An Andragogically-Centered Schema for a Heuristic Approach to Post-Collegiate Development in the Built Environment

by

Kristen Hurtado

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Graduate Supervisory Committee:

Kenneth Sullivan, Chair
William Badger
Avi Wiezel

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ABSTRACT

The discipline of continuing professional development (CPD) is well defined and established within a variety of industries, such as medical, legal, and financial. The built environment is a less defined and mature industry with respect to educational pathways and professional education, with no uniform structure. Occupational licensing, such as registered nurses, certified professional accountants, and others are well known within both their industries and the public. Additionally, occupational core-competencies are well established. Planning is a core skill set within the built environment and construction management. Definitions of the term "planning" vary quite broadly across the built environment, but generally includes activities such as risk identification, scope identification, and scheduling. Understanding how professionals in the built environment learn to plan is critical to meeting CPD needs for planning skills and the ability of a professional to "plan" effectively. Many planning tools and software have been developed, but often rely on an individual professional's personal experiences and abilities. Limited literature in the field of professional education in the built environment has left a gap on the topic of how to train professionals in planning competencies. Survey results indicate that current training is not meeting the expectations of professionals, as only 16 percent of professionals are trained how to plan using their preferred method of learning. While on-the-job training is the primary format, the most preferred format is internal company training, but only 54 percent of companies provide this format. Mann-Whitney U and Kruskal Wallis tests were conducted and revealed that organizations with internal training programs have higher employee satisfaction with their organization's planning process. Further, organizations with internal training programs are seen as having a more formal

internal planning process. Research is needed to develop CPD within construction management and provide the foundation upon which a professional education structure can be created. An andragogically-centered schema for a heuristic approach to construction CPD is developed and tested on a seminar for pre-project planning. The full instructional design of the seminar using the model is disclosed and seminar results showed positive results and participants achieved high levels of learning.

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INTRODUCTION

The discipline of continuing professional development (CPD) is well defined and mature within a variety of industries, such as medical, legal, and financial. Construction management is a less defined and mature industry with respect to educational pathways and professional education, with no uniform structure. Occupational licensing, such as registered nurses, certified professional accountants, and others are well known within both their industries and the public. Additionally, education and experience requirements to maintain those credentials are well established. To increase the maturity of the CPD structure within construction management, research is needed to support this goal and provide the foundation upon which a professional education structure can be created. Until twelve years ago, there was no specifically designated construction education journal, as other journals infrequently published research in this field. A review of the literature is conducted to understand what has been tested in CPD within construction management and is compared with foundational adult education theories. To aid in its advancement, foundational theories and successful professional development structures are needed to inform the research agenda for construction management CPD. Foundational theories in the field of education and adult learning are analyzed. Extant research is also analyzed to understand the gaps. From this a schema, or representation of a generic construct (Smith & Ragan, 1999, p. 21), can be built through the marriage of the two fields of interest: construction management and education.

THE NEED FOR CONSTRUCTION MANAGEMENT CPD

Project execution and project success is highly reliant upon the project team. As a unit, the project team is responsible for keeping a project on time, budget, and within the expected quality parameters. Various studies have confirmed the impact that construction project managers on project success (Müller & Turner, 2007; Pheng & Chuan, 2006). The individuals that make up the project team bring varying capabilities to the team, based on their experiences and education. According to the U.S. Bureau of Labor Statistics (BLS, 2015), the highest level of educational attainment for construction managers twenty-five years and older is divided among a high school diploma (25%), some college no degree (25%), and a bachelor's degree (28%) (Figure 1). While the majority of construction managers might not be getting a formal bachelor's degree in construction management, those that do might find that an undergraduate degree alone may not be adequate preparation for CM professionals to be effective in their careers (Back et al., 2012). Education and training outside of formal degree programs can supplement this preparation and learning needed to support a professional throughout their career pathway.

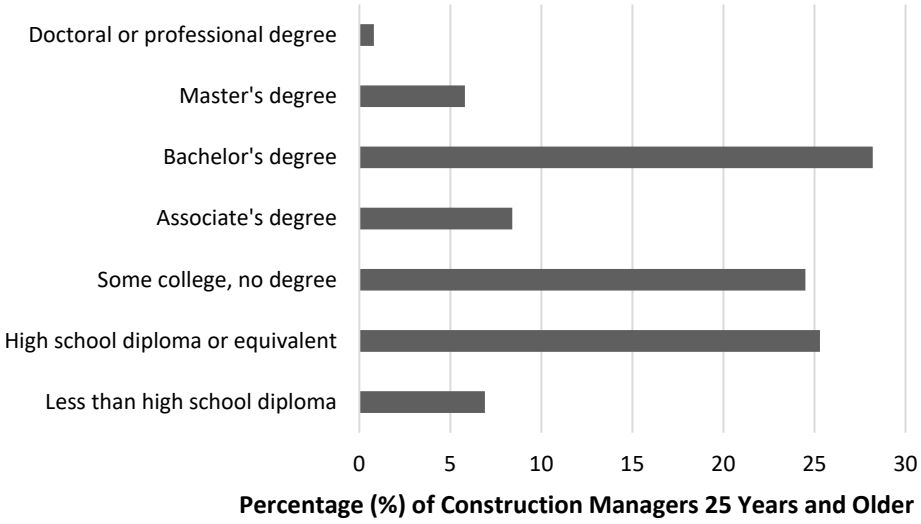

Figure 1. Educational Attainment of Construction Managers 25 Years and Older

The term “continuing education” (CE) is commonly used to describe any training attained after receipt of an undergraduate degree and/or following employment within a specific career path. Another common term used specifically in the built environment is “continuing professional development” (CPD) (Madter et al., 2012; Wall et al., 2006b). Some definitions of CPD have included any activities aimed at acquisition of knowledge and the sharing of that knowledge, inclusive of conference presentations, presentations of a paper, and other activities. Further, activities can be termed as “formal” or “informal” (Grau et al., 2012).

Many definitions of CPD focus on the physical location of the training, such as on-the-job or in a classroom and the level of rigor as being less advanced than a degree program (Epstein, 1987; NSF, 1977). Other definitions focus on the outcome or result of the education, such as a certificate or license. With all of these definitions and perceptions of what CE is, there is also dissent about what CE is not. The Federal Interagency Working Group on Certificates and Certifications found the common person has difficulty differentiating the term “certification” from “certificate” (even when given examples of each). Further, the terms “certification” and “license” are not always distinguishable, and holders of a certification or license do not see their certification or license as educational credentials, but regard them as professional qualifications (Bielick et al., 2013). For the purposes of this research, CPD is taken to mean the training and education of a professional to better meet their career and job-specific performance goals.

CPD in the built environment is informal and lacks an overall strategic approach at regulatory, company, provider, and participant levels (CIC, 2010; Madter et al., 2012).

Professionals must use judgement in selecting the appropriate means to meet this requirement. The training of Project Management capabilities within the built environment has largely been informal (Scott et al., 1997).

Despite the lack of uniformity in nomenclature, the need for professional education has persisted and is strong throughout industries, especially in construction management. With approximately 38 percent of adults reported holding a certification, license, or sub baccalaureate educational certificate in 2010–11 in the United States (82 million adults), there is a large population taking advantage of this learning pathway (Bielick et al., 2013). Further, the Association for Talent Development (2016) reports an increase in per employee spending on training as well as an increase in the number of hours of training.

The need for construction professionals to gain education beyond their undergraduate degrees has been noted throughout the years (Epstein, 1987; Kwofie, et al. 2018; Madter et al., 2012; Oglesby, 1982; Oglesby, 1990; Stukhart, 1989). Further, the reliance upon on the job experience to provide a construction professional with the abilities they need to lead and manage may no longer be enough on its own (Scott et al., 1997). While some companies may consider it important to develop their staff, a survey of companies found that forty-one percent of project manager (PM) respondents felt their company prepared them for their PM role (Carbone & Gholston, 2004). Increasingly, external bodies, such as ABET (n.d), are setting forth a recognition of "life-long learning" within their school accreditation standards.

Until twelve years ago, there was no journal dedicated or named under the topic of construction education, with other journals infrequently publishing research in this field. The body of knowledge on construction professional education is comparatively smaller

than professional education in other fields. The need for published studies on the topic of CPD in construction and for research tests that measure the impact of CPD efforts has persisted for many decades (Epstein, 1987; Grau et al, 2012 Opfer, 1992). Construction CPD represents an area of great opportunity for both research expansion as well as practical application in the industry.

CHAPTER 2

LITERATURE REVIEW

CONSTRUCTION MANAGEMENT CPD

Over the years, researchers have explored the field of continued professional development (CPD) in the broader built environment across a variety of topics as described in the following sections. The main topical areas uncovered in the literature are: needs assessments (both generally and specific to a particular geographical region), competencies and credentials, knowledge management, the use of technology and specific media, and instructional strategy.

Needs Assessments

One of the first major steps in the creation of a CE program is to evaluate the needs of the target population for the training. Various needs assessments have been conducted in the construction industry, but have focused on very specific skilled trades, craft, or labor training needs (Evia, 2011; FAS, 2006; Hou et al., 2017; Wang et al, 2010). Others have been broader in identifying industry agnostic project manager competencies (Omar & Fayek, 2016). Further, others have been conducted within a specific geographic market, mostly focused on skilled trades/craft/labor training needs (Kwofie, et al. 2018; Rodríguez-Garzón et al., 2015; Su et al., 2013). Molenaar & Saller (2003) identified the need for design/build training in the construction industry, by topic. Dowlatshahi (1996), sought to understand the needs of the professional education of professional engineers, scientists, and engineering technicians. The results showed: (1) a moderately strong demand for continuing education offerings; (2) continuing-education needs are either marginally or poorly met; and (3) management-related interdisciplinary and cross-functional programs

and subject areas are most preferred. Pappas (2005) rated the quality and availability of training and development programs in the USA and Canada and identified subject area deficiencies.

The training needs assessment type of articles highlight the importance of ensuring the training matches the needs of the identified learners. This can vary, depending on the perspective taken, "As the building industry evolves, a variety of gaps in the skills of the workforce become evident, which are seen differently depending on the perspective within the industry supply chain" (McCoy at al., 2012). Indeed, varying stakeholders such as educational providers, employers, and employees often have differing perspectives of what is needed in terms of professional education. McCoy et al. (2012) uncovered the following main drivers to achieving more effective training in the residential green building industry: 1) employer demand; 2) market transfer; 3) training content; 4) training format; 5) market demand. The need for CPD in the built environment truly spans job functions, topics, and geographies.

Studies within a Limited Geographic Scope

Within the area of needs assessments, studies about the professional development needs of specific groups within a specific geographic area have also been conducted. Hu et al. (2016) conducted a needs assessment of CM skills for professionals in China, and found 22 skills areas that matched in level of importance and strength of current need/gap. Barreto et al. (2017) identified the barriers to the professional development of qualified women in the Peruvian construction industry. Further, Al Mohsin et al. (2018) researched the impact and need for CPD for civil engineers in Baghdad. Ameh & Odusami (2014) studied the extent to which certain courses pertinent to project management were covered

in the undergraduate curricula and post qualification education in Nigeria. The results indicated that, among the professional groups surveyed (architects, engineers, surveyors, and builders), civil engineers had the biggest gap and showed subject areas of weakness by group

Rodríguez-Garzón, et al. (2015) sought to understand how training affects construction workers' perceived risks related to safety. By distributing a survey prior to risk safety training, the researchers were able to gather workers' perceptions of risk and compare it to their number of hours of previous training. Risk perceptions were based on nine attributes established in the literature. The results showed that workers' with a low perception of risk were less trained than workers' with a high perception of risk were. The researchers found that more training increases the perception of risk among construction workers. Ahn (2013) sought to model construction workers' absence behavior against social learning models to identify needs and trends.

Competencies and Credentials

Articles pertaining to competencies identified the type of skills or qualities of particular job roles, such as Site Superintendents (Gunderson & Gloeckner, 2011) and Project Managers (Hanna et al., 2016). Credentials and training, along, do not guarantee performance. Hannah et al. (2016) found that merely going to training and having certifications does not differentiate an average from an exceptional PM. Under the theme of credentials, papers discussed the requirements of the Restoration Industry Association's Certified Restorer credential (Rapp & Pan, 2010), comparisons of results of attaining the LEED AP, CPC and DBIA credentials (Bruce et al, 2010), and civil engineering licensure requirements versus other professions (Banik, Daugherty, Kleweno, Bazan-Arias, Berry,

Richards & Casazza, 2015). These studies represent a part of the CPD environment, with credentials being one offering to obtain CPD.

Knowledge Management

Knowledge management (KM) and internal company tools to capture lessons learned on projects are common topics and somewhat related to adult education. KM takes an objectivist viewpoint with its assumption that the majority of knowledge is explicit and can be easily assimilated from one person to another (Boyd, 2013). Goh et al. (2013) utilized the workshop as a method for risk management on a design-build Malaysian university construction project. The workshop was a two-day exercise, wherein all project stakeholders (owner, architect, engineers, and contractors) attended and identified the potential risks on this project and analyzed their probability, impact, and risk rating. While not used in an adult educational setting, the workshop method had the effects of: increasing understanding about project risks, of the project itself, promote the concept of risk management, and raise awareness about risk management.

Also related to project-based approaches to planning and lessons learned, Love, Ackermann, Teo, and Morrison (2015) studied a program wherein 129 water infrastructure projects that were delivered over a five-year period implemented a program to prevent rework. Through site visits, interviews, and observations, the program is characterized and described. The main defining features of this program were: authentic leadership was engaged, a learning climate was established, behavioral changes were encouraged, coaching was utilized, collective learning was encouraged, and cultural changes took place. In additional to policy changes, the program implemented a lesson learned and innovation

register as well as post-completion workshops to engage lessons learned and feedback from all parties (i.e. contractors, sub-contractors, etc.) to improve future projects.

Boyd (2013) uncovered the challenges with KM, as it is challenging for practitioners to articulate their knowledge. Bijleveld & Dorée (2014) sought to turn experiential (tacit) knowledge into processes and procedures (explicit) for asphalt road construction equipment operators in Netherlands. Javernick-Will & Levitt (2010) identified the need, types, and modes to transfer institutional knowledge from international construction projects, to reduce uncertainties for construction companies on international projects. Wanberg et al. (2015) studied three communities of practice (COP) of two multinational engineering and construction firms to identify their composition. A community of practice can be defined as a grouping of professionals that are seeking to share knowledge and assist fellow members when needed. Due to a principle called homophily, COPs tended to be composed of members that are culturally and geographically similar, limiting the variety of knowledge. This research looked at the effect of geographic and cultural diversity on patterns of knowledge sharing within large, geographically, and culturally diverse COPs initiated by managers. After examining three COPs within two companies (in the areas of: Six Sigma, Computer Aided Drafting, and transportation), the researchers found geographic and cultural homophily was significant. As a result, the researchers recommended that COPs focus on events, such as face-to-face meetings, conferences, and periodic training with relevant groups of professionals that are already acquainted with one another. This research thus takes on a socio-cultural perspective of learning. When seeking to establish knowledge management and COPs, one of the intended outcomes is geographical diversity, which, in practice, can be quite

challenging to attain within functional groups. Through their development and measurement of a web-based tool for owner change management training, Lines, Perrenoud, Sullivan & Smithwick (2015) found that training and tools could ease organizational-level change management.

Use of Technology and Specific Media

Several studies discuss the impact of technological advancements shaping training. In parallel with the advance of new technologies in education, similar studies have been conducted about the use of technology in CPD programs, agnostic to the specific subject being trained (Alshawi et al., 2006; Wall et al, 2006). Others have investigated the use of games (Badger et al., 2010), gaming technologies (Al-Jibouri & Mawdesley, 2001), and simulations (Gonzalez et al., 2015; Sumner & Slattery, 2010).

Instructional Strategy

On the topic of the ways that construction professional education could be improved, Opfer (1992) noted that professional education has foundational differences from a regular academic course. Namely, professional education "students" are not a "blank slate" as they bring experience to the table and are and more focused on common problems and ways to solve them versus theoretical concepts. In his analysis of construction safety training, Wilkins (2011) found an underlying need for trainers in this field to consider approaches that were more appropriate for training adults versus adolescents. The considerations of the learners, specific to CPD, is part of this research and is discussed in more detail in subsequent sections. One important distinction is that the term 'learner" is purposely used in this research in lieu of "student" to denote an adult education participant with professional experience.

