career on R&R (%)	Percentage of work in career on STOs (%)	Project cost for STO in question ($)
Sum	1,323	1,107			5,471,100,000
Average	20	17	56	42	81,658,209
Minimum	2	2	5	5	250,000
Maximum	41	41	100	90	1,600,000,000
Standard deviation	10.32	8.56	28.74	24.35	203,331,135

Note: PM=project management; R&R=renovation and revamp; and STO=shutdown/turnaround/outage.

The research team classified the value of a priority outlier as plus or minus 1.5 standard deviations away from the overall mean. The validity of the individual respondents was then scrutinized. Any participant whose responses included three or more priority outliers were classified as respondent outliers. Of the 67 total participants, seven were determined to be respondent outliers and were excluded for final prioritization calculations. This vetting process is discussed in more detail in Whittington et al. (2008).

In the final state of the tool, each of the nine categories has been assigned a transformed "value" or "prioritization" based on a total score for all categories of 1,000 points as shown in Table 4. This transformation was done to provide tool users a simple method of assessing the readiness of their projects during the planning process. Each of the categories is assessed by the planning team in terms of its readiness based on a sliding scale. This overarching assessment score gives a subjective method for determining areas which need additional planning effort. A higher total score (up to 1,000 points) indicates poorer definition of planning preparedness.

The structured workshop setting also allowed for facilitated discussions in order to determine strengths and weaknesses of the new tool and planning method, a process that would not have been possible with traditional survey methods involving industry feedback. In each of the workshops, from two to four small work groups (5–8 individuals) was constituted and a facilitated discussion ensued evaluating the entire tool and approach. Each work group reported back to the entire charrette group and a general discussion occurred. Comments were collected on a flip chart and summarized. This input provided the researchers and steering team with immediate feedback which was used to modify the approach (including slight modifications to future charrettes) and a rich source of insight into how to use the tool. An excerpt from selected comments is given in Table 5.

In total, the workshops allowed the researchers to obtain 67 unique perspectives representing 39 individual companies focused on the STAR Tool and method. Although not reported here, other analyses such as charrette to charrette, owner to contractor, and specific industry sector differences were also evaluated. The participants were able to interact with peers in similar industries and learn novel approaches to common challenges (Whittington et al. 2008). In addition to the data and input given earlier in this section, the researchers were able to observe the interest and engagement of the participants in the charrette setting. Nothing in the observations and during the interactions at breaks and lunch gave an indication that the research efforts were off base. To the contrary, the enthusiasm and continued discussions provided some assurance that this tool and data set were needed to help manage STO projects.

In addition to research charrettes, this investigation also used the initial survey discussed above, 25 case study analysis of completed renovation projects using pattern matching software, and evaluation of an existing database of project data totaling over $35 billion, focusing on practice use and project performance metrics. Results from these four data collection strategies allowed triangulation of key findings. As part of a follow-on effort to test the STAR Tool, it was effectively used on four STOs, with testing still ongoing (Whittington et al. 2008). The final report and tool were provided to charrette participants after publication.

Table 4. STAR Tool Categories and Statistics

Category	Prioritizations (%)	Standard deviation	Priority outliers (exceeding +/−1.5 std dev)	Relative importance (0–1,000) scale
1. Design for constructability analysis	13.4	5.94	5	134
2. Permit requirements	6.3	3.55	4	63
3. Equipment and material status	14.0	5.48	7	140
4. Procurement procedures and plans	8.8	3.62	10	88
5. Project control requirements	12.0	4.99	8	120
6. Engineering/construction plan and approach	14.2	5.74	9	142
7. Shutdown/turnaround/outage requirements	16.3	6.66	6	163
8. Commissioning	7.3	4.29	8	73
9. Startup requirements	7.7	3.57	7	77

Table 5. Selected Small Group Comments, February 2008

Comment category	Specific issues
Overall observations	• Tool will be usable early in planning, not just end of process • Tool needs to emphasize safety more • Leadership focus during this process is sometimes problematic • Team needs to address timing of the evaluations with the tool • Switch order of category 9. Commissioning with category 8. Startup in the tool *and so on*
Engineering/construction plan/approach	• Manpower density/loading should be addressed • Craft timing is critical to this process • Quality hold points should be established for dismantling and erection of equipment • A strategy for shared resources must be developed • Quality assurance, inspections, cranes, safety, lay down/warehouse scaffolding need to be emphasized • Flexibility to adapt to market changes (retention of labor) should be part of considerations • Setting priorities between projects that are within the STO should be part of the consideration • What are the STO drivers? Time versus cost versus quality *and so on*.

