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Safety Prequalification Factors for the Selection of Contractors Within the Steel Industry

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SAFETY PREQUALIFICATION FACTORS FOR THE SELECTION OF CONTRACTORS WITHIN THE STEEL INDUSTRY

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The purpose of this study was to: examine whether safety criteria commonly applied in general industry for contractor selection is actually valued by steel industry safety professionals; identify if criteria commonly used for the selection of construction contractors, but infrequently observed for general industry contractor safety prequalification, is valued by steel industry safety professionals; and to understand how steel industry safety professionals value the services of third party contractor safety prequalification services. To accomplish these objectives, safety professionals employed by Steel Manufacturers Association member companies were surveyed. Survey respondents' current job position, steel industry years of experience, predominant steel industry background, and number of major contractor accidents observed were compared to eight contractor criteria: injury history, reputation, employee training and certification, financial stability, liability and regulatory history, written safety programs, work capacity and related work experience. Likert scales were used.

Results indicate respondents highly value each of the contractor prequalification criteria provided, but show highly differentiated preferences when asked to rank their importance. Contractor injury history, employee training and certification, capacity to complete the work safely, and liability and regulatory history were most highly ranked. Written safety programs, a common component of contractor safety prequalification

practices were third lowest in importance. With limited exceptions, the independent variables of respondent role, years of steel industry safety experience, predominant background and number of accidents observed were not significant in determining priority given to the eight criteria. Respondents believe a combination of internal resource and third-party service provider resource is preferred for facilitating contractor safety prequalification. Third party service providers are most valued by respondents for reduction of administrative burden, greater expertise and efficiency benefits. Respondents acknowledge contractor written programs and self-reported loss data are largely not verified at their contractors' place of business or work location.

This study is significant given the scarcity of general industry contractor safety prequalification research. This study will serve as a baseline measurement of existing contractor safety selection factors valued by steel manufacturing industry safety professionals, thereby providing an empirical foundation on which future research may expound.

ACKNOWLEDGMENTS

Answering questions not previously asked requires a study population. I am grateful to the Steel Manufacturers Association for providing access to its member company safety professionals. Particular thanks is given to Phillip K. Bell, president, and to Adam Parr, vice-president. Both were supportive and patient as this study evolved. It is my hope one or more lessons herein prove helpful to the industry's major injury prevention efforts.

I must also thank each of my dissertation committee members for their unique and important contributions. My request of Christopher A. Janicak, Ph.D. to serve as committee chair proved especially wise; his answer and actions more than generous.

My colleague and friend, Rick Kilpatrick, joined me as a member of our university's first Safety Sciences Ph.D. cohort. Without reciting our challenges, suffice it proved important to frequently consult and commiserate with a last college roommate. Blessings on him and his house, always.

Last is the example of my father, The Reverend, Dr. James Bernice Wilbanks. Born into the era of the great-depression. Lost nearly to burns as a child. Served honorably our nation, first as army private then master-sergeant, in the Pacific, World War II. More than 50 years ministry in the service of the Presbyterian Church, U.S.A., and more specifically to Christ Jesus our Lord, His kith and kin. Sixty two years married at this writing to my mother, Sarah Jane. Together they raised four; good folk, all. A bachelor degree received through the GI Bill, then a masters but to learn more; finally, an honorary doctorate, well *earned*. Noteworthy is his journey began without a high-school degree. His 1944 draft notice preempted. The 'greatest generation,' indeed.

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CHAPTER 1

INTRODUCTION

Safety prequalification practices are increasingly recommended and used for contractor selection with the goal of reducing work-site accident risk (Burroughs, 2015; Hannan, 2015). Empirical examinations of non-safety selection factors for general construction contractors are readily discoverable (Abbasianjahromi, Rajaie, & Shakeri, 2013; Holt, Olomolaiye, & Harris, 1994; Manu, Ankrah, Proverbs, & Suresh, 2013). However, there is a scarcity of contractor safety prequalification studies, whether for manufacturing generally or its many segments such as steel manufacturing. This is a curious reality, as there are common, well established general industry contractor safety prequalification practices as well as an increasing number of third party service providers facilitating the process for general industry (Philips & Waitzman, 2013). Are the commonly applied selection factors reflective of what safety professionals actually find important when selecting or retaining contractors? This study will serve as a baseline measurement of existing contractor safety selection factors valued by steel manufacturing industry safety professionals, thereby providing an empirical foundation on which future research may expound.

Increased Risk of Utilizing Contractors

There can be great benefit to utilizing contractors rather than maintaining sole reliance upon internal resources to affect needed projects or tasks. Outsourcing allows an organization to reduce costs by maintaining a minimum workforce while allowing it to focus on its core business, promoting specialization both within the hiring and contracted company (Kozlovská & Struková, 2013; Yemenu & McCartin, 2010). Manu et al. (2013)

specifically described the benefits of contracting as including: labor flexibility; transference of high-risk activities; bargaining ability; transference of financial risk; and avoiding workers compensation costs.

However, anecdotal evidence of serious accidents associated with the use of contractors is ubiquitous (Cox, 2014; "Explosion highlights," 2012; Fehrenbacher, 2013; "Los Alamos lab," 2015; OSHA, 2016; Silver, 2015). Construction, an industry composed entirely of contract workforces, nominally accounts for 1,000 fatalities per year in the United States, or nearly three per day; the majority of these fatalities are incurred by specialty trade contractors (Mroszczyk, 2015). Catastrophic events, such as the explosion in Toulouse, France in 2001 that claimed 30 lives, 13 of whom were subcontractors (Nunes, 2012), makes vivid the reality contracting projects and services includes potential risk as well as benefit.

The Bureau of Labor Statistics reports contractors demonstrate greater fatality rates than their host or hiring organizations (Pegula, 2014). More than half of all contractor fatalities are incurred in construction and extraction activities; falls, pedestrian vehicular accident, struck by object, electrocution and non-roadway incidents are the greatest fatality type, Figure 1. The Steel Manufacturers Association shares approximately 30% of all mill fatalities over a seven year period were suffered by contract workers (A. Parr, personal communication, January 3, 2017), Figure 2.

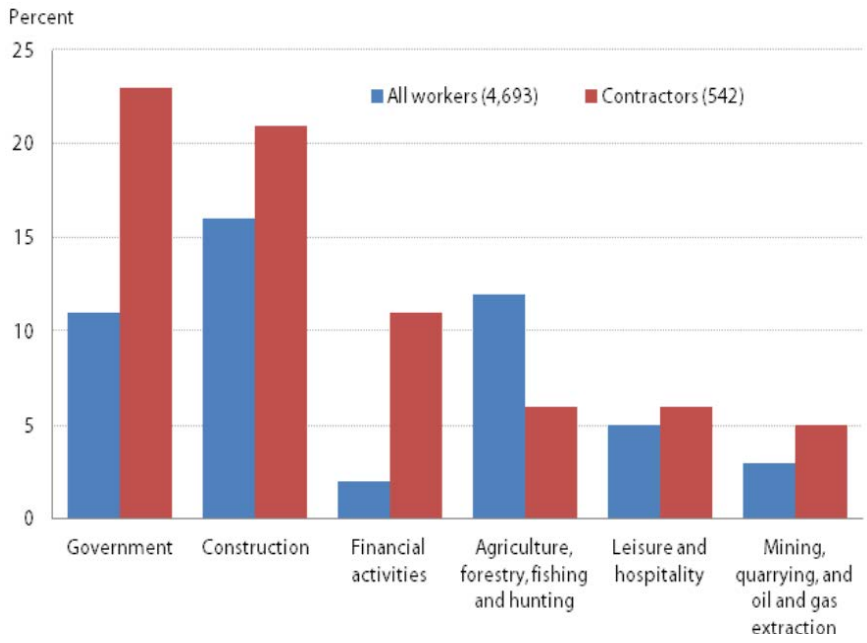

Figure 1. Private sector, non-governmental agencies, contractor fatalities compared to all workers. Adapted from "Fatal Occupational Injuries Involving Contractors, 2011" by S. Pegula, 2014, p. 2. Copyright 2014 by Monthly Labor Review.

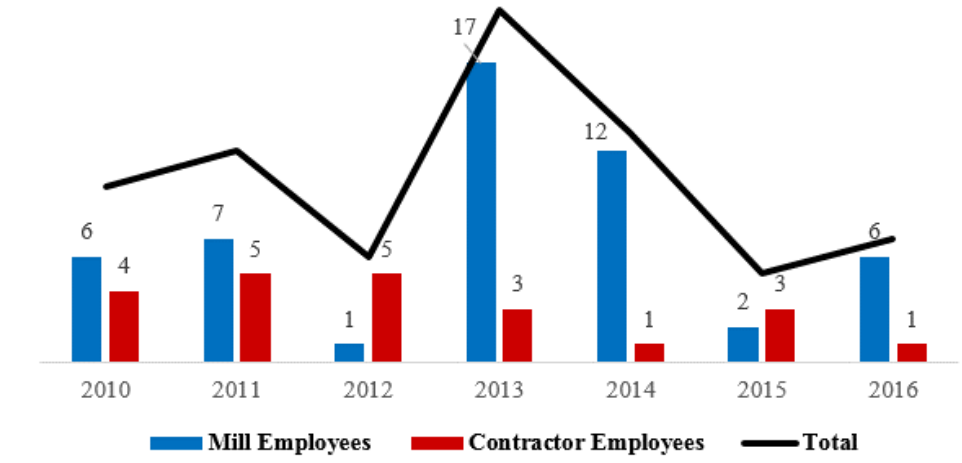

Figure 2. Steel mill industry fatalities, 2010 through 2016. Steel Manufacturers Association. Used with permission.

Contractors with high employee turnover as well as smaller contractors and those experiencing growth may be at greater risk of accident (Hinze & Gambatese, 2003). The non-routine nature of contractor activities are significant factors influencing major injury accidents (Manuele, 2008); this includes work in new or changing environments in which higher risk tasks are performed, and frequently by those with inadequate experience or training. Higher workloads with demands for high quality required in a limited time and for limited money are additional factors, along with conflicting goals, lack of common methods, role ambiguity and inadequate: planning; safety measures; training; and subcontractor selection (Inouye, 2015; Nunes, 2012). Differences in employment relationships, cultural and linguistic barriers, supervision, and communication lines too can be problematic (Nunes). Toole (2002) studied construction incidents in the United States and identified seven factors related to injuries and fatalities: training; deficient enforcement of training; lack of proper safety equipment; task sequencing; unsafe site conditions; not using safety equipment; and poor worker attitude.

Contractor Safety Prequalification

The National Safety Council's Campbell Institute gathered environmental, health and safety professionals in 2014 representing diverse general industry (non-construction) companies to identify gaps in contractor safety management, collect contractor safety best practices, and challenges in evaluating and monitoring contractor safety (Inouye, 2015). Its subsequent report recognized five components to the contractor safety life-cycle: prequalification; pre-job task and risk assessment; contractor training and orientation; monitoring of job; and post evaluation. This research focuses on the process of 'prequalification,' generically defined as a "pre-tender process used to investigate and

assess the capabilities of contractors to carry out a contract satisfactorily if it is awarded to them" (Hatush & Skitmore, 1997a, p. 20; Truitt, 2012). Prequalification attempts to match contractor and host employer expectations and raise the standard of contractor safety performance over time (Philips & Waitzman, 2013).

The current emphasis given to contractor safety prequalification in the United States may trace its roots to the Occupational Safety and Health Administration's (OSHA) Process Safety Management Standard, 1910.119 (H)(2)(i) (Occupational Safety & Health Administration, 2015). The standard was promulgated following the 1989 Chevron Phillips explosion in Pasadena, Texas in which a contractor had experienced a fatality at that same site within the prior year and was integral to the subsequent disaster sequence, (Molinaro, 2004); 23 employees were killed and 314 were injured following the massive release and ignition of a highly flammable gas. As part of the process to promulgate its standard, OSHA commissioned a study to understand the prevalence and trends of contract work use, the motivation for using contract workers, the role of safety in their selection, safety training received by contract workers, the responsibility for contract worker safety oversight and contract worker injury and illness experience (Kochan, Smith, Wells, & Rebitzer, 1992). Significant reported findings were direct hire employees were older, more educated, more experienced, paid higher and had a stronger command of the English language than contract hire workers. Forty percent of hiring company respondents did not include safety as part of their contractor selection process. Roughly half of all direct hire contract workers did not receive industry specific or pre-work off-site training by their employer. Site specific contractor injury and illness data was not collected by the majority of hiring plant managers. Interestingly, contract hire

employees had a lower accident probability when supervised by the host plant than those supervised by their contractor employer, thus giving further light to then safety weakness in the contractor supply chain.

Formalized contractor safety prequalification in the United States therein was 'born,' certainly so for process industries because employers with 'affected' processes were thereafter required to obtain and evaluate information regarding safety performance and programs when selecting a contractor (Occupational Safety & Health Administration, 2015). More recently this has transpired beyond process industries (Inouye, 2015; Philips & Waitzman, 2013; "U.S. Contractor," 2015). Indeed, publically traded companies are now found to utilize contractor prequalification as evidence to stock-holders safe working conditions are assured (Burroughs, 2015). As example, the Edison Electric Institute has developed an industry-wide Contractor Safety Program for contractors that build and maintain electric generation, transmission and distribution facilities; its goal is to develop a comprehensive, nation-wide database for utilities to make better contractor safety selections (Cauchon, 2014). ConstructSecure has been introduced in the construction industry as a balanced scorecard combining safety performance metrics to allow general contractor project managers to evaluate bidding companies before work is awarded (Sparer, Murphy, Taylor, & Dennerlein, 2013). Models for contractor prequalification are also found abroad. The Dutch petrochemical industry introduced VCA in the 1990s (Nunes, 2012), an acronym translated as a Safety, Health and Environmental Qualification System. It relies on detailed questionnaires to assess prospective contractors' occupational safety and health working practices. Successful contractors are issued a certificate and thus are provided entry to perform high-risk work, e.g.,

construction, maintenance and industrial cleaning. Unsuccessful contractors are excluded.

Positively reinforcing the trend toward institutionalizing some form of contractor safety prequalification are the requirements found in several occupational health and safety management system standards. The British Standards Institute (BSI) Occupational Health and Safety Assessment Series 18001-2007, for example, specifies conforming organizations "shall implement and maintain controls related to contractors and other visitors to the workplace (2007, p. 8)." Contractor safety prequalification is one means to satisfy such requirements.

Similarly, the American Industrial Hygiene Association and American Society of Safety Engineers (ANSI/AIHA) Z10-2012 Occupational Health and Safety Management System (OHSMS) specifies conforming organizations shall:

> define and assess the OHSMS competence needed for employees and contractors; and "establish a process to identify, evaluate and control potential health and safety risks:
>
> A. To the organization's employees from contractors' planned and unplanned activities, operations, and materials on the organization's premises, and
>
> B. To the contractors' employees from the organization's activities and operations. This process shall include appropriate contractor health and safety performance criteria (2012, p. 18).

Expected Value of Contractor Safety Prequalification

Abbaspour, Toutounchian, Roayaei, and Nassiri (2012) recognized the particular importance of understanding the compatibility between a company's health, safety and environmental management systems and that of its contractors and their sub-contractors and developed an extensive assessment system based on Shewhart's ideas on quality (Sliwa & Wilcox, 2008), i.e., *plan*, *do*, *check* and *act*. Smallwood (1998) identified lack of prequalification as a predominate factor in the frequency of fatalities in South African construction industry, but moreover contractors of all sizes are in need of health and safety advice, education and training and, when provided, the client company's priorities of cost, quality, schedule and productivity are promoted. The hiring companies, via prequalification, are positioned to positively influence contractor safety and health performance by doing so 'upstream' of the contractor's work being awarded or begun since contractors are likely to react to owners who apply non-price criteria (Waara & Brochner, 2006). Kochan et al. (1992) found, in their study of process industry contractor management practices, the few plants with the most rigorous selection procedures with significant weighting for safety also reported the lowest injury experience among their contractors. Some believe selecting a contractor with a history of good safety performance provides assurance of future safety performance; selecting a contractor with poor safety performance portends the opposite (Kozlovská & Struková, 2013). Echoing are Yemenu and McCartin (2010) who considered contractor prequalification to be a fundamental aspect of 'actively managing' contractors, , i.e., a process they conclude produces lower contractor Total Recordable Incident Rates (TRIRs) than reported by their peers. Further, improvement to loss rates may be

promoted since hiring companies have the ability to establish baselines from which the progress towards lower rates may be monitored year after year ("U.S. Contractor," 2015).

The selection of a qualified contractor provides confidence project goals will be met, and the process provides a standing list of contractors from which to choose for project bid invitations (Baghdassarian, 1999; El-Sawalhi, Eaton, & Rustom, 2007). Palaneeswaran and Kumaraswamy (2001) stated prequalification of contractors eliminates undesirable contractors (unresponsive, irresponsible or incompetent), and encourages healthy competition among qualified contractors, minimizes risk while increasing client satisfaction and provides improved balance between price and performance choices. Contractors too may desire prequalification criteria because it eliminates competition from marginally qualified contractors (NCHRP Synthesis 390, 2009). Tam (1992) believed excluding contractors from 'eligible to bid lists' actually accelerates the process of contractor selection, thereby freeing hiring companies to focus on other priorities; the "most qualified contractor correlates to the lowest administrative burden" (NCHRP Synthesis 390, 2009, p. 7). Arslan, Kivrak, Birgonul, and Dikmen (2008) described the systematics of contractor prequalification as being valuable for reducing selection subjectivity bias.

Contractor Safety Prequalification Practical Challenges

If it is accepted there are significant benefits to contractor safety prequalification, it also must be accepted there are significant challenges to doing *it* well. Variables potentially adversely influencing the acceptance or rejection of contractors include: selection criteria; efficacy, evaluation variability and verification; increased reliance upon third party prequalification services; and disuse of non-safety criteria.

Selection Criteria

ANSI/AIHA's Z10-2012 encouraged a "prequalification process to review past performance with emphasis on leading and lagging indicators, regulatory violations, [OSHA] 300 logs, insurance loss runs and safety, health and environmental program content and staff" (Appendix J, 2012, p. 59). The wide use of those specific metrics were confirmed by the Campbell Institute (Inouye, 2015) and others (Abu Nemeh, 2012; Hatush & Skitmore, 1997a). However, the validity of those contractor safety prequalification selection criteria, as commonly applied in general industry, is largely anecdotal.

Philips and Waltzman (2013) performed the most extensive summary and critique of contractor safety prequalification practices and recognized the disparity in selection criteria employed by individual operating units, cross company criteria and also criteria facilitated by third-party evaluation companies. They concluded imposing criteria 'separates the wheat from the chaff' but which criteria is best remains unanswered. They witnessed subjective criteria, such as a contractor's safety culture, as an important indicator of future performance but admitted such data can be costly and challenging to collect and measure. Thus there is a tradeoff between subjective and the more readily measured and assessed objective criteria. Problematic to over-reliance on objective criteria, say Philips and Waltzman, is it "tries to be such that all can agree whether the criterion was met or not. But the narrowness of objectivity can possibly mean that the criterion is not measuring what the system hopes it is measuring (2013, pp. 25-26)." The principle risk is binary 'yes' or 'no' criteria, while logical and efficient, presents the risk of a 'good contractor' being disqualified (Ali, 2005; Holt, 1998) and, reciprocally, a 'bad

contractor' may be qualified. A better understanding of a contractor's strength of relationships, communication, integrity, fairness, professionalism, creativity and innovation (Baroudi & Metcalfe, 2011) would provide a more 'humane' prequalification system, perhaps more capable of separating the 'wheat' from the 'chaff.'

Singh and Tiong (2006) argued contractors do not believe it is appropriate to generalize decision criteria to all projects. But Hatush and Skitmore (1997a) concluded development of a standardized criteria for contractor selection is achievable, and with it a quantified selection framework for "accurate, reliable and efficient decision making" (p. 37), i.e., 'efficacy'. Which is correct? Janicak (2010) might suggest, regardless of one's paradigm, the following questions must be answered when determining contractor selection performance criteria: "Is the data readily available? How accurate is the data? Is the data easily understandable? Is the data a true measure of the indicator or could there be biases? Could there be reliability issues with the data?" (p. 30).

Efficacy

A contractor's ability to meet or exceed prequalification criteria and achieving acceptable subsequent performance is not guaranteed (Doloi, 2009). Construction "industry practitioners have been proposing different methods and procedures for contractor selection, most of them have shortcomings in drawing a clear link between the selection criteria and the project success leading to a win-win situation to all parties" (2009, p. 1246). There has been a proliferation of prequalification models (Ali, 2005) of increasing complexity and conflicting objectives (Watt, Kayis, & Willey, 2010). If the qualifying criteria imposed by the hiring organization is invalid, the resources expended and the decisions made therein consign the entire process to waste and irrelevancy.

Yemenu and McCartin (2010) found prequalification efficacy is further important simply because of the administrative burden imposed on both the hiring organization and the prospective contractor. Administrative processes are required, personnel must devote time to attending them and duplicative and inconsistent efforts can create delay and inaccurate evaluations. The authors believe this problem is magnified by the lack of standardization of selection criteria across all hiring companies and industries, yielding that contractors must conform to a myriad of hiring client demands. The range of qualification criteria can merely be the verification of insurances to integrated audits with complex grading systems (Baghdassarian, 1999; Jennings & Holt, 1998).