Some of the recent research in construction education involves the use of technologies to simulate or recreate "real world" scenarios for students that do not have experience to compare or use as a frame of reference (Jaselskis et al., 2011; Rojas & Mukherjee, 2005). While this may hold true for undergraduate students or professionals transferring to the built environment from another industry, construction professionals may not have this same gap. Further, a key component of extant models of the process of learning is the role of prior knowledge or experience. To be effective, instruction seeks to stimulate recall of prior knowledge to allow the processes of assimilation or accommodation to take place and maximize long-term memory storage of learned material (Gagné & Driscoll, 1988; Gagné & Medsker, 1996). Therefore, as the process of learning for professionals is nuanced as compared to students, the design of instruction for professionals considers different factors as the basis of its design to be effective.

While industry-wide needs assessments, use of technologies, and credential/certificate outcomes all warrant further investigation, the focus of this research is in the CPD of construction professionals within managerial roles and not prescriptive to a particular geographic location.

Need for Exploration of Foundational Theories in Education

The field of engineering education is experiencing challenges communicating and disseminating engineering pedagogical innovations (Borrego, Froyd, Hall, 2010; Wankat, 2012). Undergraduate education is a more central topic and has more research tests than construction CPD, but it is still considered to be at risk for disseminating innovations. With the paucity of peer reviewed literature on construction CPD, the state of CPD might be closer to a crisis.

Further, it is suggested that the diffusion of interdisciplinary knowledge is also a complex process. For example, the body of knowledge within the field of education is useful to educators across disciplines. However, educators in higher education may not be aware of the important foundational theories within education, key constructs, and the overall body of knowledge since educators are not required to take any classes nor have a degree in education. Moreover, educators may not be fully exposed to developmental psychology foundational theories and research that could improve their teaching (Pourchot & Smith, 2004). A gap in interdisciplinary knowledge sharing can inhibit the full potential to advance research.

LEARNING THEORIES

There is no single, universal theory of learning (Alexander et al., 2009; Gagne & Medsker, 1996, p. 10; Minter, 2011; Ormrod, 2016). Further, the definition, conditions, and processes behind learning have been investigated over the centuries by psychology and education academics and professionals. Many researchers note that learning theories evolved from advances and emerging needs in modern society and closely followed the field of psychology (Ashworth, Brennan, Egan, Hamilton, & Sáenz, 2004, Edgar, 2012). The fields of psychology, anthropology, and philosophy have and will continue to have a profound impact on the field of education. The complexity of the relationships between research in learning, educational psychology, and instructional design was best described as "…complex, more like an interacting ecology of ideas and practices than a clear hierarchical organization" (Lawton et al., 2012).

As defined by Alexander et al. (2009), modern leaders in educational psychology, "Learning is a multidimensional process that results in a relatively enduring change in a person or persons, and consequently how that person or persons will perceive the world and reciprocally respond to its affordances physically, psychologically, and socially" (Alexander et al., 2009). With learning being such a multi-dimensional process, it can be quite challenging to describe just how learning occurs. Not accounting for biological tendencies, maturation, or short-term recall, "The process of learning has as its foundation the systemic, dynamic, and interactive relation between the nature of the learner and the object of the learning as ecologically situated in a given time and place as well as over time" (Alexander et al., 2009). From this perspective, the motivation to learn can be influenced by the learner themselves, the timing, and the environment.

Without attention to any one specific theory, Alexander et al. (2009) defined their nine principles of learning in order to properly analyze existing perspectives of learning as to whether they are a viable operationalization of the construct. Their nine principles of learning state that learning: (1) Is change (which ranges from dramatic to imperceptible, can occur over infinite scales of time, and is invariably systemic); (2) Is inevitable, essential, and ubiquitous; (3) Can be resisted; (4) May be disadvantageous; (5) Can be tacit and incidental as well as conscious and intentional; (6) Is framed by our humanness; (7) Refers to both a process and a product; (8) Is different at different points in time; and (9) Is interactional. Further, it is important to note that no single theory of learning covers all aspects of learning (the what, where, who, and when), rather certain theories focus on a particular aspect (Alexander et al., 2009). For the purposes of this research, the learning theories discussed focus on the "what" aspect of learning.

Learning Theories in the Field of Education

The educational needs of society and theories behind how one is educated were largely influenced by the social backdrop and current viewpoints in various disciplines during that time. The field of psychology was greatly impactful on learning theories, many of which were based on the observation of animals in experiments (Gagne & Medsker, 1996, p. 10). In the early 1800s, when psychologists began formal study of learning, the methods used were types of introspection or looking into one's own head and portraying what was on their minds (Ormrod, 2016 p. 6). Prior to the 20th century, education was focused on knowledge of facts and literacy. Recitation literacy, which is knowledge gained through the recitation of facts, reading and writing literacy, and knowledge of spoken language was associated with learning (Edgar, 2012). After WWI, the focus in education shifted to determining the role of secondary education and how to measure its impact on achievement later in life and in college. With the onset of WWII, America saw a great need for trained personnel that were not only literate, but could also interpret and understand what was needed. Further, with international technological advances being made, such as the launch of Sputnik, the US started rethinking its focus further and set in place policies to improve math, foreign language, and science education. The focus shifted from recitation learning to extraction learning, whereby the learner must be able to understand and analyze information (Edgar, 2012). The introduction of television, the personal computer, and the internet were all significant milestones in society that also had their impact on learning theories and educational technology of the times. Over time, learning theories changed from learning being thought of as the memorization and

statement of facts, to an intricate and cognitive process that is very much influenced by internal human factors.

Throughout the history and evolution of the field of education, certain thought leaders, and especially psychologists, very greatly influenced learning theories. Two important distinctions when discussing learning theories are: 1) their development was the result of an evolution of thought, led by many different theorists with some leading multiple areas of thought and 2) learning theories are not mutually exclusive – some contain similar principles in nature and are not so distinct (Ormrod, 2016, p. 8). Further, many researchers are unsuccessful in their attempts to place one theory against the other, reduce one theory to a single construct, and/or provide a comprehensive historical account of a theory's development (Gagne & Medsker, 1996, p. 10). Learning theories have had many different names, but are most commonly referred to as (in order of history of development): 1) Behaviorism; 2) Cognitivism; and 3) Sociocultural Theories. A deeper dive into the theorists' viewpoints, explanations of the process of learning, and key concepts helps to put perspectives of construction CPD into a greater context within the field of education.

General Learning Theories

Behaviorism

The behaviorism movement was fueled by leaders such as John Watson, Edward Thorndike, Ivan Pavlov, and B.F. Skinner, from the early 1900s. The key understanding of behaviorists is that learning involves a behavior change. Behaviorists also consider the main principles of learning as equally applicable to different behaviors, regardless of the species (Ormrod, 2016, p. 36). The species itself is considered a "black box" in terms of

the internal processes that explain how learning occurs and is born with a "blank slate" wherein the environment impacts the organism (Ormrod, 2016, p. 37).

Certain behaviorists considered learning to be the process of forming a relationship between a stimulus and response (classical conditioning) and motivation to learn was driven by needs and reinforcement/rewards (operant conditioning). An example of classical conditioning was Pavlov's testing with dogs wherein a bell was rang prior to receiving a treat, resulting in a conditioned response for the dog to salivate with only the sound of the bell even if no treat were presented (Edgar, 2012). Classical conditioning involves a response that is involuntarily made by the learner and may explain physiological responses that learners acquire with a specific stimulus, such as emotional responses, attitudes, fears, and other reactions.

Examples of operant conditioning were Thorndike's experimentation with cats wherein he found that hungry cats learned how to pull a hanging string to release the door to get food after several unsuccessful attempts (Bransford et al., 2000, p. 7) and B.F. Skinner's similar box wherein rats learned to press a metal bar and pigeons learned to peck at a metal disk to release food (Edgar, 2012; Ormrod, 2016 p. 48). Skinner's focus on reinforcement (vs. reward) led to the notion of extrinsic (external/environmental) and intrinsic (internal/personal) reinforces (Ormrod, 2016, p. 52). This organization of instruction and development of theoretical constructs in the field of education also led to other advancements during this time. Programmed instruction, computer-assisted instruction, and mastery learning started building their foundations, leading to further development of the field of education (Ormrod, 2016 p. 112)

While the relationship between stimulus and response seemed to apply to observable behaviors quite well, behaviorism lost favor with some due to its inability to explain mental states such as thinking, understanding, and reasoning (Bransford et al., 2000, p. 8, Ashworth et al., 2004). Some modern behaviorist theories have started to include cognitive factors in certain aspects (Ormrod, 2016, p. 74); however, behaviorists' lack of attention to the human side of thinking and learning brought attention to alternative perspectives.

Humanism

As a pre-cursor to the cognitivism movement, humanism viewpoints started taking root in counseling psychology. Humanism describes how individuals acquire emotions, attitudes, values, and interpersonal skills (Ashworth et al., 2004; Ormrod, 2016). Carl Rogers and Abraham Maslow are known for being thought leaders of this movement. Rogers was a counseling psychotherapist and thought the model for the ideal therapist-client relationship could be applied to other domains, particularly education, this feeds into concepts such as the self-directed learner, and Maslow's hierarchy of needs holds the need for self-actualization as the ultimate need and is also the main goal of education from a humanistic point of view (Ashworth et al., 2004). Some have disregarded the theories of Maslow and his hierarchy of needs, mostly due to its lack of research, its highest level of self-actualization as being so rare and the source of motivation being purely internal that it disregards environmental contexts that may impact motivation (Ormrod, 2016). Humanism does offers useful insights into motivation and its impacts on learning, such as the desire to gain wisdom or use creative expression (Ormrod, 2016). Attention to motivating factors of learning led to a movement to understand the context of the learner.

Cognitivism

In the late 1950s, cognitive science emerged as a new movement that focused more on understanding humans and environmental factors (Bransford et al., 2000, p. 9). Applying the field of cognitive science to learning brought a new meaning to learning beyond memorization of facts and recognized the possibility of varying levels of understanding or expertise. Emerging ideas on the connections between facts and understanding, including the conditions or contexts they are applied under started circulating during this time (Bransford et al., 2000, p. 9). In contrast to behaviorists' view that observable behavior denotes learning, cognitivists hold that mental activity impacts learning and the nature of a learner's mental processes are factors in what they learn and how they learn (Ormrod, 2016, p. 160). Thus, the development of learners' cognitive processes started coming into focus during this time.

The focus of cognitive-developmental theories is on the changes in thinking processes that change with age and experience (Ormrod, 2016, p. 301). The notable psychologist, Piaget defined his four levels or stages of cognitive development, which viewed inner cognition as an ongoing process (Edgar, 2012). Children's early development structures were quite different than later in life, when they were no longer considered to be a novice (Case, 1993). From this, the idea of novices and experts emerged. Experts have a more refined understanding of a concept, can easily see relationships and patterns that aren't evident to a novice, can see what's relevant, and their attention isn't distracted by complexity (Bransford et al., 2000, p. 17). Effective teaching was characterized as eliciting students' preexisting understanding of the subject matter to be taught and giving opportunities to build on – or challenge – their current understanding or schema (Bransford

et al., 2000, p. 15). While children tended to be the focus, these perspectives came to later shape advances in understanding adult learning theories.

Piaget is also known for theorizing that children become more aware of their environment through the processes of assimilation and accommodation. Assimilation is responding to and possibly interpreting an object or event in a way that's consistent with an existing schema, while accommodation is either: modifying an existing scheme to account for the new object or event or forming an entirely new scheme to interpret it. To move towards increasingly complex forms of thought, children undergo a process of equilibration, from equilibrium to disequilibrium (mental discomfort that occurs when they try to make sense of what they observe) and back to equilibrium again (Ormrod, 2016, p. 280). Piaget's theories began a movement toward recognizing that knowledge is the outcome of the interaction between the student and the environment (Edgar, 2012). Given these perspectives, the role of existing knowledge, beliefs, and skills greatly influences how learners recognize, organize, and interpret new information.

Within cognitivism, parallel theories developed, such as information processing theory, contextual theories, and constructivism. Some theorists also define cognitivism as information processing theory (Doolittle, 2014); however, this theory is concerned more with how humans process information (Ormrod, 2016, p. 158). Information processing theory has expanded the viewpoint of how learning takes place, but is less comprehensive in nature than a complete learning theory in itself, as it explains the internal processes that are hypothesized to occur in the brain (Smith & Ragan, 1999, p. 20). Contextual theories seek to explain the ways in which learning is tied to the physical, social, and cultural environments (Ormrod, 2016 p. 159). Contextual theories have evolved and taken on more

distinctions, such as social cultural theory, which is described later. Constructivism is described in the next section.

With the shift of understanding the background of the learner and their impact on learning, new constructs began to emerge. During this time, Gagne's conditions of learning and other theories were developed, setting up the concept of a learning environment (Edgar, 2012). Another important concept within this new paradigm and commonly cited in the built environment literature is active learning, which are techniques that recognize the importance of instructors helping learners take control of their own learning (Bransford et al., 2000, p. 12). Another new notion that emerged during this time was the importance of transferring of learning to new problems and settings (Bransford et al., 2000, p. 14). The role of the environment in learning was capturing more attention in research during this time.

Constructivism

Sometimes considered a branch of cognitivism, constructivism also focuses on the inner processes of learning. While there are many types of constructivism, their unifying theoretical belief is that learners are active, meaning that learners construct their own knowledge from interpreting their experiences (Ashworth et al., 2004, Doolittle, 2014). Some of the major thought leaders during this time were Bruner, Kant, Dewey, Goodman, and Piaget (Edgar, 2012). Doolittle (2014) defined three main pillars of constructivism: (1) the construction of knowledge is an individual and social active process; (2) constructing knowledge is adaptive, as the end result is to make the learner's thoughts and behaviors more effective in achieving one's goals; and (3) individual and social interpretation contribute to understanding one's experience. Despite having three pillars,

constructivism is still seen as having great variability and has promoted three constructivist models (Doolittle, 2014; Edgar, 2012):

1. Trivial constructivism (also known as: exogenous, cognitive, information processing, psychological, or naïve constructivism) defines learning as the process of creating accurate internal models of external structures of the 'real' world, wherein the instructor transmits knowledge to the student and the student must build an accurate reconstruction of the knowledge transmitted.
2. Social constructivism (aka: dialectical, social, sociocultural, symbolic interactionist, or idea-based social constructivism) holds that knowledge is created through the interaction of the environment and other people, while the learner's previous experiences, culture, and values act as filters.
3. Radical constructivism (aka: endogenous, schema-based, emancipatory, developmental, or psychological constructivism) holds that knowledge is constructed from both external experiences and earlier schemas, thus learning is the rebuilding and reorganization of old knowledge structures in light of new experiences (i.e. assimilation and accommodation).

Constructivism has many variations and names. Within constructivism, may complimentary theories of learning fall, such as: situated cognition, anchored instruction, cooperative learning, generative learning, exploratory learning, reciprocal teaching, cognitive apprenticeships, and information processing (Doolittle, 2014). Despite having many different names and variations, this movement started directing attention to what is learned and the active role of the learner versus the instructor (Ormrod, 2016, p. 158). Overall, constructivism is a widely applied and referenced construct, potentially due to its

perceived practicality to a variety of training environments and plethora of research experiments that have produced positive results (Gagne & Medsker, 1996, p. 12).

Social-Cognitive Theory

Originally named "social learning theory," some of its initial concepts began in the 1940s as branches of the behaviorism foundation, but eventually started incorporating more cognitive principles leading to a change in its name (Ormrod, 2016, p. 114). One of the primary leaders of its evolution into a more cognitive domain in the 1960s was Albert Bandura (Edgar, 2012; Ormrod, 2016, p. 115). Social-cognitive theory holds the following general principles: learning can occur by observing others' behaviors and situational outcomes, learning can take place without behavior change, cognition is important to learning, and humans have personal agency to be able to control various factors in their environments (Edgar, 2012; Ormrod, 2016, p. 115). Some theorists hold that the learner can be either a passive receiver of behavior, roles, and values through the social environment or an active partner in this process along with the social environment (Ashworth et al., 2004). Regardless of the specific stance, social-cognitive theory has taken on a different perspective regarding the role of the environment, others, and cognition than previous perspectives.