Recommendations for Conducting Research Charrettes

When planning and conducting research charrettes for industry feedback, there are several important considerations to ensure that the process will obtain the appropriate results. Fig. 2 illustrates the process for developing the charrette and the method is discussed briefly below. At the conclusion of each process step noted in the figure and between each charrette, the academic researchers should discuss the results with the industry sponsors in order to validate the previous steps and obtain buy-in for the subsequent steps. The feedback will provide assurance that the plans, methods, and procedures employed are the most appropriate to the research objectives of the study.

Most important in ensuring a successful charrette is the pre-work. The topic, objectives, issues for discussion, a developed and tested data collection strategy, and good background documents need to be in place prior to the workshop. Involving the sponsor and any oversight committee to the research can greatly enhance this preparation.

The researchers need to develop a list of minimum criteria for attendees. Soliciting volunteer participants typically requires the assistance of individuals currently practicing in industry, and the researchers must have a working relationship with a team of industry practitioners to facilitate this step. When developing an invitee list for the workshop, overbooking is necessary because as many as 40% or more of the confirmed attendees will be unable to attend from personal or professional reasons.

Another possibility, discussed in the focus group literature cited earlier, involves randomly selecting participants from a group of nominated (nonrandom) participants, thus mollifying some of the bias, although not all. This was not done in the studies discussed in this paper, because it is difficult to get volunteers to participate in research studies in engineering and construction. In effect, all qualified participants were asked to attend in order to get a large sample of diverse inputs. Findings from the study should reflect the nonprobabilistic nature of the participation. Theoretically, a random sample of participants could be attracted.

In addition, quota sampling could be used for specific types of studies. For instance if the study was focused on gender issues in construction, the researcher could hope to match the relative percentages of women and men currently participating in the construction industry as participants in a research charrette. Another possibility would be quotas of professionals from different regions or jurisdictions to test relative understanding or differences.

The research charrette also could be used as the first stage of a larger effort focused on a probabilistic survey. In this scenario, the research charrette experts would be used to develop or test a questionnaire for wider usage in a random survey. CII used this technique in some of the studies cited earlier to develop a benchmarking questionnaire for wider contribution of project data from its membership, although again not a random survey.

The number of participants depends on the intent of the study. In general, involvement of greater than 30 total participants will ensure that sufficient input has been received to elicit consistent viewpoints. This number is considered a large sample in statistical terms, and the writers have observed that the outcome of the data collection effort will only change slightly once this number has been reached and more data are added. However, the comments and observations in larger total samples can provide a rich source of additional insight if planned correctly. In terms of individual charrette sessions, from experience, the writers recommend that no more than 25 individuals should participate in order to keep the session members engaged and to manage the effort effectively.

The topic of the research must be interesting and the value of the workshop to the attendees must be communicated prior to the invitation being issued. The "hook" in place to gain participation is typically the opportunity to interact with other practitioners concerning the subject, and the ability to gain insight into a topic for professional growth. In almost all cases, the writers have provided takeaways (generally partially complete research products and findings to date) during the charrette for attendees and lunch as another enticement.

The meetings must be convenient in timing as well as location for the proposed attendees. Therefore workshops may need to be distributed across a broad geographic area. This also assists in limiting the potential for a geographic bias in the data, although it does not obviate the fact that this is a nonprobabilistic sample.

The industry practitioners can also assist the researchers as workshop hosts and coordinators including help with creating and
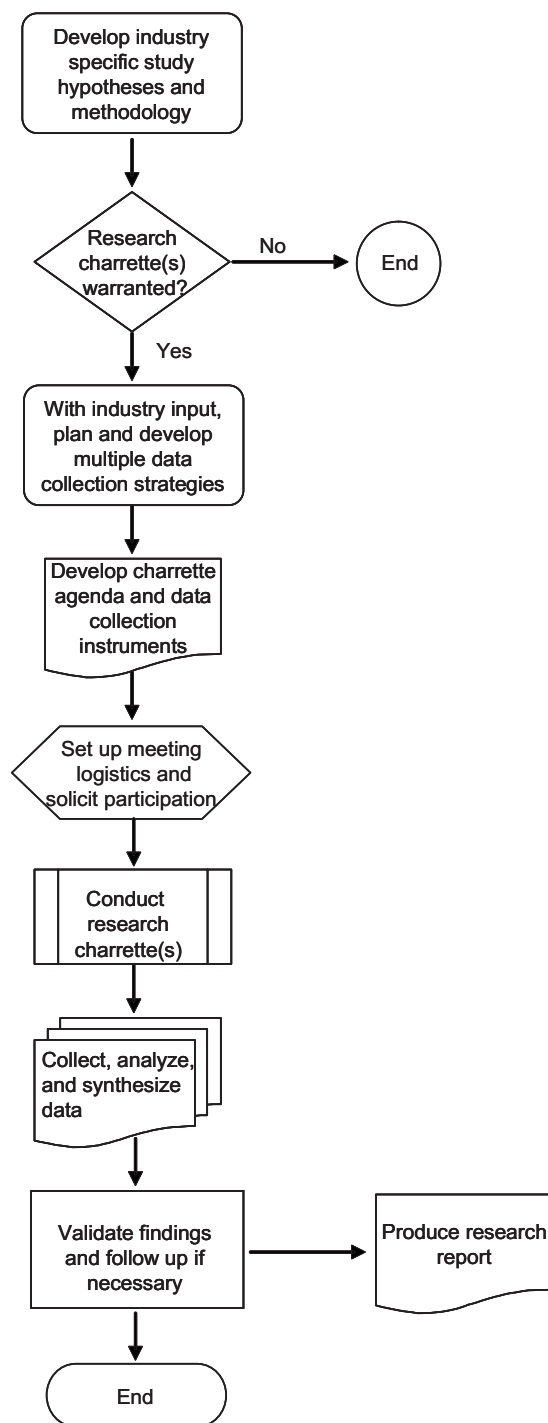
Develop industry specific study hypotheses and methodology