Evaluation Variability

Mahdi, Riley, Fereig, and Alex (2002) found selection methods are often dependent on the skill, experience and knowledge of the individual(s) evaluating the prospective contractor. Time pressures to complete the prequalification procedure may further result in incomplete and inaccurate conclusions when there is a lack of information and shortcomings in the assessor's competence (El-Sawalhi et al., 2007). This means consistency naturally varies due to subjective judgments derived from one evaluator to the next, and it is a worry, along with 'fairness,' voiced by some contractors (Baroudi & Metcalfe, 2011; NCHRP Synthesis 390, 2009). This worry is possibly less problematic when objective data is compared to stringently adhered specified limits, e.g., requiring prospective contractors to achieve a Days Away, Restricted or Transfer (DART) rate of less than 2.0 using a 100 worker rate basis. But given a hypothetical example of a submitted DART rate of 2.01, is it reasonable to ask whether the prospective contractor be given the benefit of the doubt or stridently held to the agreed

standard without further consideration? Individual factors of evaluator knowledge, skill and experience are thereby magnified.

Given the above, more problematic may be intra-evaluator judgments about the adequacy of non-quantified data, e.g., contractor policy and written compliance programs in which a wide variety of format, content and requirements, relevance and their current review and update may be found. El-Sawalhi et al. (2007) might describe this as 'noisy and uncertain data'.

Increased Reliance Upon Third Party Prequalification Services

Use of third party prequalifying companies to manage the qualification process is increasingly common and, ostensibly, for the reasons previously provided for outsourcing generally; but also because of the third-party's ability to help bridge program gaps and, thereby, increase the contractor's competitiveness for winning work (Inouye, 2015).

Contrary to possible perception, however, third party contractor qualification service providers do not verify contractor self-reported data for complete and correct recording of workplace injury or illness. Rather, they verify the related forms are correctly completed and void of form and manner errors such as data omission or undated required signatures (personal communication, W. Robinson, Browz, March 11, 2016; personal communication, K. Vickers, ISN, May 28, 2015; personal communication; K. Reeves, PEC, March 11, 2016). This is a subtle but important nuance to grasp when the word 'verify' is ubiquitously encountered within third party prequalification literature. Additionally, if the stated concern about contractor selection criteria validity is well founded it is not ameliorated through the use of third-party prequalification service providers tasked with incorporating the varying criteria established by each hiring client.

Evaluation variability and efficacy are no less problematic for the third party provider. In summary, there is no academic literature on this growing industry (Philips & Waitzman, 2013).

Disuse of Non Safety Criteria

Non safety criteria is frequently applied to the selection of primary or general contractors in the construction industry as seen in Figure 3 (Fong & Choi, 2000); but is infrequently applied in contractor safety prequalification, whether facilitated by third party vendors or hiring organizations. For example, Hinze and Gambatese (2003) studied the impact of employee attrition within construction industry specialty contractors and concluded higher turnover rates are associated with higher injury rates; a factor not commonly encountered in contractor safety prequalification schemes. Another is an evaluation of 'capacity' (Abu Nemeh, 2012; Mahdi et al., 2002), i.e., the "current position of the contractor to perform the work well" (Hatush & Skitmore, 1997a, p. 21), a prerequisite to quality. This can include management ability, adaptability and coordination; and current resources and workloads (Mahdi et al., 2002). Nunes (2012) recognized 'cooperation' and long-term relationships as important factors for promoting occupational safety and health. And Jennings and Holt (1998) evaluated construction contractor perceptions of selection criteria and found prior relationships were rated as one of the top five important factors, beaten only by price, experience, reputation and financial standing. Other factors not found to be included in general industry contractor safety prequalification are planning (Doloi, 2009) and depth of experience (Singh & Tiong, 2006), external certifications (Waara & Brochner, 2006), people (Xinyu & Hinze, 2006), quality (Egwunatum, Benjamin, & Daniel, 2012), and technical expertise (Hatush

& Skitmore, 1997a). The non-safety criteria most frequently encountered and of interest to the researcher due to the potential impacts on safety performance are contractor: capacity; experience; financial stability; and reputation.

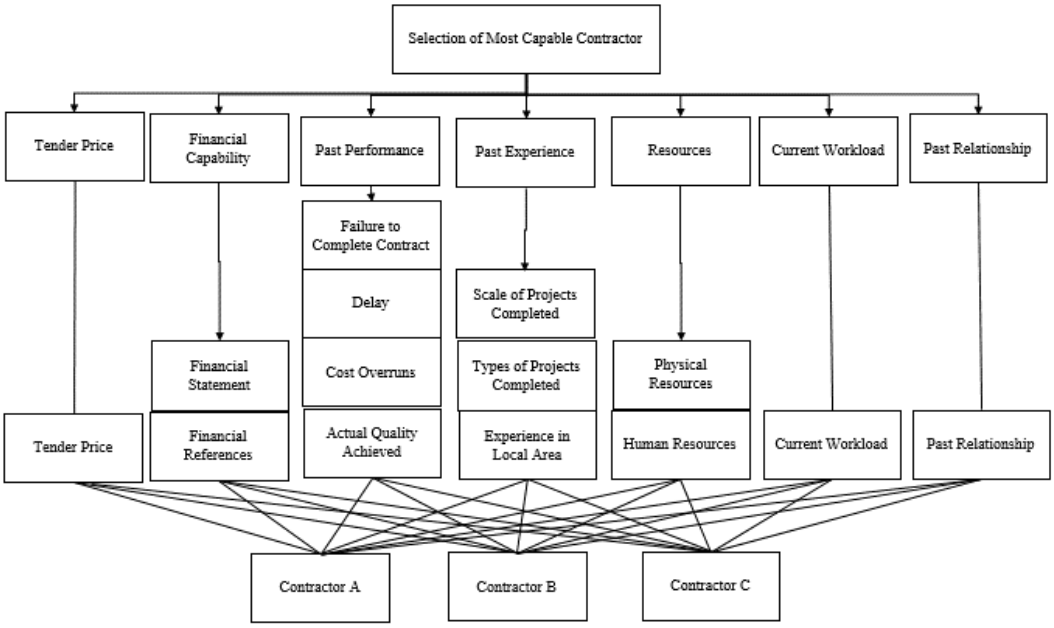

Figure 3. Hierarchy of selecting the most capable contractor. Adapted from "Final Contractor Selection using the Analytical Hierarchy Process," by Patrick Sik-Wah Fong and Sonia Kit-Yung Choi, 2000, Construction Management and Economics, p. 552. Copyright 2000.

Significance of the Problem

It is clear the 'science' of contractor safety prequalification in general industry is less than scientific. Objective criteria for broad application to all contractors remains elusive. Hiring organizations derive their own 'recipes' for success without evidence of benefit. As such, there is much more individual and company centric intuition than industry consensus when deriving prequalification criteria.

Contractors, therefore, are compelled to answer well-intended but perchance irrational or irrelevant requirements thought basic by hiring organizations to achieve a zero injury work site because they want the 'work' and to build relationships that promise more work. It is not empirically clear these demands actually bring the 'cream' to the top as much as it is clear those answering the call are most likely to rise.

There is no present remedy to inter-rater variability, whether prospective contractors are evaluated utilizing internal resource or through reliance upon more expert third party service providers.

The research introduced demonstrated there is an excess of criteria that could be incorporated for the more complete and objective selection of general industry contractors, as witnessed by the practices demonstrated in construction general contractor qualification, but these appear largely unattended by general industry hiring organizations when safety results are paramount.

The benefits of hiring organizations utilizing services offered by the burgeoning third party contractor prequalification industry has not been substantially studied, though the service offerings appear to be valued. Why?

It is not clear the general industry prequalification effort, itself, however well intended and prosecuted is value added. Affirming opinions? Copious. Data? A scarcity. It is possible the current practices, however clumsily pursued, yield great benefit and if any change is needed it is a fine 'tuning,' and not a re-build of that which is not broken. This is not proven. The researcher concludes study of the issues raised are indicated.

Statement of the Problem

Due to the significant emphasis and effort now given to contractor safety prequalification generally, whether facilitated by the hiring organization or a third party service provider, it is prudent to investigate whether the criteria commonly used are actually representative of the criteria valued by safety practitioners. Specifically, the purpose of this study is to examine whether such criteria or other criteria are significant predictors of selecting and maintaining contractors by steel industry safety professionals, and to understand how and why the rapidly increasing third party prequalification services are valued.

Research Questions

1. Are there significant differences in the perceptions of the value of the eight studied contractor prequalification criteria by steel industry safety professionals based upon organization role?
2. Is there a significant relationship between the number of major contractor injury events observed by the steel industry safety professionals and the value they place on the eight studied prequalification criteria?
3. Is there a significant difference in the value steel industry safety professionals place on the eight studied contractor prequalification criteria who have a predominant safety background and those who do not?
4. Is there a significant relationship between the years of experience and the importance placed on the eight studied prequalification criteria by steel industry safety professionals?

5. Is there significant agreement among steel industry safety professionals of the level of importance placed on the eight studied contractor prequalification factors?
6. Is there a preference demonstrated by steel industry safety professionals for facilitating contractor safety prequalification utilizing internal company resources or third party service providers?
7. What are the perceived values identified by steel industry safety professionals for utilizing third party service providers for contractor safety prequalification?
8. How often do steel industry safety professionals, or others on their behalf, conduct contractor workplace audits to verify the accuracy of reported injury/loss rates?
9. How often do steel industry safety professionals, or others on their behalf, conduct contractor workplace audits to verify the implementation of submitted written safety programs?

Assumptions

The researcher will assume the following:

1. The instrument used in this study includes scales that accurately measure safety professionals' perceptions of the value of commonly applied contractor safety prequalification criteria used by the steel industry.
2. The subjects will answer the survey items truthfully.
3. The subjects selected for participation in this study and who respond to the survey are representative of the steel industry.

Delimitations

1. This study is delimited to those variables supported by the literature and of interest to the researcher. It does not include all possible antecedent variables identified

throughout the literature review, e.g., character, incentives, country of origin, location, external certifications, project specific factors or client factors. Verification of contractor insurance, though a conspicuous qualifying factor in much of the literature reviewed and clearly important to limiting post-accident hiring organization liability, is not included in this study as it is judged by the researcher to generally be requisite of all contractors by all hiring organizations regardless of other variables. Therefore, it is not a discriminating variable for the selection of preferred contractors i.e., most all can purchase insurance to the prescribed limits if desired.

2. This study does not address lower risk contractors, i.e. under the direction and supervision of the hiring company; incidental to non-operations, e.g., vending, janitorial, catering, delivery, information technology, office and administrative, transportation, consultants, etc.
3. This study does not address subcontractors or 'latent' subcontracting that can occur with or without the knowledge or consent of the contractors or the clients (Chiang, 2009), but is directed at primary contractor safety prequalification.

Limitations

1. The sample used in this study is limited to safety practitioners working for member companies of the Steel Manufacturers Association, Washington, D.C. representing 28 member organizations 127 mills and 60,000 employees (Steel Manufacturers Association, 2016).
2. This study is limited to the assessment of safety prequalification criteria for primary contractors.

3. A limitation of this study is it will rely upon data derived from respondents' self-reported major accident events involving contractors.

Definition of Terms

Capacity: The current position of the contractor to perform the proposed project and broadly includes management ability, adaptability and coordination; and current resources and workloads (Mahdi et al., 2002).

Contractor: A contractor is an independent firm but working at the behest of another firm that exercises overall responsibility for the operations at the work site. Adapted from Pegula (2014)).

Contractor Employee Training: Evidence provided by the prospective contractor in advance of being approved by the hiring organization demonstrating its employees have the knowledge and skills needed to perform the specified work. This includes specific licenses, training certificates and excludes training provided by the hiring organization such as its work site hazard and rules orientation, etc.

Contractor Experience: A composite of the prospective contractor's technical expertise, successful past projects, knowledge of regulations, and overall and similar work history (Doli, 2009).

Contractor Injury History: Injury statistics reported to prospective hiring organizations by contractors or other parties on the contractor's behalf. This can include frequency and severity rates, experience modification rates and other loss indices.

Contractor Safety Prequalification: A "pre-tender process used to investigate and assess the capabilities of contractors to carry out a contract satisfactorily if it is awarded to them" (Hatush & Skitmore, 1997a, p. 20; Truitt, 2012).

Days Away, Restricted or Transfer (DART): nonfatal workplace injuries and illnesses requiring recuperation away from work, transfer to another job, restricted duties at work, or a combination of these actions (Bureau of Labor Statistics, 2005).

Employee: "A person who is employed by the organization or by a contractor to the organization when that person is under the day-to-day control of the organization" (ANSI/AIHA, 2012, p. 3).

Experience Modification Rate (EMR): An organization's actual claims history over a three-year period, excluding the last year and nine months, versus insurance industry predictions (Brahmasrene & Smith, 2008).

Financial Stability: A prospective contractor's financial ability to make needed safety investments and possibly constrained by financial longevity, ability to meet debt, credit level, payment history, financial statement, liquidity and other factors.

Hiring organization: A public or private company, corporation, firm, enterprise, authority, or institution, or part or combination thereof, whether incorporated or not, that has its own management functions, consisting of one or many facilities that hires contractor for the performance of workplace projects or tasks. Adapted from definition for 'organization' provided by ANSI, AIHA (2012, p. 3).

Incident Rate Calculation: Per the OSHA (2016a) an incidence rate, a measure of frequency, is the number of injuries and illnesses occurring among a given number of full-time workers (usually 100 fulltime workers) over a given period of time (usually one year).

An incidence rate of injuries and illnesses is computed from the following formula: (Number of injuries and illnesses X 200,000) / Employee hours worked =

Incidence rate. Multiple variations of rate examples include: Lost Time Accident (LTA) Rate; Days Away, Restricted or Transfer (DART) Rate; and Total Recordable Incident (TRI) Rate. Severity rates can be calculated by substituting the number of injuries for with the number of days lost or restricted in a given period of time.

Liability and Regulatory History: The prospective contractor's recent history of regulatory compliance violations and investigations, in addition to litigation history in which the prospective contractor is either the litigant or defendant.

Lost Time Accident (LTA): A workplace injury or illness that involves one or more days away from work (Occupational Safety & Health Administration, 2016b).

Major Injury Accident: A major injury results in short or long-term disability, including lost time accident, permanent disability or death.

Prequalification: A "pre-tender process used to investigate and assess the capabilities of contractors to carry out a contract satisfactorily if it is awarded to them" (Hatush & Skitmore, 1997a, p. 20; Truitt, 2012).

Reputation: The opinion of how a prospective contractor has performed in the past and is performing at present for delivering projects on-time, within budget and to specifications that include injury prevention and regulatory compliance.

Risk: "An estimate of the combination of the likelihood of an occurrence of a hazardous event or exposure(s), and the severity of injury or illness that may be caused by the event or exposures" (ANSI/AIHA, 2012, p. 4).

Safety Programs: Written documents provided by the prospective contractors to hiring organizations specifying the contractor's safety requirements for its organization

and employees, and the means to ensure the programs' implementation and maintenance. This includes, but is not limited regulatory required programs.

Total Cases: The number of nonfatal injuries and illnesses that a company experiences in any given time frame (Bureau of Labor Statistics, 2016).

CHAPTER 2

LITERATURE REVIEW

Introduction

The purpose of this study was to examine commonly utilized criteria for contractor safety prequalification, as well as select non-safety criteria frequently utilized for the selection of general contractors in the construction industry, in contrast to their perceived value to steel industry safety professionals. To facilitate a comprehensive literature review, multiple databases were utilized including ProQuest digital dissertations, EBSCO HOST, Google Scholar and others. This review identified a number of different criteria used in the contractor qualification process for both safety prequalification and for selection of preferred general contractors for construction projects.

Factors Frequently Used for Contractor Safety Prequalification

The following factors are predominantly encountered for the conduct of contractor safety prequalification: contractor injury history; contractor employee training; liability and regulatory history; and safety programs.

Contractor Injury History

Contractor injury experience and rates are given heavy emphasis by hiring organizations (Cauchon, 2014; Inouye, 2015; Philips & Waitzman, 2013; Sparer et al., 2013). This practice is likely a function of the apparent objectivity afforded by quantifiable data. Commonly requested data includes: workers compensation Experience Modification Rates (EMR), Total Recordable Incident Rates (TRIR), Days Away/Restricted or Transfer rates (DART), fatality and other injury rates. The reported

rates are often subsequently compared to North American Industry Classification System (NAICS) industry averages to judge the contractor's relative performance to peers.

Philips and Watzman found, through a review of data provided by a third party contractor safety prequalification service, historical lost time accident (LTA) rates were strongly predictive of current performance, and were a stronger predictor than Experience Modification Rates (EMRs), though both LTA and EMR data were useful performance predictors (2013). Manuele (2013), however, regards loss rates as lagging indicators, since its measures are variations of injury and illness frequency and severity calculations and, as such, are analogous to 'rear-view mirrors;' past performance is not prologue, whether judged bad or good. Manuele does admit, however, the utility of lagging indicators for confirming trends but even this value is not guaranteed. Stricoff (2000) describes several factors contributing to erroneous conclusions when considering loss rates even when used to trend data. To be statistically significant, rate outcomes must be measured over a long-period, else rate increase or decrease may simply be a response to random variation and not reflective of any significant change in the safety system. But 'time' in terms of injury and illness rates is a function of hours worked more than linear time.

Consider the average number of full-time workers per 'establishment' in the United States over a recent 18 year period was approximately 16, and the average size 'firm' (that could contain multiple establishments) was approximately 22 workers (Choi & Spletzer, 2012). Consider also the Bureau of Labor Statistics reports the average injury and illness rate per 100 full-time construction workers in 2014 was 3.6 (2016). A single injury for construction contractors of such establishment and firm sizes, for

example, would produce an injury rate between 8.7 and 12.0 if a 100 worker rate basis and an average hours worked per annum per worker of 2,080 (40 hours per week multiplied by 52 weeks) were assumed. Whereas a hiring company employing 100 would report a rate of 0.96 by comparison for a single injury, eight to 12 times less than the prospective contractor's injury rate. Thus, if a hiring organization requires at least average industry performance from its prospective contractors, disqualification of the prospective contractor might be likely since it is between two and four times worse than the comparison group average due to a single, and perhaps benign, injury or illness event, e.g., a foreign body in the eye at a windy and dusty work site even though sealed eyewear was worn.

This gives rise to a worry voiced by Kozlovská and Struková (2013) that a preoccupation by hiring organizations with loss history measures may disadvantage the contractor endeavoring to faithfully report workplace accidents, while providing advantage to less conscientious contractors. Contractor concerns about the injury rate criteria being viewed as unfair and capricious increase with the emphasis given them (Stricoff, 2000). As a consequence, "people learn how to make the numbers 'come out right" (p. 37), as there is little incentive to fully disclose all incidents (Ng, Cheng, & Skitmore, 2005). "Competition not only begets improvement, it stimulates cheating" (Philips & Waitzman, 2013, p. 23). There are documented cases of fraudulent injury reporting within contractor organizations (Cox, 2014; Gochfeld & Mohr, 2007; Wilbanks, 2016). It should be noted injury and illness rates are self-reported by the prospective contractor (Yemenu & McCartin, 2010), i.e., and often are taken at face value without detailed audit. The consequence of blithely accepting submitted loss information

is witnessed in the case of Pacific Gas and Electric Company's selection of Cleveland Wrecking Company, whose employee was killed during the demolition of a power plant (Cox, 2014). Cleveland did not faithfully disclose its injury accident history that subsequently was found through independent investigation to be greater than any of the other four competing bidders. This provided Cleveland with undue advantage when bidders' scorecards were compared.

Use of EMRs are considered an important alternative to simple short-term injury rate calculations since the most recent three year loss experience is utilized, and also because EMRs are normally independently calculated and reported by insurance providers. But Brahmasrene and Smith (2008) note EMRs too are subject to interpretation foibles. Less severe but more frequent injury claim histories result in greater deterioration of an entity's EMR than less frequent but more severe claims, a counter-intuitive reality. Also, EMR calculations favor companies with greater revenue over those with less revenue though no difference in safety efforts or results may be in evidence. Imriyas (2009) provides a concise summary of EMR shortcomings for contractor safety prequalification, as seen in Table 1.

Table 1

Shortcomings of the Experience Modification Rate

Author(s)	Criticism
1. Everett and Thompson (1995)	• The EMR is a complex approach • The EMR cannot fairly compare the safety records of different contractors • New contractors are forced to pay more premiums since they are not experience-rated
2. Hinze, Bren, and Piepho (1995)	• The EMR value is decreased as the project size increased • Highly paying contractors will have lower EMR values
3. Coble and Sims (1996)	The EMR can be vulnerable to fraud by contractors to obtain low premiums in three ways: • Manipulating the payroll of workers • Misrepresenting work classification • Manipulating company ownership
4. Hoonakker et al. (2005)	• The EMR is a lagging indicator • The EMR is based on worker classification and not on jobs, which impedes the interpretation of the results

Note: Adapted from "An expert system for strategic control of accidents and insurers' risks in building construction projects," by K. Imriyas, 2009, *Expert Systems and Applications*, (36)2, Table 1, p. 4022. Copyright 2008 by Elsevier Ltd.