The role of observation is an important aspect of this learning theory. Learning may be influenced by modeling behavior, wherein attention, retention, motor reproduction, and motivation play key roles (Ormrod, 2016, p. 129). A commonly used construct, self-efficacy, emerged during this time in the pursuit of understanding motivation. Self-efficacy refers to a learner's beliefs about how well they can perform a specific activity or task and is a complicated construct (Ormrod, 2016, p. 130; Schunk, 1991). Self-efficacy

has been said to potentially affect learners' choices of activities, goals, and efforts (Ormrod, 2016, p. 131), yet in practice is very challenging to measure (Schunk, 1991). Despite the strong role of the environment, social-cognitive theorists also hold that over time learners regulate their own behaviors and self-regulate themselves against their own standards (Ormrod, 2016, p. 143).

Sociocultural Theory

The sociocultural theory or cultural-historical theory is most identified by the psychologist Lee Vygotsky. In this theory, the nature of culture and its effect on learning, and the role of social interaction and its impact on the learner are key aspects (Edgar, 2012). From a childhood development perspective, cultural-historical theory holds that through informal and formal instruction, adults convey to children how their culture responds to and interprets the world (Ormrod, 2016, p. 303-310). In essence, culture is challenging to separate from teaching. Further, complex mental processes arise out of social activities, as children develop, they gradually "internalize" the processes they use in social contexts and begin to use them independently. Through a process termed "appropriation," children incorporate their culture's tools in their own individual manner(Ormrod, 2016, p. 303-310). Adults are seen as the "models" through which children develop examples of model behaviors, attitudes, etc.

Some modern applications of sociocultural theory are communities of practice and apprenticeships. In communities of practice, learning is enabled in a group setting where the individual members have common goals and desires, meeting regularly in pursuit of these interests (Ormrod, 2016 p. 314). Professional associations, clubs, and coalitions are common examples. In apprenticeships, a novice learns from an expert through use of

varying levels of modeling, coaching, scaffolding, articulation, reflection, increasing complexity of the task at hand, and exploration (Ormrod, 2016, p. 316).

A summary of the evolution of learning theories and their main constructs is presented in Table 1.

Table 1

Summary of Evolution of Learning Theories

	Behaviorism	**Cognitivism (multiple branches)**			**Sociocultural**
		Cognitivism	**Constructivism**	**Social-cognitive**	
Timeframe	1900 – 1950s	Early 1960s		**1970s**	**1960s**
Thought Leaders	Watson, Thorndike, Pavlov, and Skinner	Piaget, Gagne	Bruner, Kant, Dewey, Goodman, and Piaget	Bandura	Vygotsky
Goal of learning	Behavioral change	Understanding	Achieving learner's goals	Self-regulation	Contextual
How learning takes place	Observe change in behavior/actions	Internal mental processes	Making meaning from experiences	Observation	Contextual
Role of environment	Stimulus	Internal processes	One input	Interaction	Active

ADULT EDUCATION PRINCIPLES AND THEORIES

Since the 1970s, research has supported that there is a difference between educating adolescents and educating adults. Psychology and studies of the brain have paved the way for both general and adult-specific learning considerations for educators. Some of the common myths associated with adults as learners being limited in capacity, constrained by

previous experiences, and potential due to aging have been found that they are untrue. According to Pourchot & Smith (2004), the three common myths are addressed are:

> "The trajectory of adult intelligence is multi-directional. While some declines occur with aging in the fluid mechanics of intelligence, some fluid abilities may also be maintained in areas of high-level expertise. There are also corresponding increases in pragmatic, or crystallized, intelligence…Adult cognition tends to be highly contextual and domain specific. Adults demonstrate adaptive and compensatory abilities by utilizing experience-based cognitive strategies and developing expertise through practice in specific domains…Adults are capable of higher-order thinking and use of cognitive structures that are unique to adulthood. Postformal theory and research show that adult thinking may be relativistic, dialectical, metasystematic, and generative (i.e., problem finding) in nature. These qualities allow adults to excel in interpersonal relationships, social knowledge, practical judgment, creative endeavors, and the development of wisdom."

The education of adults is defined as andragogy (Knowles, 1972; Knowles, 1989; Mezirow 1981). Jack Mezirow and Malcom Knowles are considered founding leaders in this area, widely cited, and regarded highly by the field of education (Hoggan, 2016). These theorists have many commonalities and have paved the way of organizing the principles of adult education into "charters" and "tenants." Fields that are underdeveloped in terms of professional education can learn from how Knowles, Mezirow, and others define learning and what motivates or drives adults to learn as they look to create structure around their educational programs. Despite the particular learning theory or theories deemed as relevant by any researcher or educator, the use of Mezirow and Knowles' tenants can still be applied.

Adults as Learners

Malcom Knowles is considered by most as the father of adult education and is most known for his book, "The Modern Practice of Adult Education," which lays the framework for the field of adult education and guiding principles. Since the publishing of his book in

1970, Knowles work has been cited over eight thousand times in books and journal articles. Of particular importance is his definition of andragogy and its main assumptions.

A quick look into the history of education reveals much about its present state. Prior to the fall of Rome, the great leaders of education: Confucius, Jesus, Socrates, Plato, Aristotle, etc. taught mostly adults and their model was that learning was a process of learner discovery and dialogue. The theories of these first leaders were soon labeled pagan by others and forbidden during the establishment of monastic schools and pedagogical models in the seventh century. Pedagogy comes from the Greek word "paid" meaning child and "agogus" meaning leader of. Andragogy comes from the Greek word "aner" meaning man, as differentiated from boy. Andragogy can be defined as "the art and science of helping adults learn" (Knowles, 1972).

Andragogy is not about defining specific characteristic differences between children and adults, but is more about the assumptions about adults as learners. Knowles' (1972) four main assumptions of andragogy are reflected in the following understandings: changes in self-concept, the role of experience, readiness to learn, and orientation to learning. An individual's self-concept moves from total dependency to being self-directed, which defines when they truly become an adult and any return back to dependency can interfere with their learning. Adults prefer experiential teaching techniques that involve analyzing their experiences, mostly because they feel their experiences define them as a person and if ignored, feel devalued as a person. As opposed to adolescents being ready to learn what they should because of their academic and biological development, andragogy assumes adults are ready to learn what they need to because of the phases of their life and relationships as employees, leaders, spouses, parents, etc. Adolescents are

more oriented to a time perspective of learning that is delayed or will lead to future application (i.e. you will need to learn this for high school, etc.). Whereas, adults typically enter into education to address or improve a current life challenge, and thus are more oriented towards a current perspective of learning, wherein they can immediately apply what they just learned. Therefore, it is assumed that adolescents are more subject-centered, while adults are more problem-centered.

In his six assumptions of the andragogical model, Knowles revealed some of the key differences between adults vs. adolescents as learners, such as, adults: need to know why they learn something before undertaking to learn it, need to be seen and treated by others as capable of self-directed learning, bring more experience and previous learning than adolescents that may have both positive and negative effects on their learning, more easily learn what they need to know or do in order to improve their real life situations, are more oriented to life task or problem-centered learning as opposed to subject-centered learning, and may carry a negative self-concept as a student (1989).

Knowles (1972) defines education as a process of inquiry and self-direction. As with any process, the steps and sequencing of events are critical. Knowles (1972) defines the following seven elements of process design of adult education: setting a climate (making the learning environment welcoming and reinforcing the instructor's role as a facilitator), mutual planning (gaining input from students during the course's initial development), diagnosing needs for learning (including student pre and post assessment), formulation of the program's objectives (especially those that are important to the larger society), planning a sequential design of learning activities, conducting the learning experiences, and evaluating the learning (including student self-assessment). Through

these seven elements, instructors can easily understand the differences between an adult learning environment and an adolescent classroom. By establishing learning as a process whereby adults 'take the steering wheel,' Knowles set the stage for later theorists, such as Jack Mezirow.

Transformative Learning

Jack Mezirow is considered the founder of transformative learning in adult education. Mezirow's research is cited in many other scholarly works and his articles typically have upwards of two-thousand citations each. One of his foundational journal articles is the most read article in Adult Education Quarterly (1981) and describes the roots of his work. Mezirow was very influenced by German philosopher Jurgen Habermas and Carl Marx, as reflected in the essence of his theories on adult education. According to Mezirow (1981), knowledge can be classified into three domains: technical, practical, and emancipatory, each with their own methods and goals of instruction. Technical can also be classified as work, empirical knowledge, and is governed by rules. The second domain can also be described as communicative action, with the goal to understand meaning and is approached through systematic inquiry. The final domain involves self-reflection and perspective transformation, which is of the most interest to adult learning theory.

Perspective transformation was first revealed to Mezirow through a national study of female college re-entry programs. The concept of "meaning perspective" was established as "the structure of psycho-cultural assumptions within which new experience is assimilated and transformed by one's past experience" (Mezirow, 1981). The women studied had psychocultural assumptions rooted in the stereotype of the "proper" roles of women and experienced internalized strong feelings in defense of these expectations.

> Perspective transformation is the process:
> of becoming critically aware of how and why the structure of psycho-cultural assumptions has come to constrain the way we see ourselves and our relationships, reconstituting this structure to permit a more inclusive and discriminating integration of experience and acting upon these new understandings (Mezirow, 1981).

Mezirow (1981) then uncovered the ten elements of perspective transformation as observed in his female college re-entry programs, with the first element being a disorienting dilemma, followed by multiple elements involving self-reflection and assessment, and ending with emergence into society under the new perspective. He also found that the first element of a disorienting dilemma, which is particularly traumatic, can increase the likelihood of a perspective transformation.

Along with other theorists in psychology (Hoggan, 2016; Nohl, 2016), Mezirow (1981) holds that only adults can truly participate in self-consciousness or reflectivity, which have varying levels that may be experienced throughout the stages of adult psychological development. Critical awareness or critical consciousness is defined as "becoming aware of our awareness and critiquing it" and is attained through perspective transformation (Mezirow, 1981). Understanding how perspectives are created and used reveals the uniquely adult aspect of perspective transformation.

A perspective is a complicated aspect of the mind and is uniquely developed over an individual's lifespan. With age and maturity, an individual creates systems of categorized or stereotyped information that helps sort their perceptions and improves their abilities to anticipate reality. Perspectives govern thinking processes, feelings, and behavior. With experience, their category system reinforces their expectations and soon

becomes a model of their world. Perspectives are limiting or shaped by an individual's: culture, language, personal preferences, and science (Mezirow, 1981).

Returning to the domains of learning, Mezirow (1981) argues that the majority of educational approaches and instructional design are appropriate for task-based education in the technical domain of knowledge, not practical and emancipatory domains. The typical approach is to set learning objectives, behaviors to be learned, and tasks wherein learners can acquire these competencies. Examples of a suitable educational approach to perspective transformation is leading learners to identify the reasons behind their cultural myths and feelings and how they created their perspective, then giving them access to alternative meaning perspectives to understand their reality (Mezirow, 1981). The instructor can create learning experiences that test an individual's critical assumptions and bring these items into their consciousness. An example of this experience with the goal to challenge the very nature of the teacher-student relationship, a learner is placed in a situation wherein the teacher rejects their traditional role as information distributor/director and acts more as a resource or facilitator (Mezirow, 1981). While likely an uncomfortable situation quite distinct from task-based environments, the learner would be in a position to recognize and critique how their assumptions on authority have led to their perceptions and behaviors towards teachers. While each learning domain has its own unique approaches and methods, most situations involve more than one learning domain (Mezirow, 1981). A broader approach to education and instructional design is needed to meet the needs of these dynamic domains.

In his foundational work, Mezirow (1981) sets a charter for andragogy, beginning with its definition as: "an organized and sustained effort to assist adults to learn in a way

that enhances their capability to function as self-directed learners." Further, his twelve elements define that andragogy must enable the learner to achieve certain goals as follows:

1. Decrease dependency on the educator
2. Establish learning relationships between others
3. Define their learning needs and perspectives
4. Be responsible for their learning program, objectives, and progress
5. Contextualize what they are learning in relationship to their problems, concerns, and understanding
6. Take on more decision making by using experiences that require a choice, with varying options and perspectives of others
7. Use criteria to judge that are inclusive, self-reflexive, and involve experience
8. Be able to approach learning in a reflective and self-correcting way related to classifying, perspective taking, choosing, and habits of learning
9. Take on problem-solving including collective action, public issues, and personal problems
10. Understand they are a learner and doer, encouraging opportunities for change, taking risks, and support groups without judgement
11. Be exposed to instructional methods that are experiential, participative, and modeling, using learning contracts
12. Understand they have a full range of choices and how they can improve the quality of choosing overall (not making a specific choice)

Application of Adult and Transformative Learning Theories

Understanding that adults have different needs in the educational environment and are motivated differently than adolescents is helpful for the instructor designing curriculum. To better understand how to apply these foundational adult educational theories, a recent research study was sought out specifically in the field of engineering to allow the researcher to apply these concepts to the desired area of study. The study, conducted by Kaihlavirta, Isomöttönen, & Kärkkäinen, (2015), seeks to measure their applications of adult learning theory and the impacts on their students related to motivation and transformational learning.

The increase in unemployment in the Finnish technology and information and communication technology field beginning in 2008 brought about the need for a continuing education program. This program allowed the attainment of a master's level degree in industry-targeted fields within the span of two years. Data on student motivation and use of adult learning techniques were gathered via an ethnographic research method, wherein the researcher/author was also a participant in the continuing education program. Student feedback was gathered via interviews and direct observation by the ethnographic researcher and team.

One of the first challenges experienced in this study was a lack of understanding of how the students' motives impacted the success of the program. The enrollment was the first symptom of a potential issue, as many students dropped out of the program before finishing. The students that dropped out were contacted and listed the following reasons: full-time work prevented studying (52%), marketing of the continuing education program mismatched reality (22%), were later re-employed (9%), personal business activities (9%), and changed to a different field of study (9%) (Kaihlavirta et al., 2015). Due to the long-

term nature of this program, it is useful to understand the background of this perceived challenge.

The researchers classified students' motivation factors as either being intrinsic or extrinsic to gain a better understanding of this challenge. The main intrinsic motives were: pride to have been selected to enroll in this program, socio-emotional as evidenced by the formation of peer groups, and a lack of being able to focus on specific areas they considered useful (fixed curriculum) led to decreased intrinsic motivation (Kaihlavirta et al., 2015). The main extrinsic motives were: economic value of the degree, fear of being unemployed, professional growth, improvement of operational skills, and feeling their degree was socially valued (Kaihlavirta et al., 2015). While each educational program is unique and the foundation of this program rested in the need to reduce immediate unemployment, some of these motivating factors may be similar to other professional education programs.

The other main challenge experienced by the researchers was an unsuccessful attempt to implement transformative learning concepts. The main assignment that utilized transformative learning required the students to relate their previous work experiences to their group work in the classroom in a reflective essay. After frustration from the teachers as well as the students, the students completed the written assignment. The researchers discovered that the format of the assignment was not appropriate, the students enjoyed reflecting on their experiences through dialog during supervision sessions. While the format could be improved upon, this illustrates the difficulties with application of transformative learning concepts in the learning environment. As with any theory, the authentic application of the main concepts can be challenging and may require further testing and research to accomplish mastery.

Criticisms and Affirmations

As transformative learning has taken on new meaning since its initial development in the 1970s, some researchers have begun to criticize its definitions and phases (Newman, 2012; Nohl, 2015; Hoggan, 2016). Some of the criticisms come from the methodology under which the theory was developed and its potential limited applicability to females returning to college. Others have contested that the theory can be better described in fewer phases (Nohl, 2015; Hoggan, 2016). Another perspective is that learning is itself change and need not be described by further theories or complicated by adulthood versus childhood (Newman 2012).

The contributions of Knowles and Mezirow have stirred debates worldwide, and spurred researchers to take a closer look at how learning is defined and applied to the adult community. As a result, due attention has been paid to the variety of learners and learning environments that individuals experience. With time, theories take on and find new meaning, especially when applied across different disciplines. Some very strong parallels between the earlier foundational learning theories and newer adult learning theory can be highlighted. For example Piaget's notion that novices vary from experts in how they learn. Additionally Piaget's notions of assimilation and accommodation can be seen in Mezirow's work on transformative learning, with accommodation being more challenging.

EDUCATION FOUNDATIONAL CONVENTIONS

A summary of the main educational conventions is needed to both ensure clarity is provided on key terminology and conceptual assumptions, as well as to promote awareness of core educational theory to construction CPD professionals/trainers.