↓

Research charrette(s) warranted? — No → End

↓ Yes

With industry input, plan and develop multiple data collection strategies

↓

Develop charrette agenda and data collection instruments

↓

Set up meeting logistics and solicit participation

↓

Conduct research charrette(s)

↓

Collect, analyze, and synthesize data

↓

Validate findings and follow up if necessary → Produce research report

↓

End

Fig. 2. Research charrette development process map

communicating the specific workshop logistics such as material and equipment needs, room layouts and seating arrangement, the presence of breakout rooms, food and drink availability, handouts, nearby hotels, and parking and meeting location access/security arrangements for attendees and hosts. Packets of handouts for the attendees must be carefully created with defined takeaways and data collection forms which are given at the beginning of the charrette. A useful method to ensure that the appropriate forms are used and returned is to color-code the handouts.

On the actual day of the meeting, the strategy and agenda for the workshop must be fully formed. The agenda should allow not only for several periods of informal networking among the participants but also periods of structured discussion. The researchers should present a brief background on the history of the research topic as well as expected outcomes of the workshop.

The use of facilitated small group discussions in individual break out rooms allows for a free flow of ideas between the industry practitioners and the research team. These groups should be made up of 6–10 participants. Unlike surveys and questionnaires, this time allows for ideas to be discussed and the researchers to interact with the respondents to clarify thoughts and points. The agenda should allow time for feedback by these small groups to the entire charrette to communicate developed thoughts and ideas to everyone.

Additionally, at least preliminary analysis of the collected data should be presented to the workshop participants so that they get immediate feedback concerning how they responded compared with participants at other workshops held a different times and locations. Appropriate appreciations, long-term follow up, and validation needs to be performed after the workshop has been concluded and final results presented to participants. Although not done in any of the studies cited in this article, charrette participants could also be contacted after a period of time has elapsed in order to gain additional insight.

Lessons Learned

After conducting a variety of research charrettes, several lessons have become apparent. Among these

- Performing prework and gaining industry input in preparation to hold the charrette is imperative to ensure that the time spent during the charrette is efficient.
- Providing clear and concise logistics information, including premeeting information such as location, travel suggestions, agenda, session objectives, and so on will make the session participants better prepared to participate effectively.
- Using a local active session sponsor who can set up meeting logistics and ensure that several participants can attend helps in getting the appropriate number of participants to the charrette.
- Pretesting all data collection strategies prior to holding the charrette is essential. Again, sponsor representatives can provide a good test set. The first charrette held for the international project risk study used an unworkable comparison and collection strategy (Walewski et al. 2004). This mistake caused the researchers to employ a remediation strategy to collect additional information after the charrette was completed.
- Developing the list of invitees is not easy. It is difficult to confirm that the participant's backgrounds are appropriate for the particular research topic ahead of time. The participants comprise a nonprobability sample and researchers must state caveats in any data conclusions to account for this issue. In some cases, participants must be removed from the data sample after completing the charrette if they did not meet a screening parameter, such as years of experience.
- Employing the research charrette as part of a multiprong research effort is best. Case studies, source document review, additional questionnaires, follow-on use of the findings, and so on should be used to triangulate or validate the findings.
- Involving industry participants in the charrette gives the researcher access to follow-on data input and also sets the stage for buy-in and usage of the results by industry participants.

Conclusions

The charrette has been used effectively for planning capital projects for many years. More recently, as related herein, research charrettes have proven to be an effective method for data collection in industry best practices studies. It allows researchers to gather data relatively quickly, collect valuable input from experienced practitioners, make excellent industry contacts, and gain insights with several collection strategies as outlined earlier in this paper. This method has some limitations, however, such as nonprobabilistic samples and limitations on the type of data that can be collected.

Researchers should consider the charrette as one part of an overall data collection effort for industry best practices studies. Effective prework, involvement of sponsors, good logistics preparation, and sound data collection strategies during the charrette provide the basis for its successful application.

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