In summary, injury and experience rates, however formulated, provide an important but small and, perhaps, clouded window through which the prospective contractor's safety performance may be viewed. The utility of self-reported data depends, in large, upon the honesty of the contractor (Kozlovská & Struková, 2013). Yet the use of injury and experience rates for contractor safety prequalification is pervasive and may unduly influences contractor selection by hiring organizations.

Contractor Employee Training

Among the revelations about contractor safety practices in petro-chemical operations discovered by Kochan et al. (1992) following the 1989 Chevron Phillips explosion in Pasadena, Texas, were training inconsistencies between contractor worker and host-plant full-time employees. It was learned 48% of all direct hire contract

workers had received no industry specific or pre-work off-site training by their contractor employer; and 54% had received none prior to beginning work at the plant where assigned. Further, employees of the host plants were found to be provided significantly more safety training than their contractor employee counterparts; and contract workers were half as likely to receive annual safety training from the contractor employing them. Host plants frequently conducted site specific orientations for contract workers, but these were normally two hours or less in duration in 54% of the contractors surveyed.

Contractor training was of concern to the researchers since contractor workers were directly involved in the Philips disaster. Allen (2011) reports the plant had approximately 950 direct hired employees and 600 daily contractors. One of the contractors was Fish Engineering. It had been inspected by OSHA 44 times in the prior 17 years; seven in response to a fatality or other calamity. Fish's direct participation in maintenance work requiring use of lock-out/tag-out procedures within a highly hazardous process was associated with the blast killing 23 people and injured more than 300.

OSHA's subsequent Process Safety Management of Highly Hazardous Chemicals standard, 1910.119, conspicuously established new training requirements for both the employer (section (g)) and contractors (section (h)) (Occupational Safety & Health Administration, 2015). Specific related contractor requirements when working on affected processes thereafter included (p. 7):

- (i) The contract employer shall assure that each contract employee is trained in the work practices necessary to safely perform his/her job.
- (Manu et al.) The contract employer shall assure that each contract employee is instructed in the known potential fire, explosion, or toxic

release hazards related to his/her job and the process, and the applicable provisions of the emergency action plan.

- (iii) The contract employer shall document that each contract employee has received and understood the training required by this paragraph. The contract employer shall prepare a record which contains the identity of the contract employee, the date of training, and the means used to verify that the employee understood the training.

While the referenced OSHA standard applies only to employers and contractors working with processes involving highly hazardous chemicals, its subsequent influence upon contractor safety prequalification practices for other industries is apparent. The Mine Safety and Health Administration (MSHA) has identified training as a deficit related to independent contractor fatalities in metal and non-metal mines (National Mine Health and Safety Academy, 2006); assurances are required that contract personnel are adequately trained for the safe operation of equipment, and also for general procedures to safely perform tasks. General industry companies participating in the Campbell Institute's survey of contractor safety practices such as U.S. Steel, Fluor and BNSF all now require evidence of training for contractor workers (Inouye, 2015). This includes specialized training for higher risk work such as work at heights, confined space entry, energy control and others. Some training is transacted online and others perform it at the hiring organization's location or otherwise require it of contract workers before work is allowed. The Builders Merchants Journal advises its United Kingdom subscribers that hiring organizations are wise to ensure verification of construction contractor skills, experience and knowledge (Southall, 2015). Enshassi, Choudhry, Mayer, and Shoman

(2008) reported construction injury rates were shown to decrease when new contract workers were provided hazard awareness training, and also increased when such training was not provided. Lack of adequate contractor training was linked by Baghdassarian (1999) as a cause of poor performance that impacted productivity in power plant construction.

All the aforementioned are supported in recognized occupational health and safety management systems standards such as BSI 18001. It requires conforming organizations to "ensure that any person(s) under its control performing tasks that can impact on OH&S is (are) competent on the basis of appropriate education, training or experience, and shall retain associated records" (p. 11). This, of course, includes contract workers.

Assurances of contractor worker training is recognized as a "crucial element of a facility's safety program" (Bennett, 2000, p. 28), and so has become a central component for contractor safety prequalification activities, regardless of the industry examined. Its value is emphasized by Nunes (2012) who concluded "training and education on OSH [occupational safety and health] issues aligns standards and procedures among [hiring] clients and contractors, harmonizes safety culture and improves OSH performance" (p. 3066). A study conducted by Demirkesen and Arditi (2015) confirm Nunes's conclusion, i.e., most large U.S. (construction) contractors strategically value effective safety training for achieving improved safety performance. The researchers provide caveat, however. Organization, feedback, content, process and worker issues all are fundamental inputs and constraints to training quality. Doing it (training), proving it and doing it well are each different dimensions to all training, no matter the worker or format. The subject of contractor safety prequalification in the context of training criteria chiefly examines

'proving it.' On that basis alone it is identified as a compelling criteria to test in a study of steel industry safety practitioners' contractor selection priorities.

Liability and Regulatory History

The regulatory compliance and liability history of prospective or current contractors is a worry that looms large for hiring organizations. Thus the two factors are often advised to be included for risk management's sake as part of a comprehensive contractor prequalification effort (Ioma, 2002; Weaklend, 2009).

One reason for this worry is OSHA's Multi-Employer Policy that can yield significant liability for the hiring organization since it can be cited for acts and omissions depending on its own judged status as the hazard *creating*, *exposing*, *correcting* and *controlling* employer (Occupational Safety & Health Administration, 1999). Related, the Mine Safety and Health Administration (MSHA) requires operators to submit accident reports for those employees under its control, including contractor employees (Smith, 2014); "the party responsible for maintaining a safe working environment in the mine is the party who is to be responsible for notifying MSHA of any accidents" (p. 51). MSHA, therein, assigns this aspect of contractor 'liability' to the mine operator. Ramani (2000) found an owner in Ontario, Canada can be charged for a construction worker's death at their work site; and also a contractor's litigation tendency can become a liability for the hiring organization, whether the contractor is more often the defendant or the plaintiff.

There may or may not be a statutory duty of care imposed upon the hiring organization, and it may or may not be delegable (it expressly is not in the case of general contractors engaging in federally funded work per 29 CFR 1926.16, Rules of

Construction (Mroszczyk, 2015)). Contract language may or may not reduce the hiring organization's liability (Ivensky, 2015). These challenges have also been realized abroad, in the United Kingdom, for example (Manu et al., 2013; Southall, 2015) and in Europe (Nunes, 2012). While United States and Canadian workers' compensation statutes generally provide exclusive remedy for the employer and employee following a workplace injury or illness, those same protections are not guaranteed to the hiring company when an employee of its contractor incurs a work related injury or illness. The injured or ill contractor worker or their heirs may be able to file a civil lawsuit against the hiring company for its acts or omissions (Burroughs, 2015; Ioma, 2002; Ivensky, 2015; Philipson, 2011; Silver, 2015). As evidence, one steel producer was recently found liable for 75% of a $3.75 million dollars judgment for the value of a contractor employee's life who died at its work site from an industrial accident, and 75% of $1 million for the deceased's pain and suffering (Silver, 2015). Prime (or general) contractors face the same concern when sub-contractors are hired (Ivensky, 2008), but one that is exacerbated in the circumstance in which a subcontractor defaults, resulting in an increased enthusiasm for subcontractor prequalification systems to stem the costs of contractor default insurance (Aon, 2014).

Beyond the issue of increased financial liability, hiring organizations may be justifiably concerned about regulatory compliance as an indicator of a prospective contractor's general attitude and efforts for safety. A study conducted by Weil (1996) concluded employers were often significantly motivated to comply with OSHA regulations despite the low probability of inspection and significant fines. Mendeloff and Gray (2005) similarly found a connection between regulatory requirements and

managerial attention to safety. The presence of OSHA, itself, and the *possibility* of inspection and fine can have a disproportionately positive effect on industry's commitment to comply. A hiring organization so disposed would likely view quite negatively a prospective contractor's history of non-compliance (OSHA, 2016) as an indifference to authority, perhaps even to its own authority; a reflection of the contractor 'safety attitudes and practices' cited by Kozlovská and Struková (2013) as one of the four most commonly used indicators for assessing safety performance for (construction) contractors. Ironically, hiring organizations may have their own compliance challenges but which can be rationalized (Ripamonti & Scaratti, 2015) and are certainly frequently disputed by them when regulatory violations are alleged (Johnson, 2013; "Milwaukee-based," 2007; "OSHA alleges violations," 1990; "Pawcatuck firm," 2010). But hiring organizations place significant import to non-compliance when selecting contractors, as witnessed through their ubiquitous reliance upon regulatory compliance checks during the prequalification process (Inouye, 2015; ISN, 2016; Weaklend, 2009).

In summary, hiring companies have historically attempted to limit liability by limiting their knowledge and control of the work contracted (Xinyu & Hinze, 2006), fearing more knowledge and control may equal more liability (Ivensky, 2008). This is increasingly viewed as short-sighted, however, as some industries directly pay for the contractors' workers compensation costs (Philips & Waitzman, 2013), and the costs of contractor accidents are inevitably returned to the hiring organizations, if only indirectly (Gambatese, 2000). Motivating to the hiring organization, alone, is expensive work delays can be triggered by a single contractor's non-compliance (Salisbury, 2015). It is increasingly accepted measuring contractor compliance to regulatory requirements is a

valuable strategy to limit liability (Xinyu & Hinze, 2006) and to lower injury rates (Kozlovská & Struková, 2013). Tempering this conclusion is Moayed (2011) who reminds OSHA compliance only makes an organization 'average'. While 'below average' contractors can be expected to be harmed during bid selection for their histories of non-compliance, hiring organizations should be circumspect about the utility of the measure as the absence of a negative compliance history may not be inferential to selecting a 'preferred' contractor.

Written Safety Programs

"Safety performance management programs encompass the tools and techniques for guiding the safety activities of an organization (Janicak, 2010, p. 5)." Such programs are frequently required of contractors for submission and review by hiring organizations or their third party service providers and regularly require evidence of contractor employee orientation, and training and pre-job task and risk assessment (Inouye, 2015). Programs required for submission are commonly but not exclusively regulatory compliance based.

Peterson (2001) might have ascribed the affinity for regulatory compliance program submission as stemming from the 'OSHA Era' of 20th century safety management evolution. Peterson complained over-emphasis to 'programs' with inadequate emphasis given to the humans who are subject to them inevitably results in workers not caring about safety. "And we wonder why our programs don't fly! (p. 120)." Programs are not safety, believed Peterson, they are 'islands of safety,' normally in answer to the dictates of OSHA but not integrated into the overall management system (2000). Peterson challenged the effectiveness of 'programs,' asking: "Are they effective?

Do they change attitudes or behavior? Do they motivate or even communicate? (2001, p. 117)".

A current day answering of Peterson's questions in the context of contractor prequalification is muddied by the conclusions of Philips and Waitzman (2013) that hiring organizations have differing (contractor safety program) criteria and some hiring organizations have differing criteria for differing jobs. This proves a challenge for prospective contractors as shared by one contractor representative asked to cooperate with a hiring organization's third-party prequalification administrator:

> The main issue that we have with [vendor name deleted] is duplication. We have over 60 clients with [vendor name deleted]. Many asking the same questions in a slightly different way and requesting the same policies and procedures that are uploaded multiple times. Management systems and audits such as ISO 18000, provincial COR [Certificate of Recognition] programs, etc. should be considered by clients. This may mitigate the duplication and the administrative burden associated with maintaining a [vendor name deleted] subscription (Alan Brady, personal communication, November 28, 2016).

Philips and Waitzman additionally offer, however, while safety program criteria broadly differs, there appears to be some validity to requiring program submission in terms of reported loss rates, see Table 2). The authors conclude contractors successfully

completing the submission process report lower injury rates generally. Their findings are not without precedence.

Table 2

Comparison of Injury Rates and Contractor Safety Program Manual Submission

Safety Manual for Desk Top Audit	Number of Contractors	Total Injuries and Illness Rate	Restricted Cases Rate	Lost Workday Cases Rate	Fatality Rate
Incomplete Submission	751	3.07E-02	3.75E-07	3.11E-05	5.81E-09
Complete Submission	1031	1.33E-05	2.83E-07	8.87E-07	3.05E-10
Statistical Significance		9%	19%	10%	3%

Adapted from "Working Paper, Contractor Safety Prequalification," by P. Philips and N. Waitzman, 2013. University of Utah, Department of Economics, No. 2013-07, p. 128.

Arocena and Núñez (2010) published similar findings when researching the effectiveness of occupational health and safety management systems in small (fewer than 50 employees) and medium sized (between 50 and 250 employees) enterprises, the former a demographic established herein to be characteristic of many contractor organizations. Small sized enterprises were particularly interesting to the researchers because, when compared to larger organizations, they found a tendency to their demonstration of: less financial resources and health and safety management capacity; inadequate leadership commitment; less worker representation; dependence on contingent employees; dependence on larger companies economically; inadequate regulatory monitoring; and a proneness to less formal approaches to managing preventive activities. Programs tested via this study were: Planning; Control; Integration; Documentation; Emergency Planning; Training; Information; Participation; Ergonomics; Health; Change Management; and Outsourcing/Sub-Contracting. The study confirmed all participants on average, regardless of size, reported lower injury rates and, further, but small sized enterprises demonstrated lower effectiveness of their health and safety management

systems when compared to medium sized enterprises. Firms with the weakest health and safety management systems were found to have the worst reported injury rates.

However, there is no standard safety program criteria represented in their review and none is commonly agreed, it can be challenged the programs submitted for review may not have been causal to lower injury experience, but rather may merely have measured an associative effect. Note that lung cancer patients may anecdotally be found to have commonly carried matches, but it is not clear matches cause lung cancer. Perhaps what is actually measured via program documentation submission is the ability of a given contractor to complete a stringent administrative process and thus reflective of the rigor, sophistication and discipline with which the contractor organization conducts their work generally; and which too may be reflected in their lower injury rates. Positively reinforcing to such a hypothesis is Philips and Waitzman (2013) who clarify a 'desktop audit,' as portrayed in Table 2, required but the submission of a completed prequalification form along with supporting safety manual. In their study this information was submitted to PICS (now doing business as Avetta), a third party contractor prequalification service provider. The authors describe desktop audits as a 'more relaxed' level of review versus a more rigorous review including field audits. Thus theirs was an assessment of what the contractors 'said' they were doing, and not one of whether the program requirements were, indeed, routinely met. Verifying the actual use or implementation of submitted written policies is a much greater challenge.

Sparer et al. (2013) examined the Constructor Safety Assessment Program (CSAP) advocated by a group of construction safety professionals and found review of written safety policies and procedures via CSAP could not attest to the programs' actual

dissemination to workers, thus speaking to the limitation of 'desk-top' audits. Similarly, Truitt (2012) found while written program review ensures programs relevant to the contractor's work are in evidence, an implementation review facilitated via field audit to ensure the programs are implemented may be indicated. Program verification, therefore, requires more than review of the written program, but a test of its actual performance beyond the 'desk-top' (Kochan et al., 1992; Weaklend, 2009). Else the submitted programs may merely be, as Peterson warned, 'islands of safety' or worse, *paper-tigers*.

To address this challenge, ISN (2016), a third-party contractor safety management services provider claiming more than 460 hiring organizations and 61,000 subscribing contractors, has developed its 'Review and Verification Plus Services' in which submitted written programs are first evaluated through a traditional 'desk-top' review and then selectively complemented by field audits at a contractor's place of business. ISN's goal for completed field audits in 2016 was approximately 500 (J. Velasquez, business communication, October 28, 2015). This equates to 0.83% of ISN's contractor subscribers receiving an implementation audit per annum, or a more than 100 year audit cycle were all subscribers to receive field audits. There is no research discovered to support general industry hiring organizations are performing their own contractor safety prequalification achieve an equal or higher field audit saturation, thus ISN may be leading in the work of written contractor safety program verification activities.

Field verification audits may be argued as important to do, but such audits are possibly infrequently performed during contractor safety prequalification regardless of the party performing the prequalification tasks. If true, this may be attributable to what Waara and Bröchner describes as 'transaction costs', i.e., costs that "arise through efforts

to specify the project, to conduct the procurement process, to monitor the chosen contractor, and to resolve any conflicts related to the contract" (2006, p. 798). Field audits increase 'transaction costs' and, so, may be unattractive even though their conduct might ultimately lower 'production costs', i.e., the direct payments to contractors (2006).

Janicak (2010) believes the presence of a safety program is predicated upon multiple factors, including: "program development, benchmarking, auditing, measuring performance, evaluating outcomes, and managing the program based upon outcomes" (p. 5). To the extent desktop audits are elucidating, they are judged by the researcher to be limited to but one of Janicak's criteria: program development. A distinction, therefore, should be made between the use of 'safety and health programs' and 'safety systems', the latter commonly accepted as being predicated on Shewhart's PDCA cycle, i.e., *plan, do, check, act* (American Society for Quality, 2015; ANSI/AIHA, 2012; Bird Jr., Germain, & Clark, 2003; British Standards Institution, 2007; E&P Forum, 1994; Manuele, 2008, 2013). It is concluded contractor prequalification activities, whether administered by hiring organizations or third party service providers, generally examine safety 'programs,' as constituted by the submission of one or more specified documents, i.e., the 'plan', without commentary on the extent to which the plans are 'done', 'checked' or 'acted' upon. The ubiquitous reliance upon written programs for contractor safety prequalification, therefore, is worthy of challenge through further study, especially given the growing cottage industry of consultants specifically marketing to prospective contractors needing to satisfy hiring organization written safety program demands (1 Stop Compliance, 2015; Blakeman & Associates, 2013; Industrial, 2016; OSHA Safety Manual.com, 2016; Safety Service Company, 2015).

Factors Frequently Used for Construction Contractor Prequalification

The following factors are predominantly encountered for the conduct of construction general contractor prequalification: capacity; experience; financial stability; and reputation.

Capacity

Capacity is the current position of the contractor to perform the proposed project and broadly includes management ability, adaptability and coordination, and current resources and workloads (Mahdi et al., 2002). Capacity can be overlooked in preference to cost and financial qualifications, given the incorrect assumption the later rises and falls proportionately with the former (Palaneeswaran & Kumaraswamy, 1999); capacity may not rise uniformly with workload. Bakheet (1995) provides a general context for the term's common usage through alliteration: *Machines, Man-power, Materials, Money, and Management*. A more extensive delineation can be incorporated into a rating scheme resulting in conclusions of capacity risk, as seen in Figure 4.

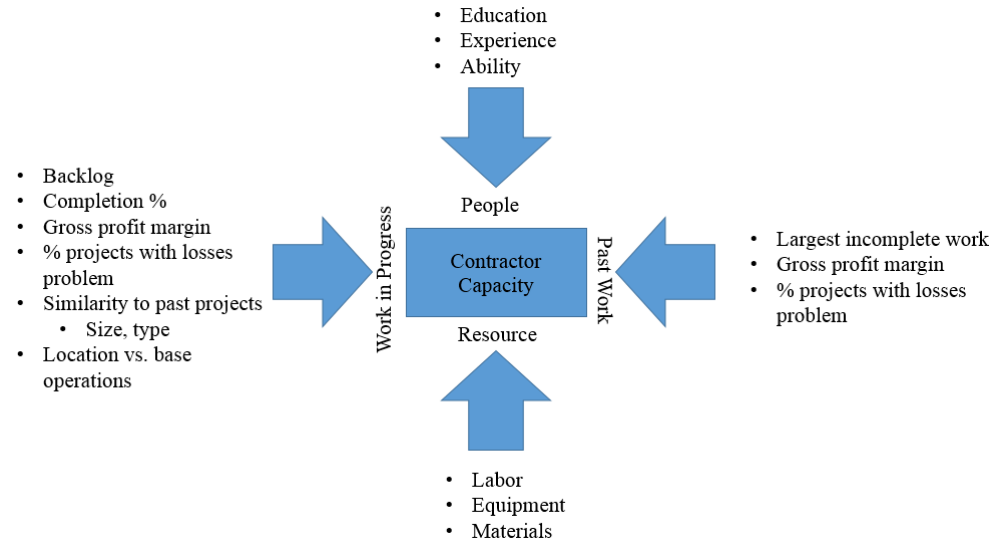

Figure 4. Contractor Capacity Model. Developed from "Contractors' Risk Assessment System," by Moataz Talaat Bakheet, 1995, Thesis, Georgia Institute of Technology. Table 16, p. 157. Copyright 1996 by UMI Company.

Lack of labor availability, equipment, construction materials, key technical resources and experienced personnel increase project risk. A model demonstrating how capacity can be considered when evaluating a contractor's tender submission is found in Figure 5.