The Process of Learning

In contrast to the initial behaviorism movement, the current theory that governs what is thought to be the process of learning and has had the most profound influence on instructional design models is under the banner of constructivism and is called "information-processing" theory (Smith & Ragan, 1999, p.20). Within this theory, learning is viewed from the perspective of processes happening that are internal to the learner. The internal learning process can be divided in to steps within this theory as: (1) attention: alertness; (2) expectancy; (3) retrieval to working memory; (4) selective perception; (5) encoding: entry to long-term memory storage; (6) responding; (7) reinforcement; (8) cueing retrieval (Gagne & Driscoll, 1988, p. 128). During the encoding and entry to long-term memory step, there are different theories on how this is organized. One theory is that a schema, or representation of a generic construct, are developed and the framework and detail is added to that framework over time (Smith & Ragan, 1999, p. 21).

Instructional Design

Instructional design is the overall planning aspect of instruction. The following definition of instructional design is used as it is both comprehensive as well as includes a relevant example.

> The term instructional design refers to the systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation (Smith & Ragan, 1999 p.2).

As profession within the field of education, an instructional designer can be seen as being similar to a project manager.

> An instructional designer is somewhat like an engineer. Both plan their work based upon principles that have been successful in the past – the engineer on the laws of physics, and the designer on basic principles of instruction and learning. Both try

> to design solutions that are not only functional but also attractive of appealing to the end-user. Both the engineer and instructional designer have established problem-solving procedures that they use to guide them in making decisions about their designs (Smith & Ragan, 1999 p.2).

Instructional systems design (ISD) is the "process of designing and developing training," (Gagne & Medsker, 1996 p. 24). Metanalyses of educational literature revealed the most prominent models for instructional design are: ADDIE, ARCS, Gagne, 4C/ID, and Dick & Carey (Göksu et al., 2017). Various models of ISD are in use, with some being proprietary to a company, but most generally follow the basic ADDIE model (analyze, design, develop, implement, and evaluate). The ADDIE model was originally developed by the US Air Force as an "instructional system" that merged the management tactics from the Air Force with programmed instruction (Department of the Air Force, 1975). The model was refined by a team from Florida State University for interservice training (Branson et al.,1975).

A commonly used model, typically referred to as the "Dick and Carey model" (Dick et al., 2015), describes instructional design as a systems approach. The nine steps of this model are: (1) identify instructional goals; (2) conduct instructional analysis; (3) analyze learners and contexts; (4) write performance objectives; (5) develop assessment instruments; (6) develop instructional strategy; (7) develop and select instructional materials; (8) design and conduct formative evaluation of instruction; (9) revise instruction; and (10) design and conduct summative evaluation. Smith and Ragan (1999, p. 7) organize their instructional design model into three steps: (1) analysis; (2) strategy; and (3) evaluation.

Learning Objectives/Content Types

The goal of instruction, or learning objective, is a mostly known concept for instructors across fields. Gagné and Driscoll's (1988) learning outcome types are both comprehensive and rooted in decades of research. In this model, there are five major types of learning outcomes: (1) verbal information; (2) intellectual skill (with subtypes: discrimination, concrete concept, defined concept, rule, and higher-order rule); (3) cognitive strategy; (4) attitude; and (5) motor skill (Gagne & Driscoll, 1988, p. 61). When looking to assign a type to a specific learning outcome, it is helpful to consider the desired outcome that the learner must achieve. Key questions in the order of learning outcome are: (1) Will the learner be able to state the desired information? (2) Will the learner be able to demonstrate the application of the skill? (3) Will the learner be able to adopt a task-appropriate strategy for aiding learning or thinking? (4) Will the learner choose the intended personal action? (5) Will the student be able to execute the performance? (Gagne & Driscoll, 1988, p. 113).

Assessments

One of the most influential representations of training measurements is Kirkpatrick's four levels (Kirkpatrick, 1979; Kirkpatrick & Kirkpatrick, 2008). Level one is reaction, which includes participants overall impressions and satisfaction with the training and/or specific aspects of the training (i.e. trainer, environment, etc.) (Kirkpatrick, 1979). The second level is learning, which is limited to the "facts and techniques that were understood and absorbed" and not on –the-job use (which is measured in part by the third level). Within this level, it is important to obtain individual learning measurements in addition to objective or external measurements (Kirkpatrick, 1979). The third level is behavior, which analyzes the change in how the learners apply what they have learned on-

the-job (Kirkpatrick & Kirkpatrick, 2008). Attaining measurements from both the learner in addition to one or more of their superiors, subordinates, and/or peers will strengthen this analysis (Kirkpatrick, 1979). The fourth and last level is results, which ties in the impact of the training on the business objectives and expectations or desired results of the organization that employs the learner (Kirkpatrick & Kirkpatrick, 2008). Considered the most challenging level to assess, Kirkpatrick (1979) offers some suggested metrics: reduction of costs, reduction of turnover and absenteeism, reduction of grievances, increase in quality and quantity of production, or improved morale.

Across Kirkpatrick's (1979) four levels, measurements will be strengthened through the use of pre and post training measurements, use of a control group to compare with the experimental group, adequate time allowed after training to collect to post-training metrics, and results should be statistically analyzed.

Instructional Strategy

While there is no single correct instructional delivery model, the general parts of the delivery of instruction can be summarized as: (1) gaining attention; (2) informing the learner of the objective; (3) stimulating recall of prior learning; (4) presenting the stimulus; (5) providing learning guidance; (6) eliciting performance; (7) providing feedback; (8) assessing performance; (9) enhancing retention and transfer (Gagne & Driscoll, 1988, p. 118).

Motivation Considerations

Instilling and maintaining learner motivation are typically key concerns for instructors. Understanding the potential sources and conditions upon which motivation persists may impact how instruction is delivered. According to Gagne & Driscoll (1988,

p. 64-67), sources of motivation are: (1) curiosity, which may impact the initial instructional event as well as the selection of stimuli that are presented in a lesson; (2) achievement, which relates to the learner's perception that the training will directly impact their performance or ability to achieve a certain goal; (3) self-efficacy, which is the learner's belief that they can successfully complete a task; and (4) mental effort or the perception of the amount of effort an individual learner will need to exert. A common model that explains learner motivation is Keller's (2017) ARCS-V model. The model has been in existence since the early 1980s as ARCS and recently added the "V." Keller's model holds that the following are conditions for maximizing learner motivation: (1) attention; (2) relevance; (3) confidence; (4) satisfaction; and (5) volition. Thus, instruction must ensure these conditions are met as part of instructional design to minimize the potential for reduced learner motivation.

ADULT EDUCATION RESEARCH TESTS IN CONSTRUCTION MANAGEMENT

A literature review of published papers of tests of adult education CPD courses, modules, content, etc. was conducted using journal databases. The initial searches yielded no results, and the keywords were expanded and broadened to gain more results for review. When the terms "education" or "training" were used, most results were related to higher education (pedagogy) or content specific pedagogy. As previously indicated, the term "continuing professional development" is one of the more consistent phrases used in construction management and was included in the keywords search. The results of the

search revealed that this phrase is used in the field of education in reference teacher professional development, which is not part of this research study.

Therefore, the search was kept very broad in terms of keywords, wherein many abstracts and texts were reviewed and found to be not applicable to this research. The defining research criteria for CPD research tests were:

- A "test" our experiment was conducted, wherein construction management professionals received training
- Construction management professionals were the recipients of the training (i.e. working professionals, not students)
- The topic or subject of the training was at a managerial level (i.e. not craft/labor skills)
- Articles pertaining to teacher training, craft/labor training, or knowledge management within a company were not part of this study and were removed. Individually, these topics represent significant areas of research and have unique constraints.
- Articles pertaining to compliance and/or safety training were removed, as these are mandatory type courses and contain regulatory constraints that may dictate the training format, methods, frequency, testing, etc.

The key educational constructs were applied to the analysis of the construction CPD research tests. Constructs were identified both through the researcher's personal journey in attaining a master's degree in education and related coursework, as well as prominently cited constructs in the educational literature. Metanalyses of educational literature revealed

the most prominent models for instructional design are: ADDIE, ARCS, Gagne, 4C/ID, and Dick & Carey (Göksu et al., 2017).

The pertinent articles are summarized in Table 2 below, separated by topic/subject, learning outcome, and instructional delivery method, assessment levels, and results. A total of six CPD research tests were uncovered. With so few published research tests in CPD, a comparison is challenging and reveals further gaps.

While the literature search was not limited to a particular time period, the years of publication of these studies are all within the past eight years, with the earliest being published in 2010 and the newest in 2015. The most common topic taught was leadership (50%). The learning outcomes of all CPD research tests were at the "cognitive strategy" level. The delivery methods were quite varied, with game or simulation being the most common. Lastly, the assessment levels were reviewed using Kirkpatrick's four levels (Kirkpatrick, 1979; Kirkpatrick & Kirkpatrick, 2008) and found that mixed assessments were performed of reaction (level one) and learning (level two). Specifically, reactions and/or learning were mostly anecdotally reported, with two of the six tests providing quantified data.

Leadership development was the topic of a research test by Back et al. (2012). In this research, an Engineering Procurement Construction Management firm sought to train its employees on the topic of leadership. An oversight committee was assembled within the firm to work with an academic team to develop a training program around leadership development. The specific topics were leadership: definition, communicating vision, integrity and ethics, creating positive change, mentoring and staff development, and self-reflection. These topics represent both an intellectual skill (defined concept) and cognitive

strategy. The program was developed as an in-person interactive program, wherein workshops, case study discussions, and flip charts were used. The program was pilot-tested within the company and refinements made. Little information is provided about the participants, except that they were employees within the firm and were generally first-time managers. The assessments conducted to measure learning, immediately following training and two months after training, revealed improvements in understanding and implementation of concepts taught. However, there was insufficient information in this paper to quantify this result. While there was no learning theory that governed the instructional design or strategy, an oversight committee gave input to the participant selection as well as aspects of the setup.

Table 2

Construction Management CPD Research Tests

Reference	**Topic**	**Learning Outcome**	**Delivery Method**	**Assessment Levels**	**Results**
Back et al., 2012	Leadership	Cognitive strategy & intellectual skill	In-person workshop	Learning, some aspects of results	Insufficient information to quantify
Badger et al., 2009	Leadership	Cognitive strategy	Game	Reaction	Insufficient information to
Badger et al., 2010	Leadership	Cognitive strategy	Game	Reaction	Insufficient information to quantify
Gonzalez et al., 2015	LEAN	Cognitive strategy	Simulations	Learning	54.3% gain in confidence
Grau et al., 2012	Front end planning, contracts and project execution strategies, and project completion and team dynamics	Cognitive strategy & intellectual skill	Classroom	Learning	84% of learners had a higher concentration of understanding
Sumner & Slattery, 2010	Proposal Response to an RFQ	Cognitive strategy	Project/ simulation	Learning	Team members' satisfaction with team processes is important to team effectiveness

Badger et al. (2009) developed a project manager (PM) card game, wherein teams of four are to select the leadership actions in response to a "project from hell" project situation. Both leadership and management actions are contained within a deck of fifty-two cards, with suits that correspond to the leadership or management style category. Unbeknownst to participants, they individually select ten leadership actions. Then, they meet with their group to discuss and select the group's ten response cards. During this time, team members negotiate between themselves and often share previous experiences that shape their selections. After completed, participants, again, select ten leadership actions individually. This concept and application represent a cognitive strategy. Comparisons between individuals' selections before and after group discussion were compared and revealed that there is generally a higher tendency for PMs to select management type of actions versus leadership type. However, there was insufficient information in this paper to quantify this result.

Badger et al. (2010) created a Senior Executive Leadership Action Cards (SEMAC) and game for construction industry senior executives. The SEMAC took inspiration from the "PM Magic Deck of Leadership Action Card Game" – the objective is to help participants better understand and experience the challenging leadership environment in construction companies that their senior executives face. The game is made up of twelve different strategic dilemmas that a senior executive may face, with the action cards representing possible reactions to a dilemma (classified by type). Each individual first picks the card they think will best address the issue at hand, then decide on ten cards as a team in groups of six and discuss the consequences. (PM Magic Deck of Leadership Action

Card Game – Teams of four to five players are grouped and assigned a "project from hell" and given a deck of cards that have leadership actions. Each individual first picks ten cards they think will best address the problems with their assigned project, then decide on ten cards as a team, and finally are individually given another chance to select their individual cards). This concept and application represent a cognitive strategy. The general outcome of the game showed an emphasis of leadership type strategies selected sixty percent of the time versus management type strategies being selected forty percent of the time. There was insufficient information in this paper to quantify overall learning results.

Gonzalez, et al. (2015) developed LEBSCO, which simulates a construction project while contrasting Lean to traditional methods. The objective is to prove benefits and educate on Lean principles. The simulation has two rounds, one uses traditional planning and the other uses Lean-based planning. The goal is to build nine houses during each round with Legos, in the sequence of: flooring, level 1, level 2, and roofing. The percentage of plan completed is calculated, along with the number of houses completed. This concept and application represent a cognitive strategy. The learners reported an overall fifty-four percent increase in their understanding after the simulation.

In their research test, Grau et al. (2012) targeted fifty supervisory "nonconstruction engineers" at a large Engineering Procurement Construction firm to train on construction management concepts. The oversight committee, instructional strategy, and assessment format are similar to those used in Back et al. (2012). While the participants were quite broad engineering practitioners (electrical, instrumentation and control, piping, process, mechanical, and structural), this study warrants further attention. The topics covered in the training were grouped into three areas and the goal to promote understanding of practices

in these areas: front-end planning, contracts and project execution, and project completion and team dynamics. These topics represent both an intellectual skill (defined concept) and cognitive strategy. The training was conducted over a four-month period, with each of the three areas being taught consecutively across two to five days. Training was delivered in an offsite classroom setting, with prep material being distributed prior to the training. During the training, group workshops were conducted to allow participants to interact with engineers from other disciplines. Via a self-assessment distributed four months post training, the researchers found a statistically significant increase in knowledge.

Sumner & Slattery (2010) sought to measure the impacts of leadership effectiveness and team process on the performance of teams assembled during a nine-day leadership development institute. These measurements were taken after an RFQ simulation exercise designed by industry professionals, wherein the participants were assigned a pre-determined team role (within four different teams) and were to respond to an RFQ for design and construction management services for a recreation project. This topic represents a cognitive strategy. Using the Leadership Practices Inventory, the Team Effectiveness Critique, and the judges' assessments, the results showed a significant relationship between team effectiveness and the team's performance (as measured by the judges). There was no significant relationship between leadership characteristics and performance.

Identifying the Educational Body of Knowledge in Construction Adult Education

Understanding how educational theories impact practice is important, yet a complex undertaking as, **"**Many instructional designs are composite with respect to underlying theories of learning" (Lawton et al., 2012). As an aside, the majority of

literature on the topic of CPD was contained in six leading journals (Journal of Professional Issues in Engineering Education and Practice, the International Journal of Construction Education Research, the Journal of Construction Engineering & Management, the Journal of Engineering Education, Construction Economics, and Automation in Construction). While there is an abundance of papers on pedagogical topics and undergraduate/graduate education programs, less than one percent of papers published within these six journals since 2010 pertains to CPD research tests.

Assessment of the referenced bodies of knowledge

The references from the six uncovered research tests in adult education were compiled and reviewed to identify the body of knowledge or common sources of CPD knowledge. A total of 173 references were listed across the six CPD research tests, with an average of 29 references per paper. References were sorted by journal publication or type of publication. A total of thirty-one percent of all references were from articles in journals within the built environment (Table X). With such a small percentage of references being from journals within the built environment, it appears that the overall body of knowledge with respect to CPD (69 percent) resides outside of journals within the built environment.

With such a small sample, it is challenging to show any patterns or trends. Three main authors were cited in more than one paper: Badger et al. (2007); Badger et al. (2008); Badger et al. (2009); and Mitchell (1998). The Badger et al. (2009) reference is for the same test analyzed above, representing a reference within the construction management body of knowledge on CPD. The Mitchell (1998) reference is a text from the American Management Association, which is not a unique construction CPD reference. Further

Badger, as an author was cited the most overall, having been cited six times. There were five authors, whose works were cited more than once in a single paper. These authors wrote on the topics of: group dynamics, culture, communities of practice, leadership, and transfer of training.