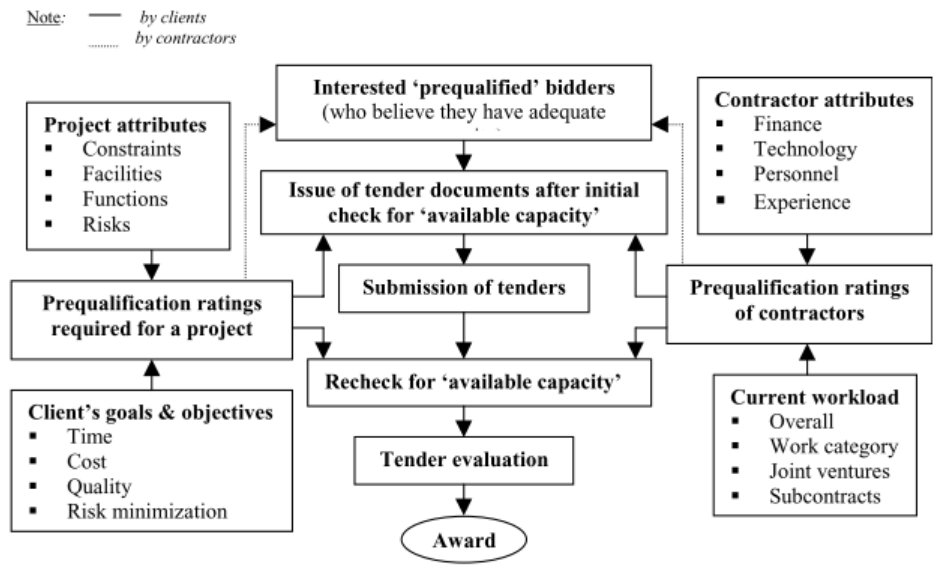

Figure 5. Conceptual model for contractor capacity evaluation. Adapted from "Dynamic Contractor Pre-Qualification," by Ekambaram Palaneeswaran and Mohan M. Kumaraswamy, 1999, *Association of Researchers in Construction Management*, Vol. 2, Figure 3, p 619.

Perhaps one of the starkest examples of increased risk from inadequate capacity is found in the May 11, 1996 crash of ValuJet's flight 592 in the Florida Everglades resulting in the loss of life of 110 passengers and crew. Matthews and Kauzlarich (2000) recite ValuJet was a rapidly growing start-up airline, operating just two planes initially and securing a total of 50 aircraft within its first 31 months of operation; the crash happened in ValuJet's fourth year of existence. The author's further note the company's motto was 'lean and mean' and relied heavily upon outsourcing. Integral to the crash was a ValuJet maintenance contractor, SabreTech, that was found directly culpable. Multiple shortcomings were identified by the Federal Aviation Administration in ValuJet's contractor monitoring (Major, 1996), with specific concerns about SabreTech including inadequate tools and materials for the work assigned to it by ValuJet, as well as the unavailability of adequate repair manuals ("Sabretech shuts down," 1997). Performance

pressure and contract penalties imposed by ValuJet onto SabreTech may have indirectly contributed to SabreTech's falsification of records (Matthews & Kauzlarich, 2000). It is clear, in retrospect, both companies lacked adequate capacity for the achievement of their respective objectives.

A less dramatic but equally compelling example of the relationship between capacity and accidents is offered by Elenge, Leveque, and Brouwer (2013). They empirically found high-levels of accidents exacted upon artisanal mining workers in the Congo. More than 72% of the 180 workers surveyed had incurred a workplace accident in the prior 12 months; 60% had experienced more than two accidents in the same period. The unsuitability of tools was found to be one of the major causes of accident as was lack of experience, and the absence of an adequate apprenticeship program or effective training generally. Each are examples of inadequate 'capacity'.

Contractor safety prequalification schemes are not found to include evaluations of capacity. Remembering the average number of full-time workers per 'establishment' in the United States over a recent 18 year period was approximately 16, and the average size 'firm' (that could contain multiple establishments) was approximately 22 workers (Choi & Spletzer, 2012), and smaller contractors and those experiencing growth may be at greater risk of accident (Hinze & Gambatese, 2003), the study of 'capacity' in the context of contractor safety prequalification appears a rational factor to consider herein.

Contractor Experience

Mahdi et al. (2002) included contractor 'experience' as one factor when proposing a Multiple-Criteria Decision Support System as a method for selecting risk optimal construction contractors; the others were past performance, or reputation, and financial

stability, also discussed in this chapter. Mahdi describes experience in the context of contractor selection as:

> (1) number of years working on similar projects and in construction generally, (2) total work volume on similar projects and in construction generally, (3) average work volume on similar projects and in construction generally, (4) working with different contract types (as indicator to the risk share willingness), (5) working in similar geographical conditions, and (6) working in similar weather conditions in similar projects.

Doloi (2009) further includes retention of key (experienced) personnel in addition to the definitions provided by Mahdi. Hatush and Skitmore (1997a) offer similar parameters. Doloi thereafter conducted a study that ultimately identified seven selection factors with sub-attributes using factor analysis for use in contractor prequalification for construction projects. Four of the factors identified by Doloi included experience related sub-attributes, i.e., technical expertise, successful past projects, knowledge of regulations, overall and similar work experience, and time in the business. Doloi then conducted a regression analysis of each of the sub-attributes associated with the seven identified factors versus the dependent variables of time, cost and quality, requirements subsequently recognized by Alzahrani and Emsley (2013) as the 'iron triangle' of contractor performance. Figure 6 portrays the results of Doloi's analysis; experience related characteristics are highlighted in bold font. Contractor 'experience,' however defined, is inextricably linked to the likelihood of a contractor performing on time, to

budget and to the quality required.

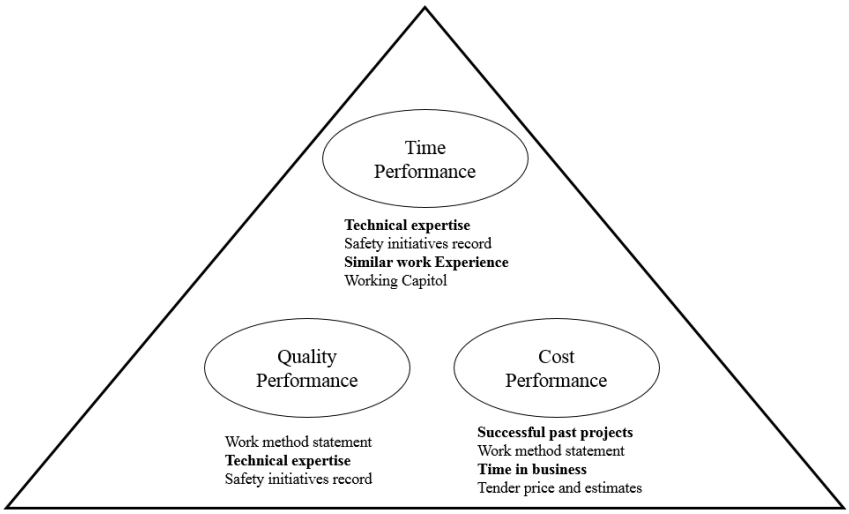

Figure 6. Time, cost and quality attributes for contractor selection criteria. Conceptual framework for contractor prequalification criteria for on-time, within budget and to quality specifications performance. Adapted from "Analysis of prequalification criteria in contractor selection and their impacts on project success," by Hemanta Doloi, 2009, Table 7, p. 1258. Copyright 2009 by Taylor & Francis.

Doloi's conclusions are broadly supported by prior and subsequent research, as well (Ebrahimi, Alimohammadlou, & Mohammadi, 2016; Egwunatum et al., 2012; Hatush & Skitmore, 1997b; Jennings & Holt, 1998; Watt et al., 2010), demonstrating the criticality of experience as a significant prequalification factor for the selection of construction contractors. However, contractor experience is not found to be routinely tested within general industry safety prequalification schemes, whether internally facilitated or by a third party service. This is ironic because the relationship between worker experience, a micro-view of organization experience, and accident frequency has been convincingly demonstrated in numerous environments (Fabiano, Currò, Reverberi, & Pastorino, 2008, 2010; Hintikka, 2011; Takeuchi, 2011), thereby informing the

researcher the importance of contractor experience, more broadly defined, could be instructive to the ability to safely complete contracted work.

Financial Stability

Contractor financial stability is, perhaps, the most basic test of whether contractors can do what is promised by them, hence its center-piece prominence in construction safety contractor prequalification schemes (Abu Nemeh, 2012; Cheng & Heng, 2004; Doloi, 2009; Ebrahimi et al., 2016; Hatush & Skitmore, 1997a, 1997b; Mahdi et al., 2002; NCHRP Synthesis 390, 2009). Bakheet (1995) recognizes financial stability (or capital) as one of the four C's relied upon by underwriters when assessing contractor bond applicants, i.e., character, capital, capacity and continuity; and provides a template for assessing contractor financial stability (See Table 3).

Table 3

Contractor Financial Stability Assessment

	Quantitative Factors	Unit	Risk* High	Moderate	Low
Backlog	Cash	Days	<7	7 to 10	>10
	Accounts receivable		>60	50 to 60	<50
	Accounts payable	Days	>60	50 to 60	<50
	Backlog vs. working capitol	Days	>10	5 to 10	<5
Net Worth	Debt to net worth	%	>3	2 to 3	<3
	Fixed asset to net worth	Multiple	>40	10 to 40	<40
	Net worth to backlog	%	<5	5 to 10	>10
	Sales to net worth	%	<10	10 to 15	>15
Profit	Gross profit to sales	%	<5	5 to 10	>10
	Overhead to sales	%	>10	5 to 10	<5
	Overhead to net worth	%	>60	50 to 60	<50
	Net profit before taxes to sales	%	<2	2 to 3	>3
	Return on Equity	%	<10	10 to 15	>15

* Example Ranges - actual values subject to hiring organization determination

Qualitative Factors

Generally Accepted Accounting Principles Applied
Accounting System(s)
Cash Flow Project Statements
Bank References
Securred Credit Line
Debt Financing
Credit Report
Financial Statements Audit

Adapted from "Contractor's Risk Assessment System, "Doctoral Thesis, Georgia Institute of Technology, by M.T. Bakheet, p. 128. Copyright 1996 by UMI Company.

Singh and Tiong (2006) studied 48 contractor selection factors in the Singapore construction sector and produced priority rankings for likelihood of successful project completion. Current financial commitments and liquidity were ranked third and eight respectively. Contractors themselves have placed similar importance of financial stability for winning work (Jennings & Holt, 1998). The term 'financial stability' is broadly interpreted to include sub-factors such as: financial longevity; ability to meet

short and long-term debt; credit level and payment history to suppliers and contractors; financial statement quality; liquidity, operations and leverage ratios (Mahdi et al., 2002). It is posited such factors may be inferential to a contractor's safety capabilities.

Truit (2012) advises contractor financial stability should be considered for safety and health reasons, as cash starved contractors or those having a high debt to equity ratio may not be able to invest in the programs, training and equipment desirable. Generally supporting this hypothesis is Hatush and Skitmore (1997a) who recognized through their related study the importance of financial stability as inferential to understanding whether the prospective contractor has at least the minimum resources required to meet the contract demands; credit status, bank status, bond status and published accounts reports are inferential to resource capability. Specifically reinforcing this premise are Dionne, Gagné, Gagnon, and Vanasse (1997) who conducted detailed study of the financial stability of airlines and their management's decisions. A database was compiled including a large number of accidents, carriers and financial structures coupled with maintenance and safety investment histories. Poisson models of accidents were estimated and evaluated using dispersion tests. Debt to equity ratio and maintenance investment were shown to have statistically significant effects on accident frequency. Importantly, negative debt to equity financial condition affected manager decision making negatively, whereas its opposite affected decision making positively. Financial realities can affect safety choices and thus create 'moral hazards.' Conversely, Wang, Hofer, and Dresner (2013) found no statistically significant relationship between airline financial condition and propensity for safety investment. The researchers did find an inverse relationship, however, between greater safety investment and decreased likelihood of accident, i.e.,

"airlines can increase their level of safety by spending more on maintenance and training (p. 31)". The ability to invest in safety, intuitively, is dependent upon resource availability for such investment, even though the 'moral hazard' concern identified by Dionne, Gagné, Gagnon, and Vanasse was not affirmed.

The availability of resource has been demonstrated in the above discussion to be requisite to a contractor's (or any organization's) ability to make safety investements. Safety investment, consequently, is dependent upon financial stability. Pilateris and McCabe (2003) admit that challenging to the hiring organization is contractors are most often privately held companies, and not subject to the accounting and reporting practices of publically held companies. This prompted the authors to develop and test their 'contractor financial evaluation model.' Data envelopment analysis (DEA) was used to produce efficiency scores yielding financial benchmarks contractors could pursue and also be compared. Reductions to the contractors efficiency score were correlated to increasing accounts receivable and payables, dept to equity, fixed assets to equity, gross profits to sales, administrative expenses; and also to decreasing net income versus sales and equity. Their work demonstrates it is possible to 'rank' the financial stability of privately held contractor firms versus their peers. This coupled with the posited relationship between financial stability and a contractor's safety investment ability and propensity, provides ample basis to promote financial stability as a basic contractor safety selection factor worthy of further study.

Reputation

Reputation is a factor commonly incorporated into the selection of primary contractors in the construction industry (Jennings & Holt, 1998), an industry that

persistently experiences high injury and illness rates (Kozlovská & Struková, 2013; Rajendran, 2013). Lewis describes 'reputation' as an asset allowing companies to charge a premium (or not) for their products and services, i.e., a positive reputation provides competitive advantage, and thus is an asset of "immense value" (2001, p. 31). The author further describes the complexity of how reputations are earned as a "fermenting mix of behavior, communication and expectation (p. 31)." But reputation for primary contractors undertaking large construction projects is an important prequalification factor moreover because failure of the contractor to perform generally can lead to excessive losses, project delays and unacceptable quality (Movahedian Attar, Khanzadi, Dabirian, & Kalhor, 2013). Thus reputation connotes more than a safety risk, but more broadly a prospective contractor's likelihood of completing the 'iron triangle', i.e., on time, under budget and to specifications (Alzahrani & Emsley, 2013). This is evidenced, for example, by Jennings and Holt who solicited regional, national and international contractors' perceived level of importance of 15 selection factors and found, using a relative index technique, reputation was considered the third most important (0.75); only price (0.89) and experience (0.77) were thought more important (1998). If a 'fermenting mix,' as believed by Lewis, Jennings and Holt have proven 'reputation' to be a powerful concoction.

Apparently confounding conclusions to the importance of reputation is research utilizing Discrete Choice Experiment methodology. It yielded reputation (company standing) was the second lowest in importance for contractor tender evaluation (Watt et al., 2010) as displayed in Figure 7. Ranked highest? Past project performance.

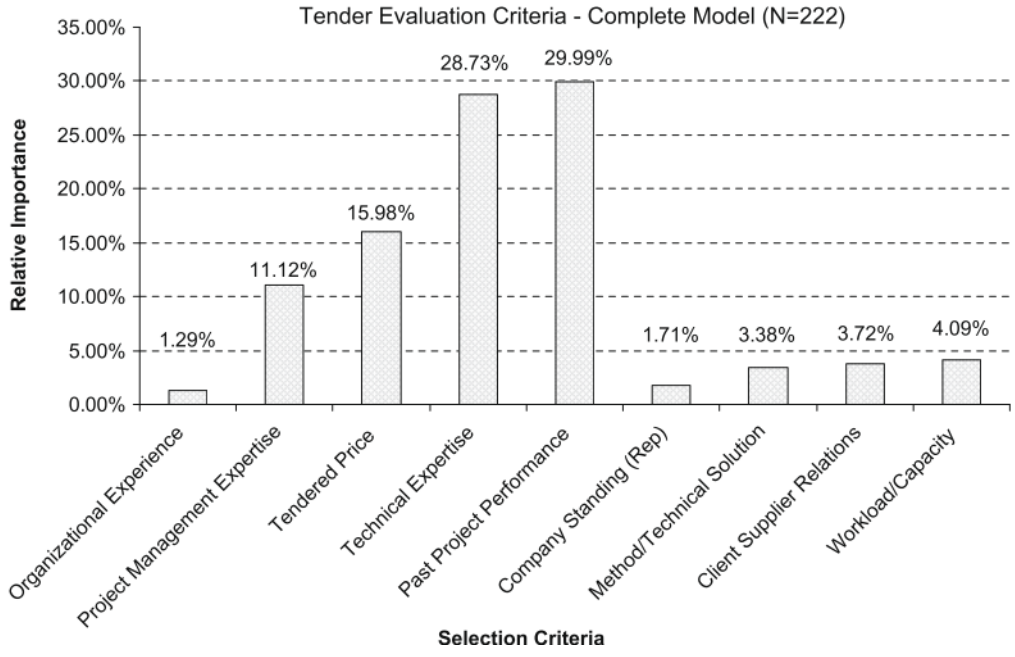

Figure 7. Relative importance: reputation and past project performance. Comparison of reputation and past project performance for contractor selection. Adapted from "The Relative Importance of Tender Evaluation and Contractor Selection Criteria," by D.J. Watt, B. Kayis, and K. Willey, 2009, *International Journal of Project Management*, Vol. 28 (2010), Figure 2, p. 58.

However, past performance is a factor readily conflated with 'reputation' because it is germane to two of the three reputation components described by Lewis (behavior and expectation), and so may be synonymous with it and other factors such as quality (Abu Nemeh, 2012; Doloi, 2009; Weaklend, 2009), and character (Bakheet, 1995). Singh and Tiong (2006) studied past contractor performance along with other factors and identified sub-categories, all of which were inferential to reputation: relationship with

subcontractors, suppliers, regulating authorities, and past project owners; correcting faulty work; completion on schedule; quality; and others.

Reputation, therefore, is a measure of success. Doloi (2009) opines it is too often subjectively assessed by hiring organizations. This is consistent with the Campbell Institute's observation (Inouye, 2015) among surveyed companies regarding their contractor safety prequalification practices, i.e., there is a lack of post job completion contractor evaluation that logically would test reputation or past performance. Perhaps this reveals a gap for safety practitioners to more fully explore when qualifying contractors. "Companies need to have full visibility in how hired contractors have performed in the past and are performing at present" (Yemenu & McCartin, 2010), a challenging but not impossible undertaking. The product of contractor safety prequalification, at its essence, is discerning which, among all possible choices, provides the greatest confidence the project will be completed successfully (Movahedian Attar et al., 2013). Success in the context of contractor safety prequalification, is the absence of accident and undue attention from regulators (Burroughs, 2015), and the question of contractor reputation is not fully resolved by a review of submitted losses. Ancient advice stresses one should "walk with the wise and become wise, for a companion of fools suffers harm" (Biblica, 2011). Assessing contractor reputation as part of a comprehensive safety selection criteria may be an important avenue for hiring organizations to *walk with the wise*.

Summary

The following conclusions are offered from this chapter's related discussions:

Contractor Injury History: Injury history is given great weight by hiring organizations when conducting prequalification of prospective contractors. The validity of this practice is in question as the data is 'lagging,' self-reported and normally not audited. False or under-reporting of data by contractors has been observed. Over interpretation of 'small numbers' frequently undermines the validity of contractor injury rates. The use of EMR statistics, like injury rates, present unique interpretation challenges.

Contractor Employee Training: Inadequacies in contractor employee training has been observed to be related to increased accident likelihood. The importance of contractor employee training is affirmed by some laws and also through numerous safety and health management systems criteria. Hiring organizations routinely provide work site orientation to contract workers, but the knowledge and skill training of these same workers is challenging for the hiring organization because achieving such presumes the hiring organization knows what training and skills are required. Examining contractor training during prequalification activities is effectively limited to binary conclusions, i.e., 'yes' or 'no' the individual(s) have or have not been trained in some specific way as confirmed through a documentation review. The quality of the training is not practically knowable but may be all that matters.

Liability and Regulatory History: Instances of contractor non-compliance, civil and criminal actions result in decreased contractor attractiveness to hiring organizations. Hiring organizations have risks that cannot be eliminated or transferred alone through

contract language. Workers compensation provides remedy to injured employees and their employers; hiring organizations do not enjoy this remedy as regarding contract employees injured at their work site. Hiring organizations may judge contractor liability and regulatory history concerns more harshly than for themselves. The absence of a contractor's negative liability and regulatory history is not necessarily reflective of the adequacy of its related proactive efforts.

Written Safety Programs: Written safety programs are routinely required and reviewed via desk-top audit by hiring organizations or their third-party contractor safety prequalification providers. There is no 'gold standard' reflecting which programs are minimally critical; the program requirements demanded of contractors are as many and varied as there are hiring organizations specifying them. Confirming the actual implementation of the safety programs is considered valuable but is not routinely done, ostensibly because of the unattractive nature of the increased 'transaction costs.' The requirement to submit evidence of safety programs is believed to be well-founded, but there is scant data to support why this is true given the data submitted is not routinely verified to be implemented in practice. Additionally concerning is contractors may frequently prevail upon consultants to produce documents merely to satisfy the demands of hiring organizations.

Capacity: The capacity of prospective contractors is commonly evaluated when selecting construction contractors but may be infrequently examined by general industry for safety prequalification of its contractors. This data point may be an 'unmined diamond' for hiring organizations since capacity constraints may be inferential to increased likelihood of accidental loss. This is especially important since the number of

employees per contractor is frequently less than 20 employees, i.e., all organizations are resource limited; contractor organizations are especially limited.

Contractor Experience: Contractor experience, like capacity, is infrequently observed as a measure of suitability during general industry contractor safety prequalification, but is commonly observed in construction industry selection practices. Since quality, cost and time are integral measures of a contractor's success, it is unavoidable contractor experience is inferential to each factor being satisfactorily met. It further is not logical or proven poor quality, cost and time outcomes are unrelated to poor safety performance. 'Experience,' or the lack thereof, remains a possible common denominator.