Table 3

Construction CPD Tests' References in the Built Environment

No.	Journal	Frequency	Percentage of Built Environment References
1	Journal of Construction Engineering and Management	13	7.5%
2	Journal of Management in Engineering	6	3.5%
3	International Journal of Project Management	7	4.0%
4	Engineering, Construction, and Architectural Management	6	3.5%
5	Journal of Professional Issues in Engineering Education and Practice	5	2.9%
6	International Journal of Construction Education Research	4	2.3%
7	Construction Management Economics	4	2.3%
8	Journal of Engineering Education	2	1.2%
9	Leadership and Management in Engineering	2	1.2%
10	Project Management Journal	2	1.2%
11	Engineering Management Journal	2	1.2%
12	Engineering Project Organization Journal	0	0.0%
	TOTAL	**53**	**31%**

Reflection

The review and analysis of the existing literature on the topic of construction CPD revealed a small quantity of research in this field. The main areas of research and discussion under the construction CPD umbrella were: needs assessments (within a particular topic or limited to a particular geographic location); competencies and

credentials, knowledge management, use of technology and specific media, and instructional strategy. Research tests or experiments of construction CPD were sought, wherein construction management professionals received training. Articles pertaining to compliance and/or safety training were removed, as these are mandatory type courses and contain regulatory constraints that may dictate the training format, methods, frequency, and testing. A total of six research tests or experiments were uncovered. With such an absence of published research experiments, this represents an area of need in construction CPD. Considering both the need and lack of published research in construction CPD, this finding is motivating for researchers to further develop this field as it represents a significant research opportunity.

The six research experiments do provide a springboard for construction CPD research, and were analyzed further to identify the body of knowledge. The topics or content in these experiments were primarily related to leadership, and represented the instruction of cognitive strategies. The techniques used were somewhat varied between classroom instruction and games/interactions. The assessment strategies were conducted at either the reaction or the learning level, with the majority of the results being reported anecdotally. Without quantified results, the return or value of the training is unclear. Overall, these experiments would be difficult to replicate, given the overall lack of instruction design details that were disclosed.

The experiments mostly relied on multiple, external bodies of knowledge. A review of the references revealed that sixty-nine percent of their references were from publications outside the built environment. Three main authors were cited in more than one paper, with two being within the construction management body of knowledge on CPD

and the other being external. There were five authors, whose works were cited more than once in a single paper. These authors wrote on the topics of: group dynamics, culture, communities of practice, leadership, and transfer of training.

Research Implications

The field of construction CPD is underdeveloped, with only six published research experiments. The six experiments were compared using foundational education concepts and revealed diversity in instructional delivery method, low diversity in topic with most being in leadership, low diversity in learning outcome, lack of fully utilizing the spectrum of assessment variables, low visibility in reporting results and value, and limited aspects of instructional design were disclosed.

A better prepared workforce, armed with targeted CPD offerings, will result in higher performing projects and higher construction quality overall. Researchers should be motivated by the paucity of CPD experiments and seek to design more experiments for testing.

CONSTRUCTION PROJECT PRE-PLANNING

The positive impact that construction planning practices have on project success has been well documented (Gibson, et al., 2006; Lines, et al., 2014; Yates & Eskander, 2002), yet application of planning practices is highly dependent on an individual Project Manager's (PM) skill set and experiences (Globerson & Zwikael, 2002; Hurtado & Sullivan, 2014; Johansen & Wilson, 2006; Laufer & Tucker, 1987; Müller & Turner, 2007). As a construct, the term "planning" is often seen alongside the PM skill set as being a core competency, such as the Project Management Institute's PMBOK (PMI, 2000),

coupled with construction management competencies (CII, 2014), and as a deliverable within degree accreditation standards, such as a safety plan (ACCE, 2017).

There is no single, accepted definition of the term “planning” in the literature as it is inconsistently used with respect to its definition and timeframe of when it occurs within a project’s lifecycle (Laufer & Tucker, 1987; Lines et al., 2014). The term “planning” is frequently associated with “scheduling” perhaps due to the perception that among cost, schedule, and quality, schedule is the factor that managers believe they can most likely impact (Laufer & Tucker, 1987). The lack of clarity of key terminology within planning makes the design of training to provide education in this core competency a significant challenge. For the purposes of this research, some of the key planning activities a project manager will perform during the initial stages of a project are: risk identification, scope identification, and scheduling

Construction project managers are expected to be able to execute proper planning practices and may not be given the full support they need to develop this ability. Employers in the built environment expect the new workforce to be "self-directed learners" and problem solving was rated as the number two most needed skill (Bhattacharjee, Somik, Young-Corbett & Fiori, 2013). Similarly, Dowlatshahi (1996) sought to understand the needs of the professional education of professional engineers, and found that companies expressed a moderately strong demand for continuing education offerings; continuing education needs are either marginally or poorly met; and management-related interdisciplinary and cross-functional programs and subject areas are most preferred. Opfer (1992) explored the continuing education needs of the construction industry and found the preferred format of the program as being: seminars/conferences, courses, and

hands-on training. Limited literature exists in the area of outlining training needs in the built environment, with most being conducted over 20 years ago.

Reliance upon on the job experience to provide a construction professional with the abilities they need to lead and manage may no longer be enough on its own (Scott et al., 1997). In response to the need for construction CPD, both informal and formal programs have been developed. The existing informal structure has led to mixed confidence in construction CPD offerings (Kwofie, et al. 2018). In some cases, the lack of structure has produced informal and ad-hoc methods of development that are not sustainable (Cervero & Daley, 2016). Further, the impact of training in the built environment and return on investment has not been adequately measured (Madter et al., 2012).

CHAPTER 3

METHODOLOGY

The development of an andragogically-centered schema for a heuristic approach to post-collegiate development in the built environment necessitated a multi-phased approach. The methodology of this research is a phased approach as described below.

- Phase one defines the extant practices for construction continued professional development (CPD) in a targeted area of practice within the construction industry, project pre-planning.
- Phase two considers the schema that has been created for adult learning in construction, and build upon it a heuristic approach for construction CPD. The heuristic is then tested on a seminar and workshop in construction CPD in project pre-planning. Further, it will identify opportunities for expansion of this research area.

EXTANT PRACTICES FOR CONSTRUCTION CPD

In order to begin to establish the need for professional training and development within the planning competency, the expectations and realities of existing planning education and training must be measured. The goal of this research is to understand how PMs learn to plan, the extant training programs offered and their quality, and unmet training areas within this competency. The following are the driving questions: (1) How are construction professionals educated/trained to plan?; (2) Is it common for companies to provide internal training programs in construction planning to their employees?; (3) What are the results/outcomes of these company training programs in construction planning?

Data for this study were collected using a questionnaire. The questionnaire was developed through the use of expert panels and several research tests. Initially, the researchers isolated the constructs to be analyzed and developed a list of research variables. The main research variables were: general background (company and individual), educational background, how the respondent learned to plan, company planning processes, and company training programs. After the initial questionnaire draft was developed, interviews were conducted with ten different construction professionals for instrument validation. The questionnaire was then revised based on feedback and adjustments made. Finally, two research tests were conducted with samples of 10 and 20 professionals that completed the questionnaire. Adjustments to questions, scales, and formatting were made to the questionnaire before finalizing.

The questionnaire consisted of a total of five sections, with seven questions pertaining to current planning processes and practices, four questions pertaining to the contents of plans, five questions regarding training, four questions on their company's background, and six questions about the individual respondent's background. The questions used a seven-point Likert scale when possible, or were open ended. Please see Appendix A for the full questionnaire.

HEURISTIC APPROACH FOR CONSTRUCTION CPD

In response to these strong needs for research tests in construction CPD on the topic of project pre-planning, there is a corresponding need for a model to incorporate foundational educational theories, adult learning tenants, and construction industry considerations to better enable research tests in construction CPD. Prior research revealed

a gap in the amount of published research tests in construction CPD. Further, these research tests did not fully disclose the details behind the CPD event to create a body of knowledge on construction CPD instructional design. There is no model for construction CPD that considers these factors, which may be a hindrance on researchers' abilities to conduct and publish research tests.

The development of construction CPD is not an easy task and may be challenging for construction subject-matter-experts to design. Further, the measurement and documentation required for a full research study requires resources and effort to validate research and publish in peer reviewed journals. These challenges may explain some of the gap in construction CPD research.

With limited published construction CPD, a variety of content remains untested. The six construction CPD tests uncovered through the literature review primarily covered the topics of leadership, LEAN, proposal preparation, and construction fundamentals for nonconstruction engineers. The focus of this research is on planning practices. In their assessment of the quality and availability of training and development programs in the USA and Canada, Pappas (2005) found that the area of risk was rated as a "B." Further, risk is identified as part of Canada's National Training Standard in Construction Planning (Construction Sector Council, 2012).

Based on the schema developed from this research's analysis of educational foundational theories and adult education principles, a heuristic approach to construction CPD is developed. The approach is termed the Adult Construction Training (ACT) and is tested in practice on a seminar in project pre-planning. The full design using the ACT is provided. The seminar was first pilot tested on a smaller group of nine professionals as

part of a construction project management certificate program. After adjustments were made, the seminar was then tested at a symposium on 185 professionals. Results and key findings are presented.

CHAPTER 4

RESULTS

EXTANT PRACTICES FOR CONSTRUCTION CPD

Data Analysis

The target population for this data collection for continued professional development (CPD) were members of the construction industry that were presently or had previously worked for general contractors or subcontractors. Thus, a purposive sampling approach (Tongco, 2007) was taken, wherein the researchers' industry contacts were sent the questionnaire. A total of 752 individuals were sent the questionnaire. A snowball sampling approach (Atkinson & Flint, 2001) was also taken, wherein individuals were asked to share the questionnaire with their peers and other construction professionals. In addition, multiple construction industry and membership organizations were contacted and asked to share the questionnaire with their membership population.

The questionnaire was distributed and administered online. The software utilized allowed the researchers to analyze the responses and determine if they were the researchers' contacts or a result of the snowball sampling population. The survey was made available for 60 days. A total of 192 responses were received, of which 112 (58%) were part of the snowball sampling population.

Company Background

Both the background of the company and the individual responding to the survey were obtained to better understand the current environment.

The respondents were asked about their organization's primary sector of business, with a list of organization types adapted from the Association of General Contractors

Workforce Survey (AGC, 2014) and expanded upon. The results show a variety of different types of businesses, with the following being most common: hospital/higher education (12%), public building (11%), and private office (11%) (Figure 2). The sizes of the companies were also varied, from less than ten employees to over 3,000 (Figure 3). Both the respondents' company types and sizes were quite varied.

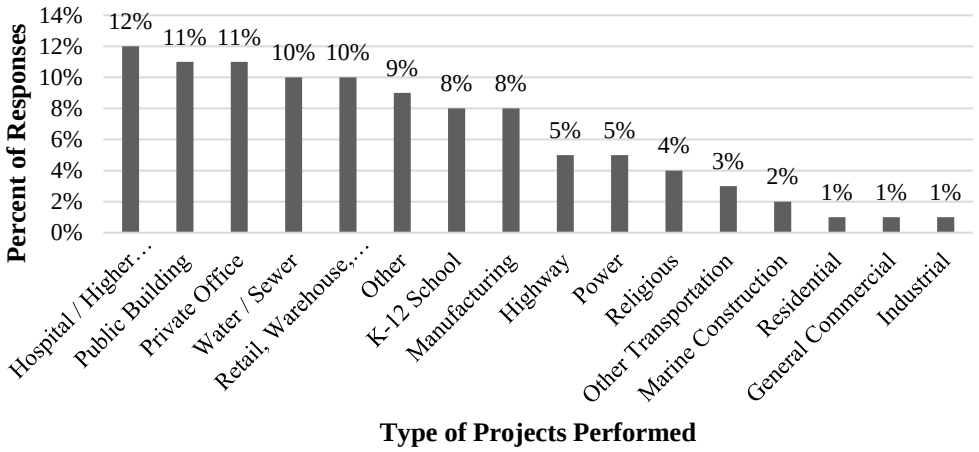

Figure 2. Type of Projects Performed By Company

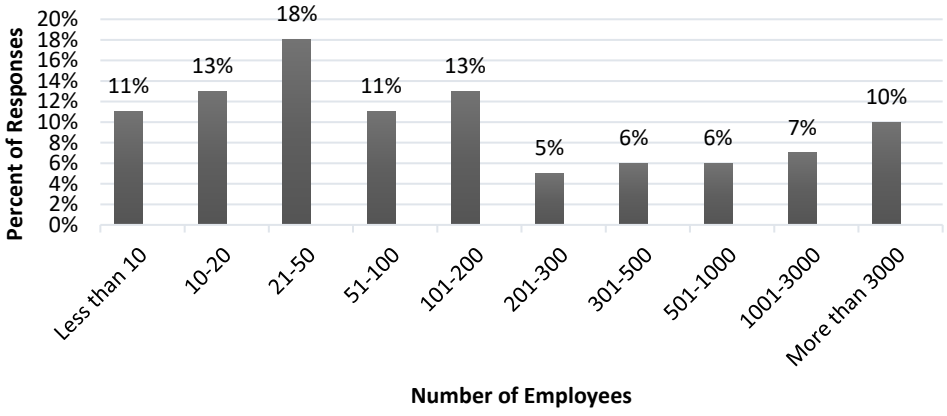

Figure 3. Size of Organization

Individual Background

At the level of the individual respondent, their professional and educational backgrounds were measured. The respondents were asked about their role in their company, with a list of roles adapted from the Association of General Contractors Workforce Survey (AGC, 2014) and expanded upon. Most respondents were at the senior level or PM level (Table 4). The number of years of professional construction experience were also varied, with the average being 21 years (Table 5).

Taking a closer look at the educational background of the respondents, there are varying levels of education among the respondents. More than half (67%) of the respondents have a bachelor's or master's degree, while 16 percent have attended some college and 16 percent have not achieved post-secondary education (Table 6). To get a better understanding of their previous education, a list of fields of study was compiled from the U.S. Census Bureau (Siebens & Ryan, 2009) and expanded upon. Respondents were asked to indicate the field of their highest level of education attained. Considering the fields that are most pertinent to construction (engineering and construction management, and architecture), thirty-eight percent of respondents had a bachelor's, master's or PhD in these fields.

Table 4

Role in Company

Current Role	%	Count
Project Manager	31%	58
President/Senior Executive	26%	48
Other	15%	28
Business Development	11%	21
Owner/Developer	9%	17
Preconstruction Manager	4%	7
Site Superintendent	2%	3
Designer/Engineer	2%	3
Field Engineer	1%	1
Total	**100%**	**186**

Table 5

Years of Experience

Years	%	Count
0-2	5%	9
3-5	10%	17
6-10	10%	17
11-15	10%	18
16-20	21%	38
21-25	8%	15
More than 25	36%	63
Total	100%	177

Table 6

Generational Affiliation

Generation	%	Count
Traditionalist (born prior to 1946)	1%	1
Baby Boomer (born 1946 - 1964)	39%	72
Generation X (born 1965 - 1978)	38%	71
Generation Y (born 1979 – 1997)	22%	40
Generation Z (born 1998 - present)	1%	2
Total	**100%**	**186**

Table 7

Highest Level of Education Attained

Answer	%	Count
Bachelor's degree	50%	94
Master's degree	17%	32
Some college, no degree	16%	30
High school graduate, not college	7%	13
Associate's degree	5%	9
Vocational degree	4%	7
Less than a high school diploma	1%	1
PhD or Other Doctorate	1%	1
Total	**100%**	**187**

Table 8

Field of Highest Level of Education Attained

Answer	%	Count
Engineering & Construction	49%	86
Management Business	25%	45
Other	8%	15
Arts & Humanities	5%	9
Architecture	5%	8
Science	5%	8
Education	2%	4
Social Science	1%	2
Total	**100%**	**177**

As 32 percent of respondents did not achieve a college degree, the certificates and credentials that respondents had already attained helped to characterize industry training achieved. A total of 70 respondents (36%) listed over 29 different types of credentials/certificates they had attained, with an average of 2 credentials per individual. Many of these certificates were unique and mentioned only once. To analyze the commonalities, a frequency table was created to better assist with understanding the various types, please see Appendix B for the full list. The most common credentials were Leadership in Energy and Environmental Design (LEED) (12%) and OSHA (10%) (Table 9).