Financial Stability: Financial stability, arguably, is the most basic test of a prospective construction industry contractor's right to win work from hiring organizations. It is not routinely tested in general industry contractor safety prequalification. Investing in safety is specifically predicated upon the ability to invest generally. Objective measures to assess financial stability are known, even in the case of privately held companies which is the reality of most contractor organizations.

Reputation: It is confounding 'reputation' is not measured for general industry contractor safety prequalification. Such tests possibly could be applied at least with the same expected efficacy of written safety program and injury loss rate assessments. It is sensible to conclude examinations of loss rates are a less than adequate surrogate for reputation tests; both are lagging indicators. Reputation can be a measure of 'success,' whereas loss rates are a measure of failure. Which is most inferential to lower injury outcomes is debatable.

CHAPTER 3

METHODOLGY

Introduction

The purpose of this study was to determine the importance placed by safety professionals on criteria commonly utilized contractor for safety prequalification criteria; and also the importance placed by those same professionals on non-safety criteria commonly applied for construction contractor prequalification. This chapter describes the study population, the determination of required sample size and the survey instrument. Further described in this chapter are the research hypotheses, the statistical procedures used to test the hypotheses and the criteria used to test assumptions.

Sources of Data

Population

The population used in this study were members of the Steel Manufacturers Association (SMA). The SMA membership includes 28 steel producers with 127 mills in the United States, Canada and Mexico, employing 60,000 people and contributing more than 75% of domestic steel capacity (2016). Most steel producing facilities represented by the SMA recycle scrap steel and melt it using electric arc furnace technology. The recycled steel is then rolled into various steel products, e.g., rebar, I-beams, channel, rod, pipe, etc.

The SMA has a safety committee with the specific objective of sharing knowledge between members for injury and illness prevention and to improve safety in the steel industry (2016). These goals are pursued through regular meetings of member's safety professionals in which topics of current and common interest are presented and

discussed. This includes regulatory updates, best practice sharing, review of serious incidents, fatality prevention forums and others. Safety Committee participants range from mill or plant nurses, safety specialists or technicians, plant safety managers, corporate safety support professionals, safety directors and vice-presidents; union safety representatives regularly attend these meetings as do vendors supporting the membership's safety efforts.

The inclusion criteria to participate in this study are defined as: currently employed in the steel industry; employer is a current member of the SMA; and employment role is currently safety related.

To produce a current list of potential subjects, the SMA solicited from its members the names, functional roles and email contact information for their safety professionals. This list was provided to the researcher. Participation in this study was voluntary.

Measures

The following independent and dependent variables and the rational for these variables were identified from the literature review. The dependent variables were: contractor injury history (CIH); contractor employee training (CET); liability and regulatory history (LRH); safety programs (SP); capacity (C); Experience (E); financial stability (FS); and Reputation (R). The independent variables in this study were respondent: contractor injury experience (CIE); organization role (OR); professional background (PB) and years of experience (YE). Table 4 summarizes the independent variables (IV) and dependent variables (DV), the measurement instrument, the number of items in each instrument and the range of potential scores.

Table 4

Summary of Independent and Dependent Variables

Variables	Variable Description	Related Research Question(s)	Variable Type	Range
Contractor Injury History (CIH)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Contractor Employee Training (CET)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Liability and Regulatory History (LRH)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Safety Programs (SP)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Capacity (C)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Experience (E)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Financial Stability (FS)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Reputation (R)	DV	1, 2, 3, 4, 5	Ordinal	1 to 7
Respondent Contractor Injury Experience (CIE)	IV	2	Ratio	0 & Above
Organization Role (OR)	IV	1	Categorical	1, 2 or 3
Professional Background (PB)	IV	3	Categorical	1, 2 or 3
Years of Experience (YE)	IV	4	Ratio	0 to 60

Survey Instrument and Procedures

Survey Description

An original survey instrument was developed for the conduct of this study and is in Appendix A. The survey was administered through an online platform. It consisted of 21 items designed to elicit only the data from the surveyed population needed to answer the study's nine research questions. All respondents were asked to respond to all items. Definitions for each of the dependent variables were provided. Accepted standards for survey design were incorporated (Harvard University, 2016) into the survey's design. Likert scales were utilized for non-demographic items because their efficacy has been

well demonstrated in social sciences and attitude research projects; seven point scales were utilized to increase discriminating power and internal reliability (Croasmun & Ostrom, 2011).

Data Collection Procedures

Email correspondence from the SMA was sent to identify potential respondents and to their organization's leadership prior to the survey being issued. This was done to demonstrate the importance of the study to the steel industry and to ask for 100% participation.

An electronic cover letter, Appendix B, was provided with the survey describing the purpose of the study, data confidentiality, the researcher's name, address, and telephone number. Participants were prompted to provide their consent to utilize the data provided by them, and upon provision of their electronically consent were allowed to complete the survey.

All members of the survey population were issued the survey on the same date. An email reminder was sent to the population after approximately one week. A final email was sent to non-responders prior to closing the survey approximately one month later.

Software

The survey instrument was created and distributed using the online survey platform Qualtrics. The software Statistical Package for the Social Sciences (SPSS) 23.0 was used for all statistical tests. Qualitative data for survey questions 16 through 21 was examined using Microsoft Excel 2013.

Research Question 1

Research Question

The researcher posited there were significant differences in the perceived value of the eight studied contractor prequalification criteria by steel industry safety professionals based upon organization role.

Hypothesis

For each of the eight factors:

Null Hypothesis: Medians of all groups are equal.

Alternative Hypothesis: Medians of all groups are not equal.

Variables

The independent variable was the steel industry safety professionals' organizational role. The dependent variable was the perceived importance of the eight studied contractor prequalification factors.

Statistical Procedures and Assumptions

Lund and Lund (2016, Kruskal-Wallis H Test, Introduction, para 1) describe the Kruskal-Wallish H test as a rank-based nonparametric test. It can be utilized to determine if there is a significant difference between two or more independent variable groups and a continuous (or ordinal) dependent variable. The authors identify four assumptions for this statistical test (Basic Requirements of the Kruskal-Wallis H Test, paras 1-8):

Assumption 1: One dependent variable measured at the continuous or ordinal level. The assumption is met in this study by surveying the populations' perceived value

of the eight studied contractor safety prequalification factors utilizing a seven point Likert interval scale.

Assumption 2: One independent variable normally consists of three or more categorical, independent groups. This test is met by requiring respondents to select which of the following best describes their current job position: specialist/technician/supervisor; manager; director or higher; other.

Assumption 3: Independence of observations, i.e., members cannot belong to more than one group, and there are members in each group.

Assumption 4: Conclude whether the distribution of scores for each independent variable group have the same or a different shape. The same shape allows the Kruskal-Wallis H test to identify significant differences in the groups' medians. Differing shapes allows the use of the test for identifying significant distribution differences between the groups.

Post Hoc Test

If the Kruskal-Wallis H test identifies significant differences, i.e., $p < .05$, pair-wise comparisons will be performed using Dunn's 1964 procedure with a Bonferroni correction for multiple comparisons post hoc test (Lund & Lund, 2016, Post Hoc Test, para 1, 7, 8).

Research Question 2

Research Question

The researcher posited there was a significant relationship between steel industry safety professionals' observation of the number of major contractor injury events and the value they place on the eight studied prequalification criteria.

Hypothesis

Null Hypothesis: H0: $\rho = 0$; the population correlation coefficient is equal to zero

Alternative Hypothesis: HA: $\rho \neq 0$; the population correlation coefficient is not equal to zero.

Variables

The independent variable was the steel industry safety professionals' previous experience with major contractor injury events. The dependent variable was perceived value they place on the eight studied prequalification criteria.

Statistical Procedures and Assumptions

"The Spearman's rank-order correlation (often abbreviated to Spearman's correlation) calculates a coefficient, r_s or ρ (pronounced "rho"), a measure of the strength and direction of the association/relationship between two continuous or ordinal variables (Lund & Lund, 2016, Spearman's Correlation, Introduction, para 1)." Three assumptions must be met to use this statistical test (Spearman's Correlation, Background & Requirements, paras 1-5).

Assumption 1: There are two continuous or ordinal variables measured on a continuous or ordinal scale in any combination. This assumption will be met by the use of the variable of respondent contractor injury experience, and in comparison to the respondents' perceived value of the eight studied contractor safety prequalification factors using a seven point Likert interval scale. The number of major contractor accidents observed by the respondent will be measured on the ratio scale, which is continuous and meets the assumption of the test.

Assumption 2: The two variables are paired for observation. This assumption will be met by collecting each participant's contractor injury experience allowing for dependent variable data to be paired for each participant.

Assumption 3: The two variables have a monotonic relationship. This assumption was met by visually inspecting a scatterplot graph produced from SPSS.

Significance

The significance of the Spearman correlation coefficient will be determined using a t-test and an Alpha level of .05.

Research Question 3

Research Question

The researcher posited there was a significant difference in the value steel industry safety professionals place on the eight studied contractor prequalification criteria who have a predominant safety background and those who do not.

Hypothesis

For each of the eight factors:

Null Hypothesis: Medians of all groups are equal.

Alternative Hypothesis: Medians of all groups are not equal.

Variables

The independent variable was the steel industry safety professionals' safety background.

The dependent variable was the perceived value placed by the respondents on the eight studied contractor prequalification criteria.

Statistical Procedures and Assumptions

Lund and Lund (2016, Kruskal-Wallis H Test, Introduction, para 1) describe the Kruskal-Wallish H test as a rank-based nonparametric test. It can be utilized to determine if there is a significant difference between two or more independent variable groups and a continuous (or ordinal) dependent variable. The authors identify four assumptions for this statistical test (Basic Requirements of the Kruskal-Wallis H Test, paras 1-8):

Assumption 1: One dependent variable measured at the continuous or ordinal level. The assumption is met in this study by surveying the populations' perceived value of the eight studied contractor safety prequalification factors utilizing a seven point Likert interval scale.

Assumption 2: One independent variable normally consists of three or more categorical, independent groups. This test is met by requiring respondents to select which of the following best describes their current job position: specialist/technician/supervisor; manager; director or higher; other.

Assumption 3: Independence of observations, i.e., members cannot belong to more than one group, and there are members in each group.

Assumption 4: Conclude whether the distribution of scores for each independent variable group have the same or a different shape. The same shape allows the Kruskal-Wallis H test to identify significant differences in the groups' medians. Differing shapes allows the use of the test for identifying significant distribution differences between the groups.

Post Hoc Test

If the Kruskal-Wallis H test identifies significant differences, i.e., $p < .05$, pair-wise comparisons will be performed using Dunn's 1964 procedure with a Bonferroni correction for multiple comparisons post hoc test (Lund & Lund, 2016, Post Hoc Test, para 1, 7, 8).

Research Question 4

Research Question

The researcher posited there was a significant relationship between the years of experience and the importance placed on the eight studied prequalification criteria by steel industry safety professionals.

Hypothesis

Null Hypothesis: H_0: $\rho = 0$, the correlation coefficient is equal to zero in the population.

Alternative Hypothesis: HA: $\rho \neq 0$, the correlation coefficient is not equal to zero in the population.

Variables

The independent variable was the years of experience of the safety professional in the steel industry.

The dependent variable was the importance placed on the eight studied prequalification criteria by steel industry safety professionals.

Statistical Procedures and Assumptions

The Spearman's rank-order correlation test was introduced in the Research Question 2 discussion. Three assumptions must be met to use this statistical test.

Assumption 1: There are two continuous or ordinal variables measured on a continuous or ordinal scale in any combination. This assumption will be met by the use of the variable of years of experience of the safety professional in the steel industry, and in comparison to the respondents' perceived value of the eight studied contractor safety prequalification factors using a seven point Likert interval scale. While years of experience is a ratio variable, it will be formatted in SPSS and treated as if its ordinal value, a lower order test than ratio but it allows for the test to be performed.

Assumption 2: The two variables are paired for observation. This assumption will be met by collecting each participant's years of experience allowing for dependent variable data to be paired for each participant.

Assumption 3: The two variables have a monotonic relationship. This assumption was met by visually inspecting a scatterplot graph produced from SPSS.

Significance

The significance of the Spearman correlation coefficient will be determined using a t-test and an Alpha level of .05.

Research Question 5

Research Question

The researcher posited there was significant agreement among steel industry safety professionals of the level of importance placed on the eight studied contractor prequalification factors.

Hypothesis

Null Hypothesis: There is zero agreement in the population: H0: $W = 0$

Alternative Hypothesis: The agreement in the population is not equal to zero: HA: $W \neq 0$

Variables

The independent variable was the steel industry safety professional. The dependent variable was the rank order assigned by each safety professional to the eight contractor safety prequalification criteria studied.

Statistical Procedures and Assumptions

Lund and Lund (2016, Kendall's Coefficient of Concordance, W, Introduction, para 1) describe Kendall's *W* as a test for determining inter-rater agreement or reliability between three or more raters. The following assumptions are described by the authors' as being required to utilize this statistical test.

Assumption 1: Three or more raters provide ranked responses utilizing an ordinal or continuous scale. This assumption was met by requiring all respondents to force rank each of the eight contractor safety prequalification criteria studied using the ordinal scale, one through eight.

Assumption 2: The same criteria is rated by all raters. This assumption was met by requiring all respondents to force rank the same eight contractor safety prequalification criteria studied.

Assumption 3: The raters' judgements are independent. This assumption was met by isolating the survey participation to individuals within the survey population. The population had no means to readily consult with one another while completing the survey. The respondents' rankings were not published to the survey population during the collection of data.

Significance

Significance will be determined using an Alpha level of .05.

Research Question 6

The researcher posited there was a preference demonstrated by steel industry safety professionals for facilitating contractor safety prequalification utilizing internal company or third party resources. Descriptive statistics were examined to answer this question.

Research Question 7

The researcher posited steel industry safety professionals would assign a neutral rating for perceived benefits associated with utilizing third party service providers for contractor safety. The perceived benefits surveyed were: reduced administrative burden; improved efficiency; greater expertise; cost savings; reduced contractor injuries. Descriptive statistics were examined to answer this question.

Research Question 8

The researcher posited steel industry safety professionals, or others on their behalf, frequently conduct audits at prospective contractors' workplaces to verify the accuracy of submitted injury / loss rates. Descriptive statistics were examined to answer this question.

Research Question 9

The researcher posited steel industry safety professionals, or others on their behalf, frequently conduct audits at prospective contractors' workplaces to verify to verify the implementation of submitted written safety programs. Descriptive statistics were examined to answer this question.

CHAPTER 4

RESULTS

Introduction

The survey instrument developed by the researcher for this study was distributed to safety professionals identified by the Steel Manufacturers Association. Please see Appendix A. The study survey was distributed to 178 safety professionals utilizing the Qualtrics survey software. There were 82 responses. Two surveys were partially completed, yielding inadequate data for analysis and were removed from the analysis. Thus, the response rate was 44.9%.

Descriptive Statistics

Twenty seven respondents (33.8%) identified themselves as specialists / technicians / supervisors; thirty nine respondents (48.8%) identified themselves as managers; and fourteen respondents (17.5%) identified themselves as director level or higher. Respondents were given the opportunity to identify positions not reflected in the three defined groups. Nine respondents provided position titles in the "Other" category which included coordinator, engineer, and corporate manager. Each case was determined by the researcher to correspond to one of the categories provided and were recoded accordingly.

Respondents were asked to identify the number of years they worked in the steel industry as a safety professional. The average number of years was 12.6 years, standard deviation 10.413, minimum value = 1, maximum = 44, n = 78.

Respondents were asked to identify their predominant professional background (n = 80). Fifty seven respondents (71.3%), reported a predominant safety background; eight

respondents (10%) reported a predominant operations background; and fifteen respondents (18.8%) reported a predominant supporting role background, i.e., human resources, information technology, administrative, risk management, environmental, security, and leadership, etc.

Respondents were asked to identify the number of major injuries involving contractors observed during their safety careers in the steel industry. The average was 7.7 injuries, a minimum value of 0, and maximum value of 125 for an n of 78.

Respondents were asked to rate the importance of each of the eight studied dependent variables for best ensuring an injury free job or work site. A seven point Likert scale was provided in which '1' corresponded to 'Not at all important' to '7' which corresponded to 'Extremely important.' Table 5 reflects the proportion of respondent 'moderate' or greater rankings, i.e., '5' or greater.

Table 5

Accumulated Percentage, Criteria Importance for Best Assuring an Injury Free Work Site

Percent Importance	Financial stability	Capacity	Written safety program	Reputation	Work experience	Injury history	Employee training	Liability & regulatory history
Moderate or Greater Rating	70.1	77.6	87.6	90.0	91.3	92.5	93.8	96.3

Research Question 1

Kruskal-Wallis H Test

A Kruskal-Wallis H test was performed to determine if there were significant differences in the importance ratings for the eight different criteria based upon the job role defined as: specialist / technician / supervisor, manager, director or higher. The data met all the test assumptions and the results are presented in Table 6.

Table 6

Kruskal-Wallis H Test Summary, Research Question 1

#	Dependent Variables	Median Scores* Specialist / Technician / Supervisor	Manager	Director	Test Result	DF	Significance
1.	Injury History	6.0	6.0	5.0	$X^2 = 6.648$	2	p = .036**
2.	Reputation	6.0	6.0	5.0	$X^2 = 2.595$	2	p = .273
3.	Employee Training	6.0	6.0	6.5	$X^2 = .701$	2	p = .704
4.	Financial Stability	5.0	5.0	5.0	$X^2 = .029$	2	p = .986
5.	Liability & Regulatory History	6.0	6.0	6.0	$X^2 = .385$	2	p = .825
6.	Written Safety Programs	6.0	6.0	5.5	$X^2 = 1.031$	2	p = .597
7.	Capacity	6.0	6.0	5.0	$X^2 = .604$	2	p = .739
8.	Related Work Experience	6.0	6.0	5.0	$X^2 = 3.507$	2	p = .173

* 1 = Not at all important; 7 = Extremely important.

** Significance, $p < .05$.

The results indicated no significant differences in median rankings between groups for the importance of seven criteria. There was a significant difference in the median rankings across groups for the safety professionals' perception of the importance of injury history (X^2=6.648, df = 2, $p < .05$). Post hoc tests determined the significant differences in rankings occurred when comparing specialists (Median 6.0) and directors (Median 5.0). The results are presented in Table 7.

Table 7

Post Hoc Test, Research Question 1

Comparison	Test Statistic		
Specialist	----		
Manager	5.63	----	
Director	18.392*	12.762	----
	Specialist	Manager	Director

* $p < .05$

Research Question 2

Spearman's Rank Order Correlation

Spearman's rank order correlations were performed to assess the relationships between the numbers of major contractor injuries observed during the safety professionals' steel industry career and the eight contractor qualification items. The data met all of the test assumptions and the results are presented in Table 8.

Table 8

Spearman's Rho Summary, Research Question 2

#	Contractor Qualification Criteria	Correlation of Coefficient	Significance
1.	Injury History	$r_s(76) = -.022$	0.850
2.	Reputation	$r_s(76) = -.120$	0.296
3.	Employee Training	$r_s(76) = .131$	0.254
4.	Financial Stability	$r_s(76) = .164$	0.151
5.	Liability & Regulatory History	$r_s(76) = -.063$	0.584
6.	Written Safety Programs	$r_s(76) = .034$	0.770
7.	Capacity	$r_s(76) = -.037$	0.749
8.	Related Work Experience	$r_s(76) = .059$	0.606

None of the Spearman's Rho tests were significant which indicates there are no significant relationships between the subjects' importance ratings and the number of injuries they observed during their careers.

Research Question 3

Kruskal-Wallis H Test

A Kruskal-Wallis H test was performed to determine if there were significant differences in the importance ratings for the eight different criteria based upon the safety professionals' predominate steel industry background. The data met all the test assumptions and the results are presented in Table 9.

Table 9

Kruskal-Wallis H Test Summary, Research Question 3

#	Dependent Variables	Median Scores* Safety Background	Operations Background	Supporting Role	Test Result	DF	Significance
1.	Injury History	6.0	6.0	6.0	X^2 = .958	2	p = .619
2.	Reputation	6.0	6.0	6.0	X^2 = 4.915	2	p = .086
3.	Employee Training	6.0	6.0	7.0	X^2 = 6.974	2	p = .031**
4.	Financial Stability	5.0	5.0	6.0	X^2 = 5.597	2	p = .061
5.	Liability & Regulatory History	6.0	6.0	6.0	X^2 = 2.053	2	p = .358
6.	Written Safety Programs	6.0	5.5	6.0	X^2 = 1.301	2	p = .522
7.	Capacity	5.0	5.5	6.0	X^2 = 4.793	2	p = .091
8.	Related Work Experience	6.0	6.0	6.0	X^2 = 3.862	2	p = .145

* 1 = Not at all important; 7 = Extremely important.

** Significance, p < .05.

The results indicated no significant differences in median rankings between groups for the importance of seven criteria. There was a significant difference in the median rankings across groups for the safety professionals' perception of the importance of employee training (X^2=6.974, df = 2, p < .05). Post hoc tests determined the significant differences in ratings occurred when comparing those with a predominant safety background (Median 6.0) and those having a predominant supporting role background (Median 7.0) as shown in Table 10.

Table 10

Post Hoc Test, Research Question 3

Sample	Test Statistic		
Operator	-----		
Support role	-8.05	-----	
Safety background	-8.083	-16.133*	-----
	Operator	Support role	Safety background

* p < .05

Research Question 4

Spearman's Rank Order Correlation

Spearman's rank order correlations were run to assess the relationships between the years worked in the steel industry as a safety professionals and the eight contractor qualification items. The data met all of the test assumptions and the results are presented in Table 11.

Table 11

Spearman's Rho Summary, Research Question 4

#	Dependent Variables	Correlation of Coefficient	Significance
1.	Injury History	$r_s(76) = .079$	0.492
2.	Reputation	$r_s(76) = .060$	0.602
3.	Employee Training	$r_s(76) = -.104$	0.364
4.	Financial Stability	$r_s(76) = .135$	0.237
5.	Liability & Regulatory History	$r_s(76) = -.026$	0.823
6.	Written Safety Programs	$r_s(76) = .070$	0.543
7.	Capacity	$r_s(76) = -.001$	0.995
8.	Related Work Experience	$r_s(76) = .249$	0.028*

* Significance, p = < .05

The Spearman's Rho test examining years worked in the steel industry as a safety professional and the importance rating given to related work experience was significant (Spearman Rho = .249, $p < .05$). The Spearman's Rho tests for the remaining seven criteria indicated no significant relationships between the subjects' importance ratings and the years worked.

Research Question 5

Kendall's W Test

A Kendall's W test was performed to determine if there was significant agreement among steel industry safety professionals on the importance of the eight contractor

prequalification items. Respondents were required to rank the eight contractor prequalification factors from one (most important) to eight (least important). The results from the Kendall's W Test indicate there was significant agreement among respondents on the importance of the eight factors (Kendall's W = .224, $p < .05$). The most important factor was the company injury history while the least important factor was their financial stability (See Table 12).

Table 12

Force Ranked Importance, Contractor Prequalification Factors

	Injury history data	Employee training and certification	Capacity to complete the work safely	Liability and regulatory history	Related work experience	Written safety programs	Reputation	Financial stability
Ranked Mean	3.29	3.30	3.57	4.38	4.41	4.94	5.52	6.59

1 = Most Important; 8 = Least Important

Research Question 6

Descriptive Statistics

Descriptive statistics were performed to determine if there was a preference demonstrated by steel industry safety professionals for facilitating contractor safety prequalification utilizing internal company or third party resources. The results are presented in Table 13.

Table 13

Best Means to Facilitate Contractor Safety Prequalification

	Frequency	Percent
Use of internal company resources	21	27.6
Third party service provider resources	12	15.8
Combination of internal company resources	43	56.6
Total	76	100.0

There is a preference demonstrated by steel industry safety professionals for facilitating contractor safety prequalification. A combination of internal and third party resources was preferred by more than 56% respondents, more than 27% prefer the sole use of internal resources, while more than 15% solely favored a third party service provider.

Research Question 7

Benefits of Third Party Service Providers

Descriptive statistics were performed on the perceived benefits associated with the use of third party service providers for contractor safety prequalification. The items rated were: administrative burden, improved efficiency, greater expertise, cost savings, and reduced contractor injuries.

Administrative burden

The researcher posited steel industry safety professionals would assign a neutral rating for perceived reductions in administrative burdens when utilizing third party service providers for contractor safety. Table 14 provides a summary of the Likert Scale scores.

Table 14

Reduced Administrative Burden Benefit

#	Likert Scale	N	Percent
1	No Benefit	4	5.6
2	Low Benefit	4	5.6
3	Slightly beneficial	5	6.9
4	Neutral	8	11.1
5	Moderately beneficial	21	29.2
6	Very beneficial	18	25.0
7	Extremely beneficial	12	16.7
	Total	72	100.0

Over 70% of the respondents believed the use of third party contractor safety prequalification providers was moderately, very or extremely beneficial for reducing the administrative burden of contractor safety prequalification. Over 29% of respondents believe there is no, low, slight or neutral reduced administrative burden benefit. Eight survey respondents (10%) were not able to judge the item.

Improved efficiency

The researcher posited steel industry safety professionals would assign a neutral rating for perceived improved efficiency benefit when utilizing third party service providers for contractor safety. Table 15 provides a summary of the Likert Scale scores.

Table 15

Improved Efficiency Benefit

#	Likert Scale	N	Percent
1	No Benefit	4	5.8
2	Low Benefit	5	7.2
3	Slightly beneficial	4	5.8
4	Neutral	5	7.2
5	Moderately beneficial	20	29.0
6	Very beneficial	21	30.4
7	Extremely beneficial	10	14.5
	Total	65	100.0

Over 73% of survey respondents believe the use of third party contractor safety prequalification providers was moderately, very or extremely beneficial for improved efficiency; over than 26% of respondents believe there is no, low, slight or neutral improved efficiency benefit. Eleven were unable to judge the item, or 13.75% of all respondents.

Greater expertise

The researcher posited steel industry safety professionals would assign a neutral rating for perceived greater expertise benefit when utilizing third party service providers for contractor safety. Table 16 provides the distribution of the Likert Scale scores.

Table 16

Greater Expertise Benefit

#	Likert Scale	N	Percent
1	No Benefit	4	8.5
2	Low Benefit	5	8.5
3	Slightly beneficial	4	5.6
4	Neutral	5	11.3
5	Moderately beneficial	20	32.4
6	Very beneficial	21	29.6
7	Extremely beneficial	10	4.2
	Total	69	100.0

Over 66% of survey respondents believe the use of third party contractor safety prequalification providers was moderately, very or extremely beneficial in terms of improved expertise; over 33% of survey respondents believe there is no, low, slight or neutral improved expertise benefit. Eleven were unable to judge the item, or 13.75% of survey respondents.

Cost savings benefit

The researcher posited steel industry safety professionals would assign a neutral rating for perceived cost savings benefit when utilizing third party service providers for contractor safety. Table 17 provides a summary of the Likert Scale scores.

Table 17

Cost Savings Benefit

#	Likert Scale	N	Percent
1	No Benefit	11	16.2
2	Low Benefit	5	7.4
3	Slightly beneficial	4	5.9
4	Neutral	19	27.9
5	Moderately beneficial	10	14.7
6	Very beneficial	15	22.1
7	Extremely beneficial	4	5.9
	Total	68	100.0

Over 42% of survey respondents believe the use of third party contractor safety prequalification providers was moderately, very or extremely beneficial in terms of cost savings benefit; over 57% of survey respondents believed there was no, low, slight of neutral benefit. Twelve were unable to judge the related item, or 15% of all survey respondents.

Reduced contractor injury

The researcher posited steel industry safety professionals would assign a neutral rating for perceived reduced injury benefit when utilizing third party service providers for contractor safety. Table 18 provides a summary of the Likert Scale scores.

Table 18

Reduced Injury Benefit

#	Likert Scale	N	Percent
1	No Benefit	12	18.8
2	Low Benefit	3	4.7
3	Slightly beneficial	3	4.7
4	Neutral	11	17.2
5	Moderately beneficial	16	25.0
6	Very beneficial	11	17.2
7	Extremely beneficial	8	12.5
	Total	64	100.0

Over 54% of survey respondents believe the use of third party contractor safety prequalification providers was moderately, very or extremely beneficial in terms of injury

reduction benefit; over 45% of survey respondents believed there was no, low, slight of neutral benefit. Sixteen were unable to judge the related item, or 20% of all survey respondents.

Research Question 8

Descriptive Statistics

The researcher posited steel industry safety professionals, or others on their behalf, frequently conduct audits at prospective contractors' workplaces to verify the accuracy of submitted injury / loss rates. Table 19 provides the distribution of the Likert Scale scores.

Table 19

Loss Statistics Verification Conducted at Contractors' Physical Workplace

Likert Scale	N	Percent
Never	20	28.6
Rarely: < 10% of the time	19	27.1
Occasionally: between 10% and 25% of the time	13	18.6
Frequently: between 26% & 50% of the time	9	12.9
Majority: Between 51% and 75% of the time	3	4.3
Expected: > 75% of the time	6	8.6
Total	70	100.1

Over 74% of survey respondents state such audits are never, rarely or occasionally conducted. Over 25% of survey respondents state prospective contractors' loss statistics are verified by audit at the contractors' physical workplace frequently, the majority of the time or on an expected basis. Ten were unable to judge the related item, or 12.5% of all survey respondents.

Research Question 9

Descriptive Statistics and Result

The researcher posited steel industry safety professionals, or others on their behalf, frequently conduct audits at prospective contractors' workplaces to verify the implementation of submitted written safety programs. Table 20 provides the distribution of the Likert Scale scores.

Table 20

Written Program Verification Conducted at Contractors' Physical Workplace

Likert Scale Distribution	N	Percent
Never	22	30.6
Rarely: < 10% of the time	18	25.0
Occasionally: between 10% and 25% of the time	11	15.3
Frequently: between 26% & 50% of the time	9	12.5
Majority: Between 51% and 75% of the time	3	4.2
Expected: > 75% of the time	9	12.5
Total	72	100.0

Over 70.9% of survey respondents confirm such audits are never, rarely or occasionally conducted. Over 29.2% of survey respondents confirm prospective contractors' submitted written safety programs are confirmed through audit at the contractors' physical workplace frequently, the majority of the time or on an expected basis. Eight were unable to judge the related item, or 10% of all survey respondents.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

Introduction

The purpose of this study was to determine if commonly applied contractor safety prequalification selection factors are reflective of what steel industry safety professionals actually find important when selecting or retaining contractors. Factors not commonly applied for general industry safety prequalification, but are so in construction general contractor selection, were also studied. The study also sought to identify how and why the growing third party prequalification service industry is valued. This study serves as a baseline measurement providing an empirical foundation on which future research may expound.

This chapter addresses three areas. The first section discusses the results of each of the research questions. The second section describes study conclusions and implications for steel industry safety professionals. The third section describes future research opportunities.

Research Questions

The steel industry safety professional (independent) variables studied were: organization role; years of experience; predominant background; and the number of contractor major injury accidents observed. The safety prequalification criteria (dependent) variables studied were contractor: injury history; reputation; employee training; financial stability; liability and regulatory history; written safety programs; capacity; and related work experience. The following summarizes the study research questions and results.

Organizational Role

The researcher posited there were significant differences in how steel industry safety professionals' valued the eight studied contractor prequalification criterial based on organization role.

Results test indicated a significant difference in median ratings between groups for the importance of one of the studied criteria: contractor injury history (X^2=6.648, df = 2, $p < .05$). Post hoc tests determined specialists perceived contractor injury history as being more important or contractor safety prequalification (Median 6.0) than directors (Median 5.0). This may be explained by safety specialists possibly being more closely familiar with the contractors' injury history and more likely to directly observe contractor performance and, as a result, place greater weight on the importance of injury history.

The remaining results do not support the hypothesis organization role significantly influences steel industry safety professional importance perception for the other seven studied criteria.

Number of Major Accidents

The researcher posited there were significant differences in how steel industry safety professionals' valued the eight studied contractor prequalification criterial based on the number of major contractor accidents observed.

Results from the tests do not support the hypothesis there are significant differences in how steel industry safety professionals' value the eight studied contractor prequalification criteria based on the number of major contractor accidents observed. This may be explained by steel industry safety professionals having a common value

system that (even) one major injury is *too many*, the specter of which therefore may have as much influence in their related decisions as more major injury events.

Predominant Background

The researcher posited there were significant differences in how steel industry safety professionals' valued the eight studied contractor prequalification criterial based on their steel industry background.

Results from the test indicated a significant difference in median ratings between groups for the importance of one of the studied criteria: contractor employee training (X^2=6.974, df = 2, $p < .05$). Post hoc tests determined those having a predominant supporting role background identified employee training as being more important for contractor safety prequalification (Median 7.0) than those with a predominant safety background (Median 6.0). This may be explained by the possibility those having predominant supporting role backgrounds associate the practice of safety more with the transaction of safety training, perhaps having witnessed accidents indirectly for which inadequate training was frequently an identified root cause. Those having predominant safety backgrounds, however, may have a broader view of safety practice and consider safety training an important but not a superordinate strategy for contractor accident prevention.

The remaining results do not support the hypothesis predominant background is a significant factor influencing safety professional importance perception for the other seven studied criteria.

Years of Experience

The researcher posited there were significant differences in how steel industry safety professionals' valued the eight studied contractor prequalification criterial based on their years worked in the steel industry.

Results from the test indicated a significant difference in the importance of one of the studied criteria: contractor related work experience (Spearman Rho = .249, $p < .05$). This may be explained by the possibility safety professionals are reflecting the human tendency to value and gravitate to social characteristics observed in others similar to their own, e.g., culture, demographics, language, hobbies, etc.; or in this case, depth of related work experience. Thus it is rational for steel industry safety professionals with greater experience to place greater import on contractors' experience when tasked with prequalification decisions.

The remaining results do not support the hypothesis steel industry years of experience is a significant factor influencing safety professional importance perception of the seven other studied criteria.

Criteria Importance Agreement

The researcher posited there were significant differences in how steel industry safety professionals' valued the eight studied contractor prequalification criteria.

Results from the test indicated there is significant agreement in how steel industry safety professionals' value the eight studied contractor prequalification criteria, Kendall's $W = .224$, $p < .05$. The results do not support the hypothesis there are significant differences in how steel industry safety professionals' valued the eight studied contractor prequalification criteria. This may be explained by the high degree of interaction and

best practice information sharing witnessed in the steel industry by safety professionals through such venues as the Steel Manufacturers Association's biannual safety committee meetings and interim correspondence. This may also be a reflection of broader exposure to peers through local chapter meetings and national professional development conferences, e.g., American Society of Safety Engineers; National Safety Council, American Industrial Hygiene Association, etc. Consensus follows sharing, learning, discussion and reinforced experience.

Prequalification Facilitation Preference

The researcher desired to know if there was a preference among steel industry safety professionals for facilitating contractor safety prequalification utilizing internal company or third party resources.

The study results indicate there is a preference demonstrated by steel industry safety professionals for facilitating contractor safety prequalification. A combination of internal and third party resources is preferred by more than 56% respondents, more than 27% prefer the sole use of internal resources, while more than 15% solely favor a third party service provider. Explanation for these results is offered in this chapter's second section, Conclusions and Implications for Steel Industry Safety Professionals.

Third Party Service Provider Perceived Values

The researcher desired to understand the benefits perceived by steel industry safety professionals for utilizing third party service providers for contractor safety prequalification. The items rated were: administrative burden, improved efficiency, greater expertise, cost savings, and reduced contractor injuries. Explanations for these

results are offered in this chapter's second section, Conclusions and Implications for Steel Industry Safety Professionals.

Administrative burden

The researcher posited steel industry safety professionals would assign a neutral rating for perceived reductions in administrative burdens when utilizing third party service providers for contractor safety.

The study results demonstrate over 70% of the respondents believed the use of third party contractor safety prequalification providers is moderately, very or extremely beneficial for reducing the administrative burden of contractor safety prequalification. Over 29% of respondents believe there is no, low, slight or neutral reduced administrative burden benefit. Eight survey respondents (10%) were not able to judge the item. The study results do not demonstrate steel industry safety professionals have a neutral opinion for perceived reductions in administrative burdens when utilizing third party service providers for contractor safety prequalification.

Improved efficiency

The researcher posited steel industry safety professionals would assign a neutral rating for perceived improved efficiency benefit when utilizing third party service providers for contractor safety.

The study results demonstrate over 73% of survey respondents believe the use of third party contractor safety prequalification providers is moderately, very or extremely beneficial for improved efficiency; over than 26% of respondents believe there is no, low, slight or neutral improved efficiency benefit. Whereas 13.8% of survey respondents (11) were not able to judge the item. The study results do not demonstrate steel industry

safety professionals have a neutral opinion for perceived improved efficiency when utilizing third party service providers for contractor safety prequalification.

Greater expertise

The researcher posited steel industry safety professionals would assign a neutral rating for perceived greater expertise benefit when utilizing third party service providers for contractor safety.

The study results demonstrate over 66% of survey respondents believe the use of third party contractor safety prequalification providers is moderately, very or extremely beneficial in terms of improved expertise; over 33% of survey respondents believe there is no, low, slight or neutral improved expertise benefit. Approximately 11% of survey respondents (9) were not able to judge the item. The study results do not demonstrate steel industry safety professionals have a neutral opinion for perceived greater expertise when utilizing third party service providers for contractor safety prequalification.

Cost savings benefit

The researcher posited steel industry safety professionals would assign a neutral rating for perceived cost savings benefit when utilizing third party service providers for contractor safety.

The study results demonstrate over 42% of survey respondents believe the use of third party contractor safety prequalification providers is moderately, very or extremely beneficial in terms of cost savings benefit; over 57% of survey respondents believed there is no, low, slight of neutral benefit. 15% of survey respondents (12) were not able to judge the item. The study results do not demonstrate steel industry safety professionals

have a neutral opinion for perceived cost savings when utilizing third party service providers for contractor safety prequalification.

Reduced contractor injury

The researcher posited steel industry safety professionals would assign a neutral rating for perceived reduced injury benefit when utilizing third party service providers for contractor safety.

The study results demonstrate over 54% of survey respondents believe the use of third party contractor safety prequalification providers is moderately, very or extremely beneficial in terms of reduced injury benefit; over 45% of survey respondents believed there is no, low, slight of neutral benefit. 20% of survey respondents (16) were unable to judge the item. The study results do not demonstrate steel industry safety professionals have a neutral opinion for perceived reduced contractor injury when utilizing third party service providers for contractor safety prequalification. Explanation for these results is offered in this chapter's next section, Conclusions and Implications for Steel Industry Safety Professionals.

Loss Rate Verification

The researcher posited steel industry safety professionals, or others on their behalf, frequently conduct audits at prospective contractors' workplaces to verify the accuracy of submitted injury / loss rates.

The study results demonstrate over 25% of survey respondents' prospective contractors' loss statistics are verified by audit at the contractors' physical workplace frequently, the majority of the time or on an expected basis; over 74% of survey respondents state such audits are never, rarely or occasionally conducted.

Approximately 12% of survey respondents (10) were unable to judge the item. The study results do not demonstrate steel industry safety professionals, or others on their behalf, frequently verify prospective contractors' loss statistics by audit at the contractors' physical workplace. Explanation for these results is offered in this chapter's next section, Conclusions and Implications for Steel Industry Safety Professionals.

Written Safety Program Verification

The researcher posited steel industry safety professionals, or others on their behalf, frequently conduct audits at prospective contractors' workplaces to verify the implementation of submitted written safety programs.

The study results demonstrate over 29% of survey respondents' prospective contractors' submitted written safety programs are confirmed through audit at the contractors' physical workplace frequently, the majority of the time or on an expected basis. Over 70.9% of survey respondents confirm such audits are never, rarely or occasionally conducted. 10% of survey respondents (8) did not rate the item. The study results do not demonstrate steel industry safety professionals, or others on their behalf, frequently verify prospective contractors' written safety programs by audit at the contractors' physical workplace. Explanation for these results is offered in this chapter's next section, Conclusions and Implications for Steel Industry Safety Professionals.

Summary of Statistical Tests

The importance given to the eight studied contractor safety prequalification criteria by steel industry safety professionals was quantitatively analyzed using the independent variables: organization role; number of major contractor accidents; predominant background; and years of experience. Thirty-two separate tests yielded

three significant results. Table 21 summarizes statistical significance discovered upon test completion.

Table 21

Test Significance Summary, Research Questions One Through Four

Steel Industry Safety Professionals / Studied Contractor Prequalification Criteria Importance	Organization Role	Number of Major Contractor Accidents	Predominant Background	Years of Experience
1. Injury History	x*			
2. Reputation				
3. Employee Training			x**	
4. Financial Stability				
5. Liability & Regulatory History				
6. Written Safety Programs				
7. Capacity				
8. Related Work Experience				x***

* Greater importance is given by specialists than directors to injury history.

** Predominant supporting role background respondents place greater importance on employee training than those with predominant safety background.

*** Correlation test.

The significance of respondent organization role, major accident history, predominant background or years of steel industry experience are not otherwise found to be significant variables for the eight criteria studied. Descriptive statistics summarized steel industry safety professionals' preferences and perceived benefits for contractor safety prequalification utilizing third party service providers.

Major Findings and Implications

The following is a discussion of major findings derived from this study for steel industry safety professionals. This includes: prequalification criteria relative importance; written safety programs; self-reported loss statistics; and third party service provider benefits.

Prequalification Criteria Relative Importance

One objective of this study was to determine if the contractor prequalification criteria commonly applied in general industry is reflective of what steel industry safety professionals actually value:

1. Steel industry safety professionals strongly value each of the contractor safety prequalification criteria provided when asked to rate each in isolation. But when respondents were asked to rank the eight criteria in order of importance a much different picture emerged, as shown in Figure 8.