Table 9

Top 10 Certificates & Credentials Attained

Certificate/Credential	**%**	**Count**
Leadership in Energy and Environmental Design(LEED)	12%	14
OSHA	10%	11
Company Specific	9%	10
Software	9%	10
Misc.	8%	9
Registered Engineer	5%	6
Trade	5%	6
Project Management Professional (PMP)	5%	6
Licensed Architect (AIA)	4%	5
Certified Professional Constructor(CPC)	4%	4

Planning Education/Training

The interviews and research tests offered some interesting initial results that were indicative of the overall responses. A common theme among the PMs in the interviews and research tests was the individuals' perception that effective PMs either: already possess

the skills and experience to effectively plan projects based on their on-the-job training or have a desire to learn and seek out opportunities to learn effective methods. In this way, planning can be seen more as a skill that is left up to the individual to learn. Further, there was a concern that any training methods beyond on-the-job would jeopardize a PM's time to execute their work, thereby impacting the company. On-the-job is seen as the current accepted approach, and the only approach for some companies.

Survey respondents were asked to indicate how they learned to plan, with options ranging from formal (programs) to informal (on the job). Results showed that the majority of respondents attained training in planning from on the job experience (51%), with others attending an internal company training program (18%) (Table 10).

Of those that selected an external seminar/workshop/conference, only 11 (27%) listed the names of the sessions. There were no commonalities among the sessions and included the following organizations: CII, SMACNA listed twice, FMI, ACE PM Certificate Program, PMI, AGC, DIRTT, Lemonade Stand by Maxim Consulting, , FMI – Greg Schoppman, and Best Value. While many of these organizations provide training in different aspects of management, respondents did not indicate what specific course/workshop/seminar they obtained training in planning.

Understanding that not all companies can provide internal training in planning, respondents were asked about their specific company. First, respondents were asked if their company provided internal training in planning. Results showed that 54 percent of companies provide this type of training, while 40 percent do not and 6 percent are unsure. To better understand the success of these programs, respondents were asked to rate their

satisfaction. Of those that had company training programs, 26 percent of employees were very satisfied and 56 percent were somewhat satisfied with their programs (Figure 4).

Table 10

How Learned to Plan

Training Method	**%**	**Count**
On the job (i.e. experience)	51%	163
An internal company training program	18%	57
An external seminar/workshop/conference. Please list the name(s) if you recall.	13%	41
A class taken during my master's degree	10%	32
A class taken during my bachelor's degree	5%	16
A class taken at a Community college/vocational school	3%	10
Other	0%	0
Total	**100%**	**319**

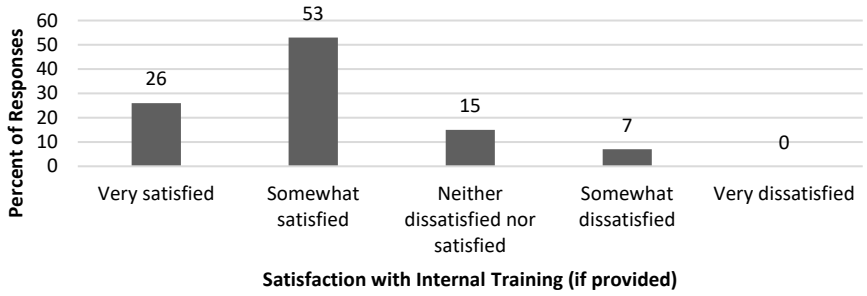

Figure 4. Satisfaction with Organization's Training/Education in Planning

Future Education/Training

Understanding that training needs may be varied, respondents were asked what topics they were interested in obtaining more training. A total of 65 respondents (46%) listed over thirty-three different types of topics of interest for future training, with an average of two topics per individual. Many of these training topics were unique and mentioned only once. The number of unique topics illustrates how broad the industry

defines the area of project planning. To analyze the commonalities, a frequency table was created to better assist with understanding the various types. The top ten most common training topics of interest were scheduling (15%) and general business/construction management concepts (10%) (Table 8). The topic of scheduling being the most common suggests that the industry continues to associate the term "planning" with "scheduling." The full 33 topics are included in Appendix C. These topics can be used to identify competencies that the industry considers as part of planning and need to be addressed in construction CPD.

Table 11

Top Ten Training Topics of Most Interest

Training Topic	**%**	**Count**
Scheduling	15%	15
General business/Construction management concepts	10%	10
Cost	8%	8
Software	7%	7
Communication	5%	5
LEAN	4%	4
Resource allocation - time, money, and labor/materials	4%	4
Risk	4%	4
Safety	4%	4
Developing Company Processes	3%	3

Comparing the format that most respondents attained training in planning with their preferred format reveals some interesting differences. The most common method for attaining training was on the job (50%), whereas this was only the second most preferred method of interest for future training (28%) (Figure 5).

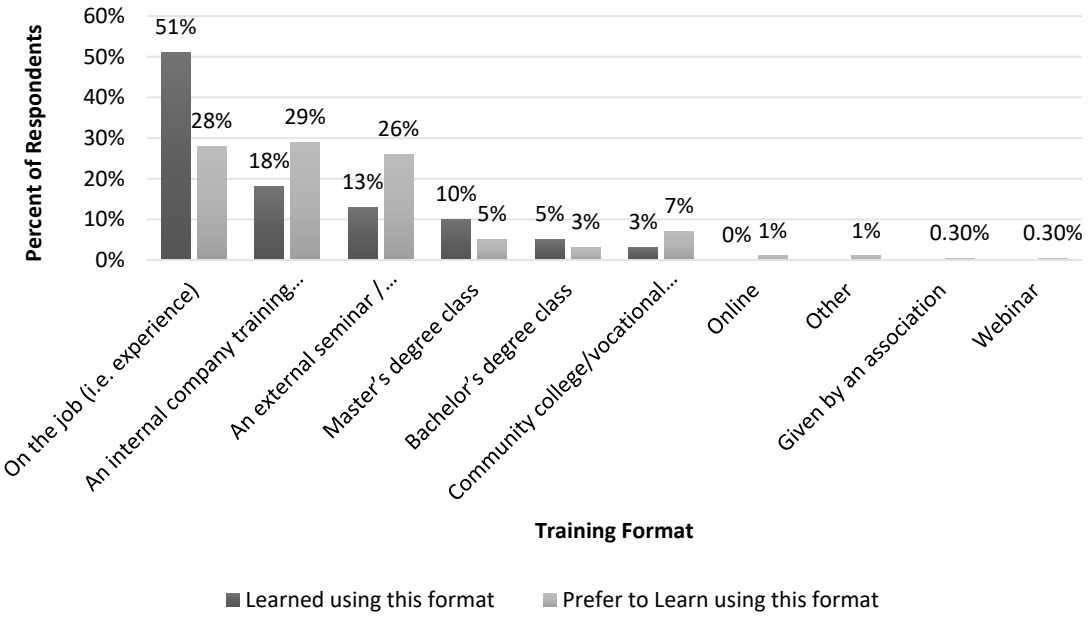

Figure 5. How Learned to Plan versus Preferred Training Format

Additional questions were asked about organizations' planning processes using a 7-point Likert scale. Respondents rated their satisfaction with their organization's internal planning processes, 59 percent of respondents were extremely or moderately satisfied (average rating of 5.27). When asked to rate the formality of their organization's internal planning processes, 43 percent of respondents strongly agreed or agreed that their organization's planning process was written and provides guidelines that everyone must follow.

Statistical Analyses

A Mann-Whitney U test was conducted to identify whether companies with internal training programs in planning had higher employee satisfaction with the company's internal planning process. The mean satisfaction rank of those who provided company training (mean rank = 97.14) was 77 percent higher than those who did not (mean rank =

54.87), U = 1441, p <.000. Organizations with internal training programs have higher employee satisfaction with their organization's planning process.

A Mann-Whitney U test was also conducted to identify whether companies with internal training programs in planning rated their company's internal planning process as being formal. The mean rank was 55 percent higher for those who provided company training (mean rank = 78.74) than those who did not (mean rank = 50.95), U = 1269.5, p <.000. Organizations with internal training programs are seen as having a more formal internal organizational planning process.

An independent sample Kruskal Wallis test was performed to identify whether the number of ways in which an individual learned to plan was affected by their role in the company, years of experience, highest level of education, field of highest level of education, and generational affiliation. This method was used to account for the non-parametric nature of the data. The results indicated that the number of ways in which the respondents learned to plan varied across different categories of their highest level of education attained (p = 0.039). Future research should be conducted to understand how field of highest education may impact training format and effectiveness.

The analysis revealed no significant differences in the number of ways an individual learned to plan across roles, years of experience, highest level of education or generational affiliation.

Discussion

At a very basic level, attaining the educational backgrounds of the respondents showed quite a varied picture of construction professionals. For example, 32 percent of respondents did not achieve a college degree and 59 percent of educated fields represented

had the potential of addressing planning competencies in construction management. Those with education in fields outside of the built environment tended to attain training in planning in multiple formats. These results indicate that professionals in construction management have varying backgrounds and are reliant upon other means of getting training in planning beyond the classroom.

Professionals must decide where to attain training or enhance their planning capability. The results show that less than 16 percent of professionals were trained to plan using their preferred method(s) of training. The majority of professionals achieve training via on-the-job experience (51%) or internal company training programs (18%). Extant training in planning is not meeting the expectations of the professionals it seeks to serve.

Internal company training is a format that is seeing good results, although less than 54 percent of companies provide this. Organizations with internal training programs have higher employee satisfaction with their organization's planning process. Further, organizations with internal training programs are seen as having a more formal internal planning process. High quality and formal internal planning processes within organizations has a positive impact on internal training provided by the organization.

Motivations for Heuristic Approach

Planning is a core skill set within the field of construction and project management. Definitions of the term "planning" vary quite broadly across the built environment, making it challenging to isolate specific planning competencies. Understanding how planning skills are learned by PMs is critical to addressing the attainment or accomplishment of planning skills and the ability of a PM to "plan" effectively.

The gap in construction professional education on the topic of planning competencies has not been addressed in the literature. The results indicate that construction professionals attain training in a variety of formats, yet the formats are not meeting their expectations. Internal company training programs are having good results in terms of trainee satisfaction and planning processes. Further investigation into successful companies' training strategies is needed.

Researchers and professionals alike can use the results of this research to better understand the gap in the planning competency. Further, the results aid in the development of education and training programs that seek to address planning. The survey used in this research can also be used to address training needs across companies within the built environment, not just contractors. Companies should better assess their internal training programs, to ensure they are beneficial to their employees' development, as many programs are poorly rated by professionals.

Future research must be developed to understand how to design training programs in planning that address the needs outlined. With extant programs being poorly rated, a new approach is needed in the training of professionals in planning.

HEURISTIC APPROACH FOR CONSTRUCTION CPD

Decades, and even centuries, of research in psychology, sociology, philosophy, and education have produced foundational models that cover what is believed to be how people learn, the key events of instruction, and learner motivation, which have been briefly summarized in the literature reviews. None of these models account for the unique considerations of construction professionals as adult learners as well as factors that are

unique to the construction industry. The Adult Construction Training (ACT) Approach or Model is developed, not to recreate the foundational works, but to build a model that accounts for construction CPD. The ACT Model's development was based upon the advancement of a schema for educational research and adult education theories described in the previous chapters. The ACT Model is meant to assist instructional designers and instructors in construction CPD in considering the unique aspects of adults/professionals as learners as well as the challenges the construction industry places on the design, execution, and evaluation of CPD. The ACT Model is structured similar to the delivery of a project, with scope and personnel factors (learner constraints and content constraints) as inputs, and the design stage, execution stage, and evaluation stage as the main process with a feedback loop where results help to refine future training design and execution (Figure 6).

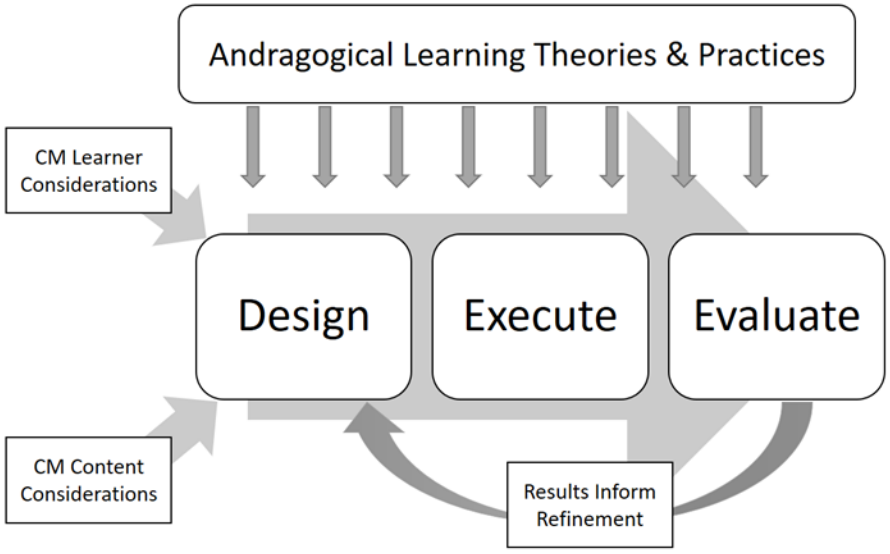

Figure 6. ACT Visual Representation

Using the ACT visual representation, the educational constructs and adult education principles can be overlaid. The adult educational principles were grounded in

the works of Malcom Knowles (1972; 1989), Jack Mezirow (1981), and Donald Kirkpatrick (1979; 2008). The construction industry considerations are explained in the following sections. To be effective as a heuristic, the model is tested on a construction CPD seminar and workshop and that test is also placed within the ACT Model. The resultant ACT heuristic can be used by designers and instructors in construction CPD to inform the design and delivery of construction CPD. The full ACT Model and the application of the ACT to the research test explained in the following sections are represented in Figure 7.

Learner and Content Considerations
Questions to Consider for Adult Learners
• What is the average participant's need for this skill/topic? • Has the need for the instruction been empirically measured? • What have been the learners' previous experiences and learning on this topic? • How relevant is the topic of the instruction to the industry? • How important is the topic/skill to the learners? • What is the benefit to the individual learner of attaining training in this skill/topic?
Construction Industry Considerations
• To better understand the participants' backgrounds, a pre-training event survey is suggested that contains questions pertaining to the learners' highest educational attainment, field of education, credentials/certificates, current job role, and type of company working for, at a minimum. • The instructor considers the potentially conflicting objectives and adversarial experiences across construction industry stakeholders (i.e. owner, contractor, designer, etc.) and seeks to unify these sentiments to produce a positive learning environment. • Relevance, importance, and benefits are measured in the pre-training survey. A general industry advisory panel or targeted practitioner committee can be assembled and used to measure these aspects as well.
Application to this Research Test
• The seminar was offered to members of a professional association. Individuals elected to attend, based upon the advertisements and perception of return on investment with registration cost. • The professional association identified the topic among a list of others as being relevant, important, and beneficial to their members.

- The attendance was not limited to a particular project stakeholder group, as the association has a mix of owner, contractor, and designer membership.
- Via a pre-training event survey, demographics were collected on participants prior to workshop to inform the presenters and facilitators, and make any refinements to the content.
- The group of facilitators served as the informal practitioner committee and reviewed the initial concepts and topics to be instructed.

Design

Questions to Consider for Adult Learners

- What skills/knowledge are intended to be taught?
- How complex will these skills be to the average participant?
- How new will these skills be to the average participant?
- How does the topic relate to learners' daily tasks/common situations?
- How will real-world or job-specific problems versus general topics be incorporated into the curriculum?
- How will the learner be able to share with others their point of view and what they are learning?
- How will the learner be held accountable and responsible for their learning?
- How will the learner be able to place what they learn within the context of their own problems, concerns, and understanding?
- When presented with different scenarios, how will the learner be prompted to choose and take on multiple perspectives?
- How will the learner be prompted to reflect and use their previous experiences to make decisions and judge?
- How will the instructor ensure the learner is confident to change and does not feel judged?
- How will the learner understand the variety of choices they can make and how to improve decision-making?
- What instructional media/technology is appropriate?

Construction Industry Considerations

- Frame content to be learned in reference to common challenges encountered on construction projects that participants can relate to.
- Consider the use of team exercises within groups that closely resemble the project team for a construction project (i.e. owner/end user, authorities, sub-disciplines, and designer).
- Select examples and team exercises that learners can relate to. Ask participants to consider multiple perspectives of construction project stakeholders, and determine if their response or thinking would be different under this perspective.
- Integrate challenges faced by construction projects, without identifying the solution. Ask learners if they have ever encountered a similar problem/decision to help them reflect.