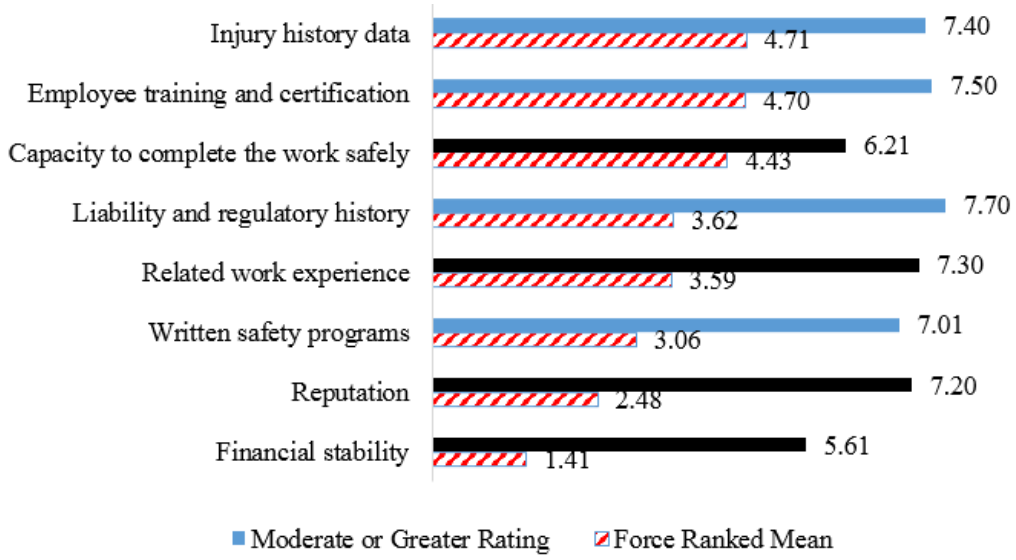

Figure 8. Steel industry safety professionals ranking of contractor prequalification criteria. Shaded bars reflect proportion of 'moderate' or greater respondent ratings converted to an eight point scale; eight equals 'extremely important. Black shaded bars reflect commonly used contractor safety prequalification criteria; blue shaded bars reflect uncommonly applied criteria. Diagonal pattern bar data reflect mean respondent forced rankings.

2. Four criteria not commonly utilized for safety prequalification in general industry but commonly utilized for the selection of construction general contractors were considered 'very important' by steel industry safety

professionals when evaluated individually: capacity to complete the work safely; related work experience; reputation; and financial stability.

Two of the four factors, financial stability and reputation, were the lowest force ranked of the eight criteria posed, but it should not be dismissed both were identified by steel industry safety professionals as generally being 'moderate' and 'very important' to an injury free job or work site before force ranking. Neither are frequently incorporated into general industry safety prequalification practices, and thereby are relevant for steel industry safety professionals to consider as potential future measures for incorporation into contractor selection and retention decision-making.

3. Contractor injury history data is the single most valued prequalification criteria by steel industry safety professionals. This observation is consistent with general industry contractor prequalification practices. Extraordinarily, respondents' personal history with major accidents involving contractors does not significantly influence their perception of the eight studied criteria, i.e., personal experience appears divorced from personal priority. Further complicating is the reality self-reported data is not found to be verified with efficacy; please see Self-Reported Loss Statistics section in this chapter. In summary, contractor injury history data is highly valued but for reasons other than rooted in personal experience, and with verified supporting data proving a scarcity.
4. Employee training and certification are assigned a nearly identical level of ranked importance as injury history data by steel industry safety professionals.

This too resonates with commonly applied general industry contractor safety prequalification practices.

Interestingly, this study additionally confirmed steel industry safety professionals having a predominant supporting role background place significantly greater importance on contractor employee training and certification than those with a predominant safety background. While interesting to know, all background types minimally rate contractor employee training as 'very important' for ensuring an injury free job or work site, thus the greater import given by those with a supporting role background may have little practical relevance to steel industry contractor safety prequalification.

5. Contractor capacity to complete the work safely is, effectively, ranked second in importance by steel industry safety professionals given injury history and training are essentially equally ranked. Capacity is not commonly incorporated into general industry contractor safety prequalification practices. Thus, a new area of examination is identified for steel industry safety professionals to consider when qualifying contractors. This is especially true as the factor is ranked merely 6% lower than injury history and employee training and certification, i.e., it is an especially highly valued factor by steel industry safety professionals.
6. Liability and regulatory history is a commonly observed factor in general industry contractor safety prequalification practices, and also is highly valued by steel industry safety professionals per their ranking preferences. The practice is thereby affirmed.

7. Contractor related work experience is ranked by steel industry safety professionals very similarly in importance to contractor liability and regulatory history. But this factor too is infrequently applied in general industry contractor safety prequalification practices, and therefore should be considered a new area of examination by steel industry safety professionals.

   This is especially important given this study identified correlation significance for contractor related work experience and steel industry safety professional years of experience. Thus it is both true steel industry safety professionals value contractor related work experience generally, and as industry safety professionals gain in years of experience, greater importance is assigned by them to contractor related work experience. Steel industry safety professionals should consider evaluation of contractor related work experience for safety prequalification.

8. Written safety programs are ubiquitous in general industry contractor safety prequalification practices but are ranked sixth (out of eighth) in importance by steel industry safety professionals, or 35% lower than the highest ranked factors (injury history and employee training and certification). Importantly, two atypically applied criteria have greater importance, i.e., contractor related work experience, and capacity to perform the work safely.

   These finding should be instructive to the emphasis hereafter given by steel industry safety professionals to written safety programs, therefore the topic is elaborated upon in this chapter's next section. Please see Written Safety Programs.

In summary, it is recommended steel industry safety professionals evaluate the order and magnitude of prequalification requirements assigned to their contractors. Perhaps some are assigning too much importance to certain factors and too little to others, i.e., if credence is given to the above. Particular priority should be given to contractor injury history, employee training and certification, capacity to complete the work safely and also liability and regulatory history. Two current areas of possible over-emphasis deserving critical consideration are discussed below: written safety programs; and self-reported loss statistics.

Written Safety Programs

Written safety program submission by contractors is a conspicuous general industry prequalification requirement and is identified by steel industry safety professionals too as being important. However, these professionals should further consider the utility of requiring submission of contractor written safety programs for other than general construction contractor safety prequalification. The reasons are several.

1. While written safety programs are considered important by steel industry safety professionals, they are rated sixth in importance when compared to the eight criteria studied, or 35% lower than the highest ranked factor (injury history). Survey respondents identify other, more important, infrequently considered factors for safety prequalification, i.e., contractor: related work experience; and capacity to complete the work safely.
2. This study further identified onsite verification of written safety programs to be rare. Desk-top audits, therefor, are the current remedy (Philips & Waitzman,

2013) but do not answer whether the various statements of good intent found in written programs are achieved in practice. Thus it is accurate to conclude hiring organizations, or those serving at their behest, are collecting 'paper', and likely very much of it but are not assured more.

3. A literature review does not yield evidence demonstrating contractor written safety programs to be compelling for mitigating legal claims against hiring organizations in the example of a contractor injury or contractor organization related accidents. Additionally, OSHA's multi-employer worksite policy (Occupational Safety & Health Administration, 1999) does not regard written programs when determining citation assignments. Instead, OSHA determines which employer, contractor or hiring organization, was responsible for *creating*, *exposing*, *correcting* and *controlling* the related hazard(s); both employers can have multiple roles. It is only after role assignment is determined by OSHA that a written program may become relevant. Know, however, there are relatively few OSHA mandated requirements for 'written' programs (BLR, 2017; Occupational Safety & Health Administration, 2017; Texas Aggregates & Concrete Association, 2011), thus hiring organizations may be imposing written program demands absent significant legal or practical benefit.
4. Written programs are often authored by consultants (1 Stop Compliance, 2015; Blakeman & Associates, 2013; Industrial, 2016; OSHA Safety Manual.com, 2016; Safety Service Company, 2015) acting on the contractor's behalf, possibly without the contractor actually participating in program definition, scope, etc., or

observed to carry out the final product's implementation. The degree of actual contractor participation is not knowable.

5. Data reflecting written safety programs as being predictive of improved accident prevention should be met with caution. The researcher has identified an example of correlation (Philips & Waitzman, 2013) through literature review, but correlation studies do not reflect a causal relationship, and so are not predictive of fewer contractor workplace accidents. Additionally, third party providers may boast of lower injury rates among their contractor population, perhaps owed in part to their customers' written program demands. It should be acknowledged third party service providers promote their services to hiring organizations that largely find contractor injuries untenable. It should not surprise contractors supporting them report lower incident rates, because those with higher rates might soon if not immediately be excluded as population participants. Stated otherwise, a club allowing only 'thin' members can readily boast of low membership obesity, yet it is not clear the former condition causes the latter.

All the above when summed begs the question: What is actually accomplished by contractor written program submissions? To answer, it is important to recognize the distinction between general industry use of contractors for service, repair and maintenance activities versus the example of a general construction contractor that may bring one or more sub-contractors for work completion. The former will frequently be expected to adhere to the hiring organizations' programs, e.g., its emergency procedures; its lock-out and confined space entry procedures; its personal protective equipment demands; its hazard communication program, etc. The contractor's written programs

thereby are often subordinate, if not irrelevant in a practical sense. In the latter example, however, the general construction contractor's written programs are frequently superordinate, but such specialty work represents a small percentage of all contract work demanded by hiring organizations (Bureau of Labor Statistics, 2015a, 2015b). The two are separate universes requiring unique management paradigms. What is paramount in both paradigms? It is the demonstration of contractor employee training and certification. Steel industry safety professionals consider this factor equal in importance to contractor injury and loss history.

In summary, steel industry safety professionals should be encouraged to leverage higher order prequalification activities identified by this study and minimize preoccupation given to written programs for service, repair and maintenance contract work. This is not because written safety programs are without theoretical or practical value, but because they are not verifiable with efficacy in the example of service, repair and maintenance contractors. Higher order activities per the study results are contractor: employee training and certification verification; capacity to complete the work safely; liability and regulatory history; and related work experience.

Self-Reported Loss Statistics

Study respondents confirm verification of contractor self-reported loss statistics is comparable to written safety program verification. Approximately 74% of all respondents never, rarely or occasionally verify the accuracy of self-reported loss statistics at their contractors' physical workplace; ten respondents were unable to judge a response, or approximately 12% of all respondents. The rarity of data audit may be due

to the increased transaction costs (Waara & Brochner, 2006) required to derive adequate confidence.

This relegates the legitimacy of self-reported loss statistics to the *honor system*. Regrettably, some will cheat (Cox, 2014; Philips & Waitzman, 2013; Wilbanks, 2016) and others will simply misstate data due to criteria ignorance, misjudgment and human error. The practical problems with utilizing self-reported loss statistics are described in Chapter Two, as were the frailties of granting such data too much credence; the scrupulous disadvantaged, the unscrupulous advantaged. Suffice, a Certified Public Accountant, e.g., would be skeptical of self-reported financial information not subject to audit and would likely find the practice in any other context, including contractor safety prequalification, peculiar. Likewise, it is submitted pharmaceutical companies aspiring to promote new drugs for novel uses would never be permitted by the United States Food and Drug Administration to do so based on self-reported, unverified data. That would be regarded as reckless, and thus harmful to the public good.

The related discussion in Chapter Two made clear third party services providers largely do not verify the validity of contractor self-reported loss statistics, but rather examine submitted information for form and manner errors, i.e., omission of dates, signatures, etc. Therefore, third party service providers deliver no more or less related benefit than hiring organizations performing prequalification activities; the data is predominantly accepted on face-value by both parties without real verification. The frequent use of the word 'verification' promoted by some third party services in this context, therefore, is at least inaccurate and perhaps misleading.

Steel industry safety professionals, however, acknowledge via this study the prime importance of injury history for contractor safety prequalification. Such history is 'very important' when evaluated without context to other criteria per the respondents, and is the highest ranked prequalification factor when all other factors are considered. Given this reality and the challenges of utilizing self-reported loss statistics, steel industry safety professionals are recommended to disregard self-reported loss statistics by current and prospective contractors and rely on independently reported data such as Experience Modification Rates (EMRs). EMRs are available, for example, through the National Council on Compensation Insurance (2017). EMRs are not a perfect solution, also as discussed in Chapter Two, but are judged preferable to self-reported data that, practically speaking, is distracting to reliable and meaningful conclusions. Remembering, the objective of contractor safety prequalification is to introduce objective facts for comparison to established norms so discriminant choices can be derived. Just as travelers cannot successfully navigate by a movable true-north, nor can steel industry safety professionals reliably navigate utilizing contractor self-reported loss statistics. This conclusion does not indict the integrity of steel industry contractors, but is based upon the reality the data provided is not valid for the intended purpose because it is not, and perhaps cannot practically be, verified with efficacy.

Third Party Prequalification Service Providers

Third party contractor safety prequalification services are a 'burgeoning industry' (Philips & Waitzman, 2013). The playing field is crowded and growing as revealed by an internet search of North American service providers; these include:

1. Avetta
2. Browz
3. ConstructSecure
4. Edison Electric Institute
5. Hellman & Associates
6. ISN
7. JJKeller
8. PEC
9. Safety Management Group
10. SMI Safety
11. The Griffen Groupe
12. Verisource

There is no central database known to this researcher available for comparing and contrasting these providers' offerings, number of hiring organizations and contractors subscribed, industry and work types represented, methods and means applied, etc. Steel industry safety professionals must therefore be their own advocate when discerning preferable providers, bereft of independent data supporting or disputing the benefits promoted to them. To assuage this concern, this study included questions directed to steel industry safety professionals for understanding if and, if so, why third party service providers are valued. Related descriptive statistics afforded by this study are summarized in Table 22; the data is graphically portrayed in Figure 9.

Table 22

Third Party Service Providers Benefits Ratings vs. Unable to Judge Responses

Associated Benefit	Moderate or Greater Rating*	Unable to Judge	N	n	Delta	Neutral or Lower Rating
Administrative Burden	71%	10.0%	80	72	8	29.2%
Expertise	66%	11.3%	80	71	9	33.8%
Efficiency	74%	13.8%	80	69	11	26.1%
Cost Savings	43%	15.0%	80	68	12	57.4%
Reduced Injury	55%	20.0%	80	64	16	45.3%

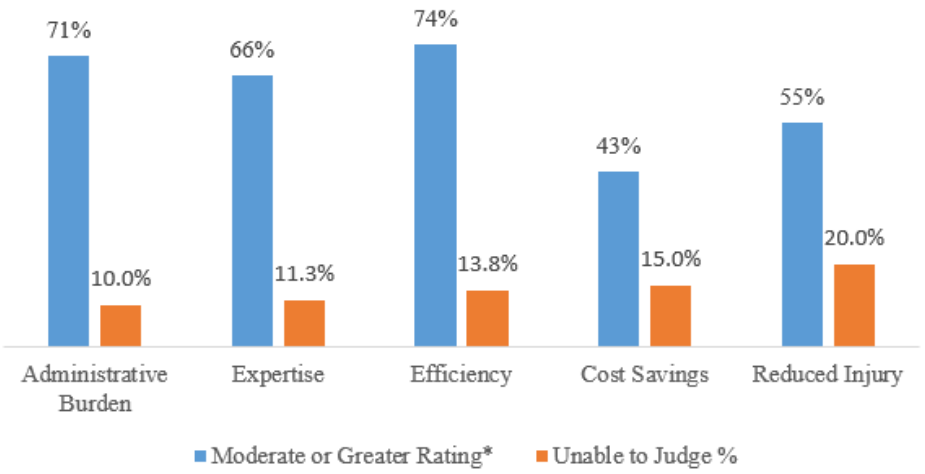

Figure 9. Third party service provider benefit rating compared to unable to judge responses. Proportion of *moderate*, *very* and *extremely beneficial* third party contractor safety provider ratings versus the proportion of respondents unable to judge the related items' benefit.

Several conclusions are possible from this data:

1. The primary benefits ascribed by steel industry safety professionals for the use of third party prequalification services at least are moderately: reduced administrative burden; greater expertise; and improved efficiency. Please see Figure 10.

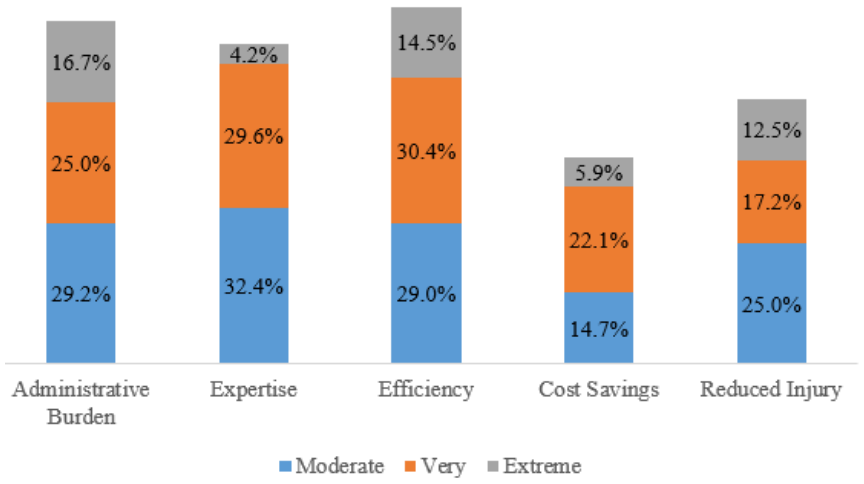

Figure 10. Distribution of moderate, very and extremely beneficial ratings, third party service providers. Steel industry safety professionals' rating of third party contractor safety prequalification service benefits, ignoring *no*, *low*, *slight* and *neutral* benefit responses.

2. Steel industry safety professionals affirm the benefit of utilizing third party service providers but do so with some reservation i.e., the majority of steel industry safety professionals do not associate third party service providers as being ‘very’ or ‘extremely’ beneficial in the ways asked. This raises the specter steel industry safety professionals believe third party services provide just enough advantage in terms of reduced administrative burden, greater expertise and efficiency to justify transferring some or all of their prequalification tasks externally.
3. Steel industry safety professionals are less confident about cost savings and injury reduction benefits associated with use of third party contractor safety prequalification service providers; please see Figure 11. This is observed in two ways:
    - Respondent neutral or lower benefit ratings increased for both the cost savings and reduced injury items, and
    - Instances in which respondents ‘unable to judge’ increased for both the cost savings and reduced injury items.

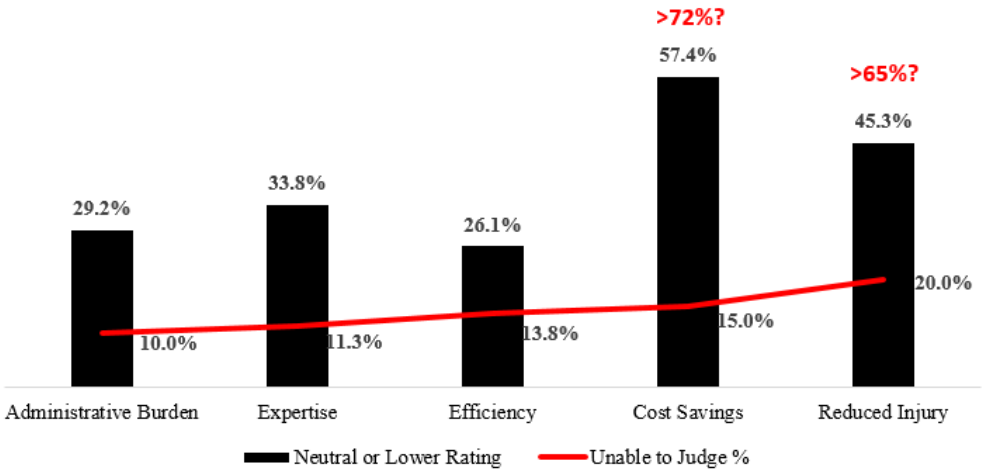

Figure 11. Neutral or lower benefit rating proportions compared to unable to judge responses. Steel industry safety professionals' neutral or lower benefit ratings for use of third party contractor safety providers versus the proportion of respondents unable to judge the related items' benefit.

An 'unable to judge' response can neither be interpreted as positive or negative, nor given any context in the continuum of negative and positive opinion. Indeed, the selection of 'unable to judge' indicates the respondent has no basis to provide an opinion. There-in-lies the conundrum for steel industry safety professionals and their third party service providers when cost savings and reduced injury benefit are considered. If in no other instances, should not respondents be convicted, and positively so, that contractor prequalification efforts result in reduced injury benefit and cost savings?

Cost savings should be a primary motivation to buyers, but it is not for the majority of steel industry safety professionals per this study. Note approximately 72% of all respondents assign a neutral benefit or lower rating to this item, or have no opinion about possible cost savings. This should be informing to an industry challenged daily by its commodity market realities requiring cost savings wherever practicable. *Easier* (reduced administrative burden), *faster* (improved efficiency) and *stronger* (greater

expertise) should provide economy (cost savings) but this is not affirmed by those on the playing field.

More so than cost-savings, reduced contractor injury benefit associated through use of third party services should be an *acid test* for their appreciation by steel industry safety professionals. However, approximately 65% of all respondents rated the reduced injury benefit as neutral or lower or have no opinion about injury reduction. This must prove challenging to steel industry safety professionals when advocating use of providers to senior leaders, leaders who are likely to demand both cost efficiencies and reduced contractor injuries. A *better, stronger, faster* proposition confidently providing neither is necessarily troubled.

All the above may demonstrate why steel industry safety professionals do not endorse third party service providers solely for facilitation of contractor safety prequalification, nor do they largely advocate a *go it alone* approach. Rather, a combination of internal and external / third party resources is the strongly demonstrated preference; Figure 12. This arrangement may be appealing in terms of transferring non-core business activities to another party while maintaining control of key activities or the ability to participate as needed to best assure the objective of reduced injury frequency and severity.

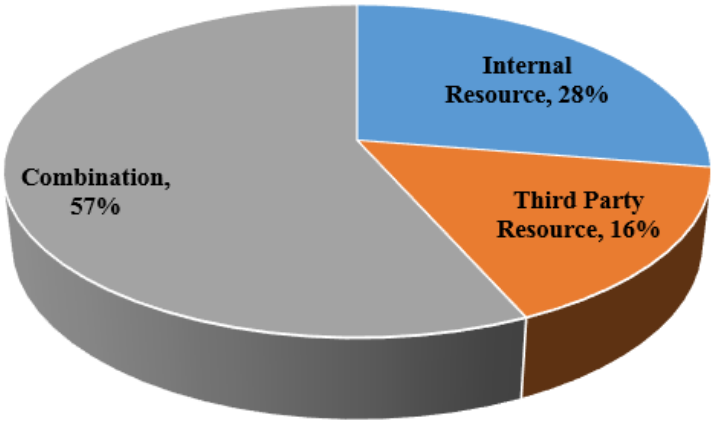

Figure 12. Preferred Means to Facilitate Contractor Safety Prequalification.

Third Party Service Provider Discussion Summary

Third party service providers are an important consideration when assessing the utility of contractor safety prequalification schemes, and precisely because they are (so) present. Such providers are desirable to steel industry safety professionals likely for the same reasons contractors are desirable generally regardless of context, i.e., affording the hiring organization the ability to maintain a minimum workforce while allowing focus on core business activities, promoting specialization both within the hiring and contracted company (Kozlovská & Struková, 2013; Yemenu & McCartin, 2010). A balanced discussion must observe the practical challenge given third party providers is the myriad of demands given them by hiring organizations, each prescribing what is *best* and largely doing so without context to *best practice*, perhaps because best practices are not found by the researcher to be empirically researched and reported. The circle goes 'round.

Service providers would surely produce greater leverage to hiring organizations if hiring organizations were unanimous in their criteria specification, i.e., acceptable loss

rates, written program specification, employee training and certification, legal and liability tests, etc. Contractors, too, would be relieved if in receipt of a consistent criteria experienced across all hiring organizations and not the seeming arbitrary demands of each company served. If steel industry safety professionals are satisfied or otherwise with third party service provision, i.e., administrative burden, efficiency, expertise, cost and injury reduction, etc., a *mirror* will likely identify those most able to affect needed change, and thereafter reflect a market ready to meet its demand.

Concluding Model

Steel industry safety professionals value the contractor prequalification criteria posed in a certain order and magnitude. Priority is also given by study participants to third party service provider benefits. Some resulting data permits *clearer* and more certain conclusions, while other conclusions are *foggy* and less certain. Clear and certain data, and higher order criteria are hereby recommended to steel industry safety professionals for contractor safety prequalification activities. The qualitative model depicted in Figure 13 summarizes the author's post research understanding of the studied subject.

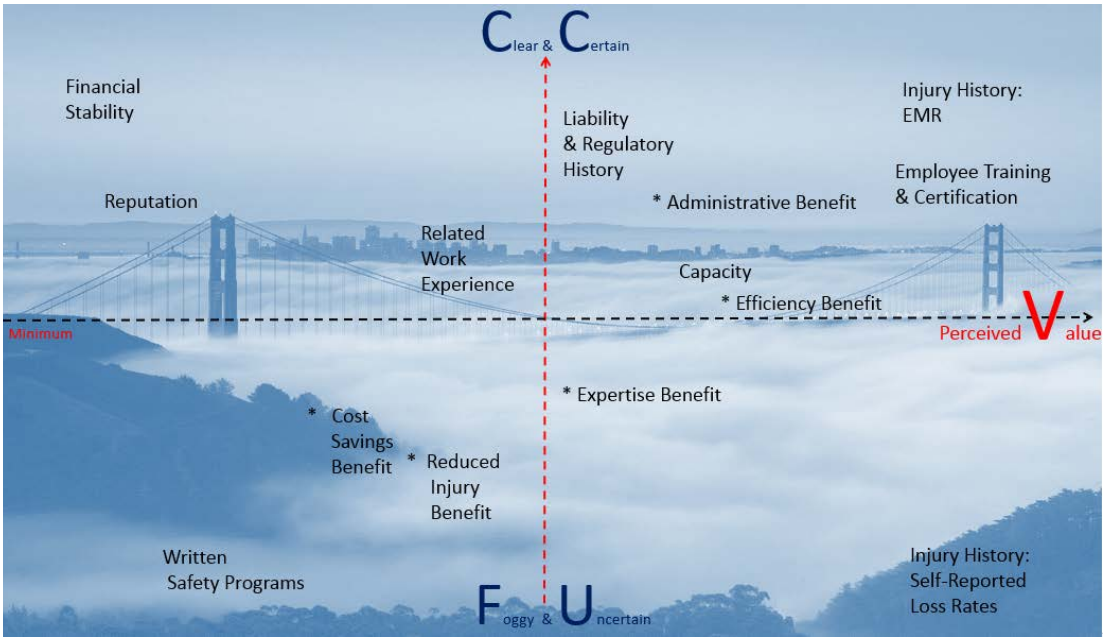

Figure 13. Contractor safety prequalification *Fog-Line* conceptual model. David. W. Wilbanks, 2017. The X axis portrays steel industry safety professionals' perceived value of: contractor prequalification criteria; and, noted with asterisks, third party prequalification services. The Y axis portrays relative data efficacy.

Future Research

The following summarizes possibilities apparent to the researcher for further contractor safety prequalification study:

1. The National Safety Council's Campbell Institute (Inouye, 2015) identified five components to the contractor safety life-cycle: prequalification; pre-job task and risk assessment; contractor training and orientation; monitoring of job; and post evaluation. This researcher regrets not incorporating into this study a test to ascertain the relative importance steel industry safety professionals assign each of the five components for ensuring an injury free job or work-site. A possibility is one or more of the components is given inordinate resource versus the relative benefit derived in actual practice. These data, if garnered, perhaps would allow industry members to better allocate limited resource for better contractor safety

outcomes, and certainly would be inferential to contractor safety prequalification criteria and prioritization.

2. The researcher observes the basic elements of this study could be repeated within the steel industry or more broadly for general industry, but targeted at operational personnel instead of safety professionals alone. A plant manager, project engineer or maintenance superintendent would certainly have unique perspectives about contractor safety prequalification. Because these personnel are the 'customers' and likely are responsible for the budgets used to pay for prequalification services, whether internally or externally supported, it would be instructive to understand their priorities and the variables influencing them through statistical study.
3. Though this study garnered important insights into which prequalification criteria steel industry safety professionals value most for contractor prequalification, it is not clear which activities, in fact, provide the most leverage for deriving the 'better' contractor. Is there a proven causal relationship between requirement 'a' and 'b' demonstrating more or less benefit? The researcher posits the actual product of contractor safety prequalification practices may lie less with what is being demanded and more with the demand of providing that which is demanded. Contractor fatigue or giving up, and not the criteria itself might be a differentiating factor. Study of this possibility is recommended.
4. An important perspective to gain is that of the contractor. What prequalification activities and requirements do they believe are most critical for identifying safe contractors? Are hiring organizations prequalification demands perceived as

useful, necessary, added value for identifying 'better' contractors? Is there a difference between contractor priorities when compared to hiring organization safety professionals, plant managers, project engineers and maintenance personnel? Are there identifiable differences among contractor safety priorities based on contractor organizations' industry, experience, education, size of organization, number of customers, average project dollar value, etc.?

5. A study of third party service providers is recommended. Comparing and contrasting services, methodologies, cost and perceived value by hiring organizations and contractors is needed by the market. This would enable 'better' providers and methodologies to be identified and place light on those less competitive. Are the benefits associated with third party service providers identified by steel industry safety professionals affirmed by general industry, regardless of industry examined? Are the various providers delivering highly differentiated services and, if so, in what ways? Do contractors and hiring organizations identify greater confidence and results from certain providers or methodologies thereby justifying a higher fee, or are all *much of a muchness* with the lowest price most attractive?
6. Should qualification be a two-way street? It is clear contractors bring risk to the hiring organization, but the hiring organization too brings risk to the contractor (Enshassi et al., 2008; Nunes, 2012). Alignment and coordination between the two parties is needed (Abbaspour et al., 2012); This could include hiring organization:
    - Provision of onsite safety orientation, training.

- Demonstration of an adequate emergency response capability
- Internal controls and resources for addressing hazards impacting the contractor but not under the contractor's direct control.
- Means available to contractor for stopping work due to safety concerns, and procedures for evaluating hazards and agreeing needed actions before resuming work.
- Process for affecting change orders demanded by the hiring organization but which can have safety implications (Rashvand, Majid, & Pinto, 2015).
- Demonstration of adequacy of hiring organization safe work systems contractors are required to adhere, e.g., confined space entry, lock-out, PPE, work at heights, etc. (Inouye, 2015)

In summary, should such tests be in evidence before the contractor bids for work? If such tests are not in evidence, should the contractor be able to demand a higher price given the higher risk, and assumed, costs associated with delivering the work safely? This is a relevant area of potential research because if the contractor incurs an accident due to a hiring organization's acts or omissions, the contractor's ability to win future work, both for the hiring organization involved but also among all hiring organizations, is harmed. What systems of reciprocity are in evidence and can they be shown to be beneficial to preventing contractor accidents? Is what is *good for the goose*, indeed *good for the gander*.

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Appendix A

Survey Instrument

1. Which of the following best reflects your current job position:

   1.1. Specialist/technician/supervisor

   1.2. Manager

   1.3. Director or higher

   1.4. Other (enter in the space provided)

   [ ]

2. How many years have you worked in the steel industry as a safety professional, regardless of job title/role or education:

   [ ]

3. Select the most appropriate response: (do not consider title, role or related education).

   3.1. My work experience in the steel industry has predominantly been as a safety professional.

   3.2. My work experience in the steel industry has predominantly been operations related, e.g., production or maintenance operations.

   3.3. My work experience in the steel industry has predominately been a supporting role, e.g., human resources, information technology, administrative, risk management, environmental, security, and leadership.

4. Estimate the number of major injuries involving contractors that you have observed during your safety career in the steel industry.

   A *major injury* is defined as one that resulted in short or long-term disability including lost time accident, permanent disability or death.

   [ ]

5. How important is evaluating a contractor's injury history data during safety prequalification to best ensure an injury free job or work site?

   5.1. Not at all important

   5.2. Low importance

   5.3. Slightly important

   5.4. Neutral

   5.5. Moderately important

   5.6. Very important

   5.7. Extremely important

6. How important is evaluating a contractor's reputation during safety prequalification to best ensure an injury free job or work site?

   6.1. Not at all important

   6.2. Low importance

   6.3. Slightly important

   6.4. Neutral

   6.5. Moderately important

   6.6. Very important

   6.7. Extremely important

7. How important is evaluating a contractor employee training and certifications during safety prequalification to best ensure an injury free job or work site? Please do not consider the training provided by your organization, e.g., work site hazards orientation, etc.
    7.1. Not at all important
    7.2. Low importance
    7.3. Slightly important
    7.4. Neutral
    7.5. Moderately important
    7.6. Very important
    7.7. Extremely important
8. How important is evaluating a contractor's financial stability during safety prequalification to best ensure an injury free job or work site?
    8.1. Not at all important
    8.2. Low importance
    8.3. Slightly important
    8.4. Neutral
    8.5. Moderately important
    8.6. Very important
    8.7. Extremely important

9. How important is evaluating a contractor's liability and regulatory compliance history during safety prequalification to best ensure an injury free job or work site?
    9.1. Not at all important
    9.2. Low importance
    9.3. Slightly important
    9.4. Neutral
    9.5. Moderately important
    9.6. Very important
    9.7. Extremely important
10. How important is evaluating a contractor's written safety program during safety prequalification to best ensure an injury free job or work site?
    10.1. Not at all important
    10.2. Low importance
    10.3. Slightly important
    10.4. Neutral
    10.5. Moderately important
    10.6. Very important
    10.7. Extremely important

11. How important is evaluation of a contractor's work capacity during safety prequalification to best ensure an injury free job or work site?
    11.1. Not at all important
    11.2. Low importance
    11.3. Slightly important
    11.4. Neutral
    11.5. Moderately important
    11.6. Very important
    11.7. Extremely important
12. How important is an evaluation of a contractor's related work experience during safety prequalification to best ensure an injury free job or work site?
    12.1. Not at all important
    12.2. Low importance
    12.3. Slightly important
    12.4. Neutral
    12.5. Moderately important
    12.6. Very important
    12.7. Extremely important

13. *Drag and drop* the following contractor safety prequalification items in order of their importance for achieving an injury free job site: “1” representing the greatest importance (at the top) and “8” the least importance (at the bottom):

    13.1. Reputation

    13.2. Injury history data

    13.3. Employee training and certification

    13.4. Liability and regulatory history

    13.5. Written safety programs

    13.6. Financial stability

    13.7. Related work experience

    13.8. Capacity to complete the work safely

14. What is the best way to facilitate the process of contractor safety prequalification?

    14.1. Use of internal company resources

    14.2. Third party service provider resources

    14.3. Combination of internal company resources and third party service provider resources.

    14.4. Other (describe in the space provided)

    ☐

    Unable to judge:

    ☐

15. Third party service providers are increasingly utilized for contractor prequalification. Rate the reduced administrative burden benefit you associate with utilizing a third party service provider for contractor safety prequalification:

15.1. No benefit

15.2. Low benefit

15.3. Slightly beneficial

15.4. Neutral

15.5. Moderately beneficial

15.6. Very beneficial

15.7. Extremely beneficial

Unable to judge:

☐

16. Third party service providers are increasingly utilized for contractor prequalification. Rate the improved efficiency benefit you associate with utilizing a third party service provider for contractor safety prequalification:

    16.1. No benefit

    16.2. Low benefit

    16.3. Slightly beneficial

    16.4. Neutral

    16.5. Moderately beneficial

    16.6. Very beneficial

    16.7. Extremely beneficial

    Unable to judge:

    ☐

17. Third party service providers are increasingly utilized for contractor prequalification. Rate the greater expertise benefit you associate with utilizing a third party service provider for contractor safety prequalification:

    17.1. No benefit

    17.2. Low benefit

    17.3. Slightly beneficial

    17.4. Neutral

    17.5. Moderately beneficial

    17.6. Very beneficial

    17.7. Extremely beneficial

    Unable to judge:

18. Third party service providers are increasingly utilized for contractor prequalification. Rate the cost savings benefit you associate with utilizing a third party service provider for contractor safety prequalification:

    18.1. No benefit

    18.2. Low benefit

    18.3. Slightly beneficial

    18.4. Neutral

    18.5. Moderately beneficial

    18.6. Very beneficial

    18.7. Extremely beneficial

    Unable to judge:

    ☐

19. Third party service providers are increasingly utilized for contractor prequalification. Rate the reduced contractor injury benefit you associate with utilizing a third party service provider for contractor safety prequalification:

    19.1. No benefit

    19.2. Low benefit

    19.3. Slightly beneficial

    19.4. Neutral

    19.5. Moderately beneficial

    19.6. Very beneficial

    19.7. Extremely beneficial

    Unable to judge:

20. What percentage of the time are audits conducted at the contractors' physical workplace by you, or others on your organization's behalf, to verify the accuracy of submitted injury/loss rates?

20.1. Never

20.2. Rarely: less than 10% of the time a contractor is to be qualified

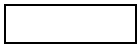
20.3. Occasionally: between 10% & 25% of the time a contractor is to be qualified

20.4. Frequently: between 25% & 50% of the time a contractor is to be qualified

20.5. Majority: between 50% & 75% of the time a contractor is to be qualified

20.6. Expected: greater than 75% of the time a contractor is to be qualified.

20.7. Unable to judge:



21. What percentage of the time are audits conducted at the contractors' physical workplace by you, or others on your organization's behalf, to verify the implementation of submitted written safety programs?

21.1. Never

21.2. Rarely: less than 10% of the time a contractor is to be qualified

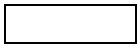
21.3. Occasionally: between 10% & 25% of the time a contractor is to be qualified

21.4. Frequently: between 25% & 50% of the time a contractor is to be qualified

21.5. Majority: between 50% & 75% of the time a contractor is to be qualified

21.6. Expected: greater than 75% of the time a contractor is to be qualified.

21.7. Unable to judge:



Appendix B

Informed Consent Letter

(Administered via Qualtrics online survey system):

Research: Safety Prequalification Factors for the Selection of Contractors Within the Steel Industry

Dear Fellow Safety Professional:

The purpose of this study is to learn more about contractor safety prequalification practices in the steel industry and is being conducted in cooperation with the Steel Manufacturers Association (SMA). You are invited to take part in this research because you are identified as a professional working in a safety capacity for an SMA member company. Survey questions concern your related personal experience and opinions. This research is being conducted by David Wilbanks, who is a doctoral student, Department of Safety Sciences, Indiana University of Pennsylvania. The information obtained will be used for dissertation research, and may be published in scientific journals or presented at scientific meetings.

This project has been approved by the Indiana University of Pennsylvania Institutional Review Board for the Protection of Human Subjects (Phone: 724-357-7730).

Completion of this survey is estimated to require less than 15 minutes.

Voluntariness and Confidentiality

Your participation in this study is voluntary**.** If you decide to participate, please know that all answers will be anonymous. Your name will not be listed anywhere in published results, and nor will your employer's name. No one, aside from the researcher, will know who participated in the study and the opinions provided.

Risks/Benefits and Compensation:

Participation in this survey has no known risks. The sole benefit to those completing this survey will be limited to a possible sense of satisfaction from contributing to the steel industry's injury prevention efforts. Your participation will not result in any other positive outcomes. For example, you will not receive any type of reward for your participation. Likewise, a decision not to participate or withdraw from the survey will have no negative outcomes, e.g., your standing with the SMA, etc.

Consent and Withdraw:

Your informed consent is required before the survey can be completed. Please note that even if you provide consent, you can withdraw from the survey instrument by simply closing your browser before submitting responses, in which case your data will be discarded. However, because submitted surveys will be anonymous, participants cannot withdraw once the survey is submitted as there will be no means to identify individual participants.

Please contact me with any questions or concerns at any time using the following email address: **D.W.Wilbanks@iup.edu**

Please indicate your consent and agreement decision by checking the appropriate box below.

I provide my consent and agree to participate in this research:
☐

I do not provide my consent and disagree to participate in this research:
☐

Sincerely,

David Wilbanks
Doctoral Student, Safety Sciences
Indiana University of Pennsylvania
10110 Post Harvest Drive
Riverview, FL 33578
813-505-5706

Christopher Janicak, Ph.D.
Dissertation Chairperson, Safety Sciences
Indiana University of Pennsylvania
136 Johnson Hall
Indiana, PA 15705
724-357-3274

Appendix C

IRB Approval

Indiana University of Pennsylvania
www.iup.edu

Institutional Review Board for the
Protection of Human Subjects
School of Graduate Studies and Research
Stright Hall, Room 113
210 South Tenth Street
Indiana, Pennsylvania 15705-1048

P 724-357-7730
F 724-357-2715
irb-research@iup.edu
www.iup.edu/irb

November 29, 2016

David Ward Wilbanks
10110 Post Harvest Drive
Riverview, FL 33578

Dear Mr. Wilbanks:

Your proposed research project, "Safety Prequalification Factors for the Selection of Contractors within the Steel Industry," (Log No. 16-281) has been reviewed by the IRB and is approved. In accordance with 45CFR46.101 and IUP Policy, your project is exempt from continuing review. This approval does not supersede or obviate compliance with any other University requirements, including, but not limited to, enrollment, degree completion deadlines, topic approval, and conduct of university-affiliated activities.

You should read all of this letter, as it contains important information about conducting your study.

Now that your project has been approved by the IRB, there are elements of the Federal Regulations to which you must attend. IUP adheres to these regulations strictly:

1. You must conduct your study exactly as it was approved by the IRB.
2. Any additions or changes in procedures must be approved by the IRB before they are implemented.
3. You must notify the IRB promptly of any events that affect the safety or well-being of subjects.
4. You must notify the IRB promptly of any modifications of your study or other responses that are necessitated by any events reported in items 2 or 3.

The IRB may review or audit your project at random *or* for cause. In accordance with IUP Policy and Federal Regulation (45CFR46.113), the Board may suspend or terminate your project if your project has not been conducted as approved or if other difficulties are detected

Although your human subjects review process is complete, the School of Graduate Studies and Research requires submission and approval of a Research Topic Approval Form (RTAF) before you can begin your research. If you have not

yet submitted your RTAF, the form can be found at http://www.iup.edu/page.aspx?id=91683 .

While not under the purview of the IRB, researchers are responsible for adhering to US copyright law when using existing scales, survey items, or other works in the conduct of research. Information regarding copyright law and compliance at IUP, including links to sample permission request letters, can be found at http://www.iup.edu/page.aspx?id=165526.

I wish you success as you pursue this important endeavor.

Sincerely,

Jennifer Roberts, Ph.D.
Chairperson, Institutional Review Board for the Protection of Human Subjects
Professor of Criminology

JLR:jeb

Cc: Dr. Christoper Janicak, Dissertation Advisor
Ms. Brenda Boal, Secretary