- As construction projects involve the balancing of stakeholder expectations, use multiple perspectives of typical project stakeholders when describing alternatives.
- Consider how learning the topic is beneficial to multiple construction project stakeholders, overall project success, and meeting the customer's needs.

Application to this Research Test

- The term "participant" is intentionally used in any documentation and communication.
- The initial seminar began with placing the topic within the challenges of construction projects and how it contributes to low performance.
- A team exercise/workshop is created using a scenario that represents a service that any stakeholder in a construction project team could understand, while not having unnecessary complexities that detract learners from the purpose.
- The group of facilitators served as the informal practitioner committee and reviewed the draft workshop during design.
- The workshop was conducted in teams that represented a similar distribution of project stakeholders to enable multiple perspectives. Facilitators monitored discussions to ensure adversarial topics were addressed cordially.
- Through the workshop scenario scope of services and the team environment used, sharing of experiences is part of the task the teams have to complete the workshop.
- In the seminar, practical examples are presented and participant feedback is solicited. The workshop scenario scope of service is another useful example and point of view of a service.

Execution

Questions to Consider for Adult Learners

- How will the instructor refer to the learners and avoid using the term "student"?
- Is the environment welcoming and not dominated by the appearance that the instructor is the subject matter expert?
- Is the environment welcoming of feedback to improve the course/program?
- What will be done if the approach to getting learners to share with others is not working as intended?
- Is the instructor able to engage learners to choose and take on multiple perspectives? If not, can something be adapted without minimizing the exercise?
- Is the instructional media selected being effective in enhancing the instruction? If not, can something be adapted without minimizing the instruction?

Construction Industry Considerations

- In lieu of the term “student,” the instructor can use the construction industry stakeholder terms (i.e. owner, contractor, designer, etc.), when needed and otherwise use terms such as: participants, team members, etc.
- The delivery of the instruction creates an environment that construction professionals can connect and relate, such as a construction project.

- The instructor should moderate the overall tone of sharing and giving feedback, to ensure it is not heavily weighted for or against any one key construction stakeholder to minimize adversity.
- The physical layout of the room or location should be open and allow participants to walk around to be able to share. If the instruction is held at a construction jobsite, some room modifications may be needed

Application to this Research Test

- Initially, there was a single instructor, then participants worked within their smaller groups, with multiple facilitators guiding them through their team exercise.
- Due to the size of the seminar, it would not be possible to maintain the integrity of the workshop in such a large group setting. The learners worked with their teams in smaller rooms.
- Continuous improvement suggestions were solicited during the debriefing session and facilitators shared their thoughts after the seminar

Evaluation

Questions to Consider for Adult Learners

- How will it be determined/measured that the participants have obtained the skills/knowledge intended to be taught?
- How will it be determined/measured that the participants have obtained the skills/knowledge intended to be taught?-How will learners' satisfaction with the training be measured?
- How will it be determined/measured that the participants are using the skills/knowledge in their jobs?
- How will any benefits that the company experiences from the learner and their learning be measured?

Construction Industry Considerations

- Incorporate feedback from multiple project stakeholders for a balanced perspective.
- Consider measuring the applications of the skills/knowledge on a construction project versus at work, generally.
- As projects are executed in a dynamic team environment, consider the impact of the project team on the learner's ability to apply their learning.
- Use the company's performance appraisal process as a potential means to identify company benefits.

Application to this Research Test

- Application of the skills was measured via the team submissions from the workshop.
- A learner satisfaction questionnaire was used as part of the pilot testing process for the workshop.
- A facilitator/observer role was created, which required two to three people to observe each team and assess the team's effectiveness and overall performance as a team.

Figure 7. The Adult Construction Training Model

Construction CPD Test

To fully test the ACT Model, a construction CPD test was created with the goal of teaching construction professionals how to approach and think about construction project planning. The workshop's development is described in terms of the ACT Model in the following sections.

Learner Considerations

The learner considerations stage includes analysis of aspects that are specific to the targeted learners for the instructional event. For construction CPD, this should include both the unique aspects of the construction industry, construction industry professionals, as well as aspects of adults as learners (versus adolescents). The working environment is the target where instructors hope learners will apply what they have learned. As a majority of the built environment is centered on the delivery of projects, the project team unit is part of learner considerations. As defined by PMI, "A project is a temporary endeavor undertaken to create a unique product, service, or result" (2008). Projects can be quite varied in scope, location, and other constraints, further contributing to their uniqueness.

The members of a project team are typically quite varied. The typical stakeholders, contractor, owner, designer, and subcontractors, represent different perspectives, which can cause tension on projects. Team integration is needed to change adversarial relationships in construction projects (Cowan et al., 2001; Kumaraswamy et al., 2005). Due to the varied time frame and frequency of projects, individual project team members may change over time, across projects, and across groups. When possible, CPD should be conducted in groups that face the similar challenges confronted within project teams (i.e. changing team members and variety of perspectives). Professionals in the construction

industry perform quite diverse roles, from physical labor to executive leadership. For example, young professionals have different considerations versus more career-advanced professionals; Project Managers versus site superintendents; etc. The dynamic nature of projects and the industry places unique challenges on designing construction CPD that need to be considered as part of the development of workshops and seminars.

Content Considerations

The content considerations stage involves analysis of the factors related to the specific material or topic that will be instructed. For construction CPD, this is related to the material and industry application of that material to be considered. For example, learning about critical path scheduling is different from learning how to operate a crane; introductory content will have different considerations versus more advanced content. Learning outcomes can be used to assess the type of content (Gagné & Medsker, 1996). The analysis of potential prerequisite skills or related topics that the learner would need to know or have completed is important at this stage. Further, learning levels can be used to assess the depth of instruction as being beginner, intermediate, or advanced or can be viewed using other models, such as Bloom's taxonomy. One benefit of Bloom's taxonomy is that it helps instructors to think in terms of behaviors that the learners are expected to be able to do as a result of the instruction (Adams, 2015).

Design

The design of instruction stage involves the creation of the instructional materials, creation of learning objectives, selection of an instructional strategy, selection of a delivery method, and creation of assessments. For construction CPD, some of the driving factors of design tend to be uncovered in learner considerations and content considerations. For

example, training site superintendents that may not be comfortable sitting for longer periods of time might have a different design than training estimators to use a quantity takeoff software on their computers. As another example, the design aspects of instruction for how to create a work breakdown structure for Project Managers, is very different from the design of instruction for how to use a virtual design software package for designers. The training and job environments of the learners may also dictate a majority of the design decisions. For example, if the training is to be conducted at a job site, there may be limits on the physical setup of the room and technology available, which may eliminate the possibility to use media or technology requiring internet.

Adult learning principles that apply to the design stage are important. Mezirow (1981) and Knowles' (1972; 1989) focus on design stems from the need to ensure learning is collaborative, relevant, and draws upon existing experiences. The learners must also feel a sense of self-direction and autonomy, as opposed to the pedagogical view of seeing the instructor as the expert.

Execute

The execution stage is where the actual instruction occurs. Delivery of instruction is intended to be aligned to how the instruction was designed in the previous stage. The instructor and the learning environment both play important roles in the execution stage. The instructor is tasked with delivering the instruction as designed, and, if needed, making adjustments to the execution to maintain the integrity of the design intent and desired outcomes.

Evaluate

To be effective, learning assessments should be designed in the design stage. The evaluation stage addresses where learning assessments are performed. A variety of assessments can be conducted, each with potentially different results depending on when they are conducted. Beyond the fundamental aspects of evaluation, industry observer assessments to judge what is practiced and any team processes was identified as an area of needed construction CPD testing (Sumner and Slattery, 2010). Further, comparison of CPD workshops or participants' results with industry applications of the same model was also identified as an area needing research (Sumner and Slattery, 2010).

Test Background

The seminar was designed to teach construction professionals how to approach and think about construction project planning, specifically the identification of potential issues prior to the beginning of the work and the start of a contract. Prior to contracting, the definition of the scope of services and/or the project is a critical factor that is related to project success, but is often poorly defined (Gibson et al., 1995; Gibson et al., 2006). As a result, projects that are poorly defined are still contracted and success is left to chance or the assigned project manager's capability.

One of the skills needed for this type of "planning" is the ability to identify potential future issues in the future execution of a service by reviewing that particular scope of work and drawing upon previous experiences. The researcher defines the issues as "risks" or "challenges." After the identification of these potential issues, potential solutions should be offered. Further, those items that may not necessarily represent an issue, rather an opportunity to truly meet the intent of the scope of work, should be outlined. These types of added items are referred to by the researcher as "value added" items. Value added items

may impact the financial, timing, and quality constraints set forth in the scope of work (i.e. additional scope of work that was missed or vaguely described, means to provide faster service at an additional cost, etc.), but represent a more accurate conception of the intended scope of work than what was described by the owner.

Structure

The seminar begins with a forty-five minute presentation that introduces the industry challenges and motivations for learning about this topic. The presentation also places this topic into the broader picture of the construction project lifecycle. A variety of good and bad examples of this topic applied within construction projects are discussed. Participants are asked to compare good and bad examples, explaining the characteristics of each.

At this time or before, learners are grouped into cross-functional stakeholder teams (with a mix of owner, designer, contractor, and subcontractor roles). This is done to ensure the exercise and learning takes place in an environment that is similar to the learners' typical construction workplace. Individuals are given a booklet that has the necessary materials to begin the workshop. After that, the seminar transitions to a group application or workshop, wherein the scope of a service is introduced that learners must respond to within their teams as if they were preparing a risk and value added assessment as the service provider. Teams typically consist of three to five people.

The scope was selected due to its ability to represent a service that any stakeholder in a construction project team could understand, while not having unnecessary complexities that detract learners from the purpose. Cognitive load, "the capacity of the brain to hold new information and concepts in mind while processing them and fitting them

into the body of knowledge already in permanent memory," (Dick et al., 2015) was also a motivating reason behind the selection of this scope. The scenario is to provide a laundry and linen service for a single family home in the southwest. The scope was written at a high-level to give participants a level of uncertainty and ability to apply the topic previously instructed. See Appendix E for the seminar booklets and further scope of the service. Within this service, learners are to identify the potential issues they may face as a provider of this service, given the specific scope of work described in their booklet.

The workshop portion of the seminar is divided into four different slots, with worksheets in the booklets that the team is to complete. The first slot, which is typically ten to fifteen minutes, gives the team time to discuss the potential risks and create a team list. The second slot, which is typically ten to fifteen minutes, is for the team to generate potential solutions or mitigation steps. A third slot is given to create value added options, which is ten to fifteen minutes as well. The final five to ten minute slot is for teams to identify items that are needed from the owner to mitigate these items and ensure a successful service execution. During these slots, there is much discussion and interactions amongst team members, given the variety of types of stakeholders within each team.

A debriefing session is held after the teams have completed their worksheets to review team responses, provide feedback, and allow learners to share what they learned through this seminar. Responses from previous tests of this workshop are also distributed to the learners to enhance their learning (see Appendix F).

Pilot Testing

The seminar was tested on a smaller group of nine professionals as part of a construction project management certificate program, conducted by university professors.

The purpose of this pilot test was to assess learners' reactions to the delivery and usefulness of the content. The pilot test assessments were conducted at the end of the 120-minute seminar. The response rate on the assessments was one hundred percent and responses indicated extremely satisfied scores with the organization, presentation, and content of the workshop (Table 12). With ninety percent indicating they would recommend this seminar to others, the researchers considered the topic appropriate and relevant. As another contribution to the value of the seminar and learner results, two individuals contacted the research team three weeks after the seminar to get copies of the presentation material because they wanted to share the topic with their co-workers.

Table 12

Seminar Results – Pilot Test

No.	Question	Unit*	Average
1	The workshop was well organized.	(1-10)	10.0
2	The workshop helped me to be able to generate project risks.	(1-10)	9.3
3	The workshop helped me to be able to generate risk solutions/mitigation steps.	(1-10)	9.3
4	The workshop helped me to create value added options.	(1-10)	9.3
5	The material presented was pertinent to my needs and interests.	(1-10)	9.3
6	Overall satisfaction of the leader.	(1-10)	10.0
7	Overall satisfaction of the workshop.	(1-10)	9.7
8	How likely are you to recommend this workshop to others?	Very likely / Not likely	90% = Very 10% = neutral

*The unit was 1-10, with a "10" meaning strongly agree or extremely satisfied and a "1" meaning strongly disagree or extremely dissatisfied

Enhancements Made to the Seminar

As part of the pilot testing evaluation, the researchers reviewed potential enhancements to the seminar. One key enhancement identified is the use of observers or

facilitators that can measure team effectiveness and performance, beyond the worksheet responses. While the teams are working, facilitators would be assigned to a predetermined number of teams to observe the team and conduct an assessment (Table 13). This assessment could then be compared to their worksheet responses and better understanding of team-based performance and potential transfer of learning to the working environments of the participants could be measured. Feedback and assessments from external sources is also an area of suggested future research in construction CPD tests (Grau et al, 2012; Sumner & Slattery, 2010).

Table 13

Team Performance: Facilitator Rubric

No.	Criteria	Scale
1	A single leader emerged.	
2	All group members engaged equally in discussions.	
3	All group members seemed to have a positive team experience.	"1" = strongly disagree: "5" = strongly agree
4	The group experienced conflicts or differences among the members.	
5	The group was efficient with their time and didn't spend time multi-tasking on their cell phones, computers, etc.	
6	The group divided the work up among individuals and did not work together.	
7	Your overall rating of how well the team performed	"1" = low & "5" = high

Additional enhancements identified pertained to collecting additional levels of assessments. The first additional assessment would be prior to the seminar, and ask specific demographic types of questions (i.e. number of years of experience, educational background, etc.). While this information was obtained during the execution of the pilot test across the nine participants, pre-surveys would be useful if this seminar would be

conducted with a larger audience to ensure a proper understanding of all learners and any potential adjustments to the content are made prior to execution. Additionally, the researchers identified that assessments conducted after a longer period after the seminar would be beneficial to measuring the overall results level (Kirkpatrick & Kirkpatrick, 2008).

Research Test

A professional association requested the seminar for their annual symposium. The professional association's mission is best described on their website as, "The movement for better project delivery and enhanced collaborative process can only happen with professionals like yourself joining others of the same caliber to practice those essential tools and find the path to the future of the built environment." The intent of the seminar was to provide their members with training and continue to gain momentum around the movement to develop high-performing teams within these members' organizations. The full agenda of the symposium is provided in Appendix D.

As discussed in previous sections, the methodology followed the design of the seminar, with some enhancements identified in the pilot tests. The professional association sponsoring this seminar did not allow all of the enhancements and suggested some further enhancements. The pre-assessment was allowed to gather basic demographic information, the post-seminar assessment was not permitted, and the facilitators were permitted but the professional association selected the individuals.

Pre-Survey Results

A survey was distributed to all registered attendees of the seminar, which included demographic information. The main questions asked are listed in Appendix G. The survey responses were used to inform the overall workshop structure.

Current Organization and Experience

Participants were asked about the type of organization where they currently work. A large portion of respondents (72%) were from either design/engineering firms (37%) or client/owner organizations (35%) (Figure 8).

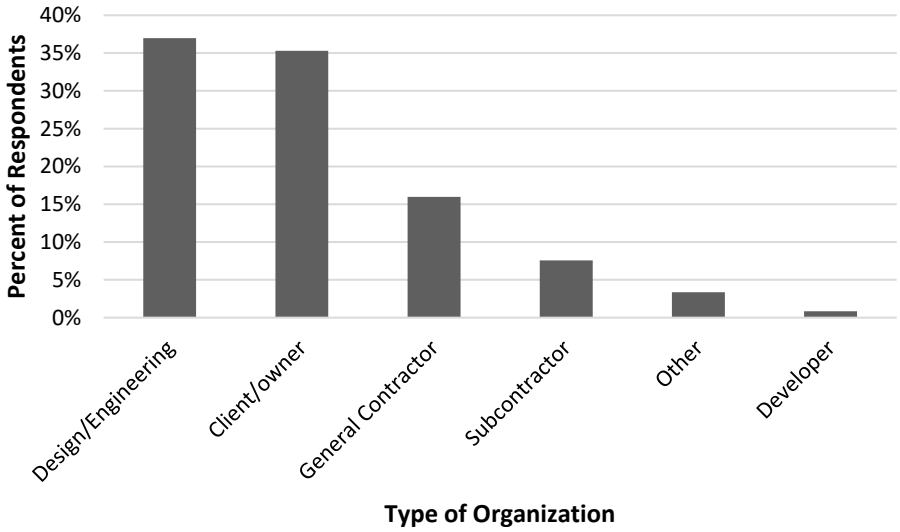

Figure 8. Type of Organization Where Currently Working

Additionally, participants were asked to indicate their current role within their organization. Surprisingly, the top two roles were: project manager (51%) and President/Senior Executive (15%). The frequencies of each role are in Figure 9.

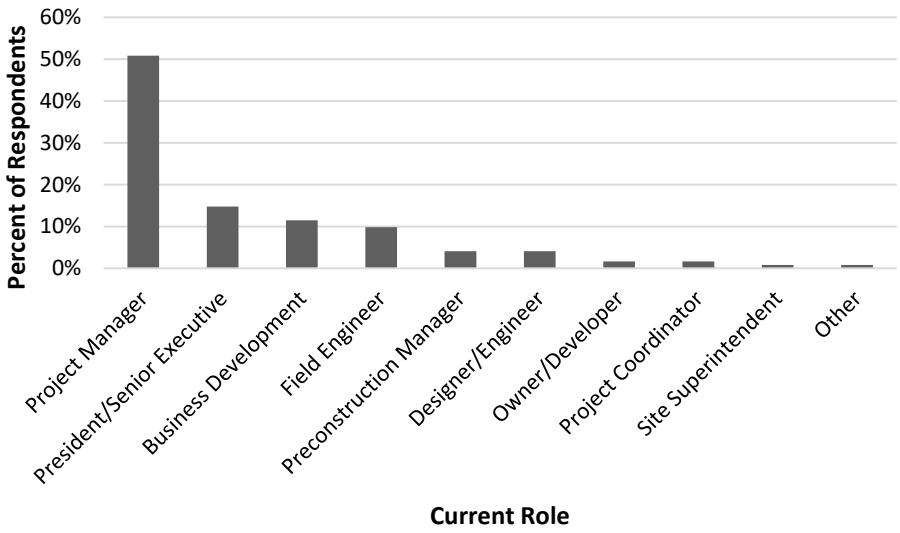

Figure 9. Current Role at Organization

Participants were asked how many years they were employed at their current organization, with the average being eight years, and the range being one to thirty-one years. Forty percent of participants had between less than one year and three years of experience at their current organization. Additionally, participants were asked how many years of professional experience they had in the architecture/engineering/construction (A/E/C) industry, with the average being nineteen years, and the range being zero to forty years. Forty-two percent had eleven to twenty years of A/E/C experience

Education

Multiple questions were asked on the topic of education and training. Participants were asked to indicate their highest level of education, with a large majority having a bachelor's degree (71%) and a master's degree (20%). No responses were received for "less than a high school diploma" or "high school graduate, not college" and were removed (Table 14).

Table 14

Highest Level of Education Attained

Level of Education	**%**
Bachelor's degree	71%
Master's degree	20%
Some college, no degree	4%
Associate's degree	4%
PhD or Other Doctorate	2%

When asked what was the field they had attained their highest level of education, Architecture (36%), Construction Management (19%), and engineering (19%) were the most common.

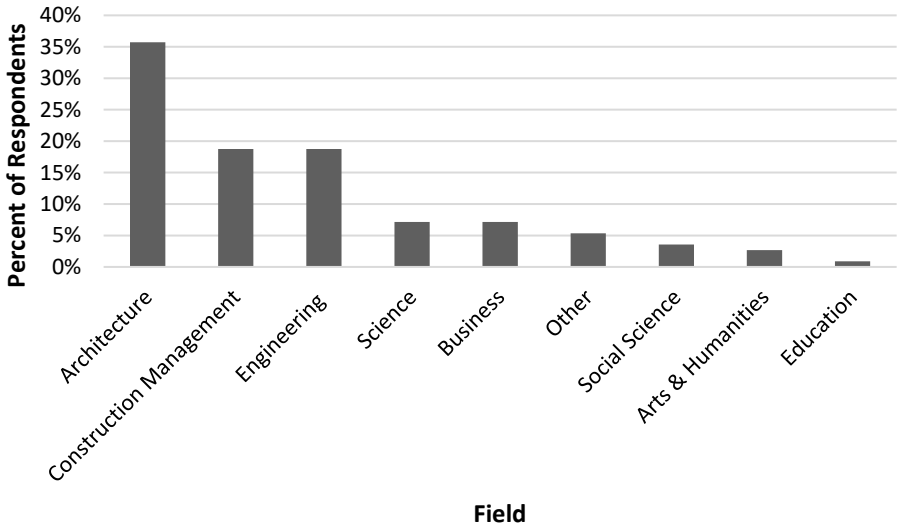

Figure 10. – Field of Highest Level of Education

The attainment of non-degree education is also of importance to this research. Participants were asked to list any technical certificates, professional designations/credentials that they had received. A total of 118 credentials and certificates were listed, with an average of two credentials per person. There were a total of thirty-

nine unique credentials and certificates listed. A full list of all of the credentials and certifications indicated are in Appendix B. The top ten most common are listed in Table X, with AIA (20%) and LEED AP (14%) being the highest. LEED overall (including AP, BD+C) accounted for more than AIA, with a total of twenty-six percent.

Table 15

Top Technical Certificates and Credentials

No.	Name	%
1	AIA	20.3%
2	LEED AP	13.6%
3	PE	9.3%
4	NCARB	6.8%
5	LEED GA	5.1%
6	CHC	2.5%
7	CMIT	2.5%
8	IIDA	2.5%
9	LEAN certified	2.5%
10	LEED	2.5%

Personal

Personal factors, generational affiliation and gender, were collected to analyze any statistical trends. The highest percentage of participants (47%) selected Generation X. Sixty-six participants identified themselves as male, thirty-three percent as female, and one percent did not wish to specify.

Other Preparation

As the facilitators were selected by the professional association, they needed some preparation to ensure they could fulfill this role. A preparation session for the facilitators was held, wherein a background of the seminar and workshop, facilitator guide, and question and answer session was provided to the facilitators. The professional

association's goal was that facilitators would be able to independently manage this workshop at some point in the future.

Results

A total of 185 professionals attended this seminar and were grouped into twenty-nine different teams of five to seven individuals. The team workshop feedback and discussion illustrated that learners were satisfied with the seminar and workshop. Additional time was requested to allow learners to provide feedback and ask questions, as the workshop was extending past the scheduled time slot. This was mostly due to the symposium physical layout and venue, as the rooms were located throughout the venue and participants needed more time to get between rooms. Further, the research team wanted to provide initial results of the workshop at the debriefing session at the end (leaving little time to analyze results in the moment). As a result of this frenzied timeframe, some of the facilitators did not turn in their observation rubrics and lost some of the team submissions. The majority of the team and observation rubrics were collected.

Team Deliverables

The worksheet deliverables of the teams were coded to ensure an unbiased assessment by the research team. The quality of the team deliverables was anonymously assessed by two independent scorers. The risk worksheet was evaluated for completeness and comprehensiveness of the risks. The value added worksheet was measured based on innovation and clarity of value-added items. The client action items worksheet was assessed for content, clarity, organization and comprehensiveness of the information. Two scorers, who have previously scored similar workshops, independently ranked and scored the deliverables of each team. The scoring method was unique, as there was no absolute

standard. Instead, the scorers used a comparative method to assign a score from one to ten (with a "one" being significantly lower quality than the average deliverable and a "ten" being significantly above the quality of the average deliverable). The intent was for the scorers to act as a typical owner, reviewing a service provider's proposal as they would in industry (on a real project). As such, it would not be uncommon to have very few "ten" scores for the deliverables. The descriptive statistics of both deliverables from the workshop are listed in Table 16. A unique opportunity, and an item identified in the construction CPD research and needing investigation (Sumner and Slattery, 2010), was the researcher's comparison of participants' results with industry applications of the same model. The industry comparison was based on 133 projects from 2006 to 2018, wherein contractors were trained as part of the request for proposal pre-proposal training and created similar deliverables as part of their proposal. Comparing deliverable one (risk worksheet), there is less than a one percent difference between the workshop participants' average score and the industry's average score and a less than ten percent difference in standard deviation. Comparing deliverable two (value worksheet), there is less than a six percent difference between the workshop participants' average score and the industry's average score and a less than three percent difference in standard deviation. With such small percentage differences, the workshop participants versus industry comparison shows little difference, suggesting high alignment. A t-test was conducted and showed no significant difference between workshop participants' and industry's performance. Considering the average proposal timeframe, the industry was afforded much more time to prepare their deliverables and formal education, yet the workshop participants had less time and were less than ten percent lower or equal in quality.

A total of seventeen facilitators observed the teams' performance. Some of the facilitators were selected because they were part of the board of the professional association that hosted the symposium. The facilitators walked around the room and gave feedback to the teams as they prepared their deliverables. In doing so, the facilitators were able to judge the overall effectiveness of the team and their abilities to work together on a common task. The scores were conducted on a scale of one to five based on their level of agreement (see Appendix E for the full rubric).

Table 16

Workshop Participants' Scores vs. Industry Scores

Criteria*	Workshop Score	Industry Score	Workshop vs. Industry
Deliverable 1 - average score	5.58	5.61	-0.5%
Deliverable 1 - standard deviation	1.73	1.90	-9.6%
Deliverable 2 - average score	5.28	5.60	-6.1%
Deliverable 2 - standard deviation	1.97	2.03	-2.9%

*Scale: 1-10, with a "1" being significantly lower quality than the average deliverable and a "ten" being significantly above the quality of the average deliverable.

Table 17

Facilitator-Assessed Team Performance

No.	Criteria*	Average	Standard Deviation	Minimum	Maximum
1	A single leader emerged.	3.15	0.70	2.00	4.50
2	All group members engaged equally in discussions.	4.06	0.77	2.00	5.00
3	All group members seemed to have a positive team experience.	4.00	0.85	2.50	5.00
4	The group experienced conflicts or differences among the members.	2.29	1.05	1.00	4.00
5	The group was efficient with their time and didn't spend time multi-	3.88	1.07	2.00	5.00

	tasking on their cell phones, computers, etc.				
6	The group divided the work up among individuals and did not work together.	1.71	0.88	1.00	4.00
7	Your overall rating of how well the team performed. ("1" = low performing & "5" = high performing):	3.64	1.20	2.50	5.00

*Scale: 1-5, with a "1" being strongly disagree.

Statistical Analyses

Statistical comparisons were made to better understand the results and impact of the seminar. A Wilcoxon signed-rank test was used to compare the team performance rating versus deliverables score. The non-parametric test was used for this comparison since the normality assumption of the data was violated due to the small size of the sample. The results revealed that team performance (Median = 80%) was significantly higher than the ratings of the deliverables (Median = 47%) at α = 0.05 (Z = -3.415, p = .001). This may indicate that teams were observed to be high performing and worked well with one another, but did not fully grasp the concept as a team. This is an important finding, as many learner assessments are conducted at the individual-level, absent of any team metrics. While certain individuals may be evaluated to have learned something, they must then translate their learning to the team environment.

Linear regressions were conducted in order to explore whether team performance and deliverables score were predicted by the composition of teams based on types of organization, role of participants, educational level of the participants, experience of the participants in the AEC industry and their current organization. The alpha, F, p-value,

correlation coefficient, and variability percentages are reported in Table 17. Multiple stepwise regressions revealed the following:

- The percentage of participants in a team from a client organization was positively correlated with deliverable score.
- The percentage of participants in a team from a subcontractor organization was negatively correlated with team performance.
- The percentage of participants in a team who were in a designer's role was positively correlated with deliverable score.
- The percentage of participants in a team who were company presidents was negatively correlated with team performance
- The percentage of participants in a team who had their master's degree was positively correlated with team performance
- No significance between level of educational achievement and team performance
- No significance between total years of A/E/C experience and deliverable score or team performance
- No significance between average years at current organization and deliverable score or deliverables score

The team's composition had both an effect on the scored deliverables as well as the team's observed performance as a team. Client and designer participants had a positive impact on deliverable score, and participants with a master's degree had a positive impact on observed team performance. On the other hand, participants that were from

subcontractor organizations or were company presidents had a negative impact on observed team performance.

Table 18

Linear Regression Analysis Summary

Comparison	α	***F***	**p-value**	**Correlation Coefficient**	**Variability**
Percentage of owners versus deliverables score	0.05	(1, 15) = 7.467	0.015	0.577	33%
Percentage of subcontractors versus team performance	0.05	(1, 22) = 7.075	0.014	-0.493	24%
Percentage of designers versus deliverables score	0.05	(1, 15) = 4.841	0.044	0.494	24%
Percentage of company presidents versus team score	0.05	(1, 22) = 6.957	0.015	-0.49	24%
Master's degree versus deliverables score	0.05	(1, 15) = 5.243	0.037	0.509	26%

Participant Feedback

The professional association conducted their standard symposium feedback to gauge the overall success of the event and consider inviting the presenters back for future events. Overall, the participants were very satisfied with the topic, seminar, and workshop (Table 19).

Table 19

Participant Feedback

No.	**Criteria**	***Strongly Agree***	***Agree***	***Neutral***	***Disagree***	***Strongly Disagree***
1	Speaker Topic Contributed to my objective for the Symposium	77%	21%	2%	1%	0%
2	Activities/Breakout sessions provided new ideas and practice methods that I can employ in my workplace	29%	61%	10%	0%	0%

3	My event experience met my objectives (knowledge, skills, networking) in attending	32%	63%	6%	0%	0%
4	If the event were held again, I would participate and recommend to a colleague	48%	51%	1%	0%	0%

CHAPTER 5

CONCLUSION

Until twelve years ago, there was no specifically designated construction education journal, as other journals infrequently published research in this field. A review of the literature is conducted to understand what has been tested in continued professional development (CPD) within construction management and is compared with foundational adult education theories. Less than one percent of articles pertained to CPD, and only six research CPD tests have been conducted.

The field of construction CPD is underdeveloped, with only six published research experiments. The six experiments were compared using foundational education concepts and revealed diversity in instructional delivery method, low diversity in topic with most being in leadership, low diversity in learning outcome, lack of fully utilizing the spectrum of assessment variables, low visibility in reporting results and value, and limited aspects of instructional design were disclosed.

Extant construction CPD practices in pre-project planning identified that the majority of training is still conducted informally and on-the-job. Internal company training programs, while infrequent, were identified as being high quality and had a significant relationship to company planning practices and processes. However, the need for construction CPD in pre-project planning is still largely unmet.

An andragogically-centered schema for a heuristic approach to post-collegiate development in the built environment is developed and tested to further the construction CPD body of knowledge. The Adult Construction Training (ACT) Model the result of the synthesis of the foundational principles of adult education, classified by the educational

constructs they explain, and differentiated by the unique aspects of construction CPD. The ACT Model is then tested by applying it on a CPD seminar for 185 AEC industry professionals. To develop the construction CPD body of knowledge, a topic previously untested in construction CPD is selected as the subject of the seminar. The professionals' learning and behaviors were assessed, as these are key unmet areas of study within construction CPD.

Discussion

The gaps and research agenda for construction CPD represents a large opportunity for researchers and practitioners alike to aid in its development. A better prepared workforce, armed with targeted CPD offerings, will result in higher performing projects and higher construction quality overall. Researchers should be motivated by the paucity of CPD experiments and seek to design more experiments for testing. The research agenda for formulation of these tests to be useful to building the body of knowledge are outlined.

Understanding both the gaps in extant construction CPD tests and the external nature of the body of knowledge, a proposed research agenda is offered. The proposed research agenda for construction CPD is as follows:

- Increase the number of research experiments and tests in construction CPD
- Expand research experiments to a variety of topics within construction management competencies
- Use assessments from different perspectives, both internally and externally to the learners

- Full disclosure of research tests is provided, including: instructional designs, assessment tools, etc.
- Promote research and review of the field of education by CPD practitioners to ensure adult learning and other heuristics are followed.

The research exposed and identified a call to action for both practitioners and academics to develop construction CPD. Practitioners should be encouraged by the results of internal training programs and motivated to further explore this method. Academics can gain further insight into construction CPD instructional design through this research and the developed ACT Model. Another benefit of this research is to provide colleagues and like-minded professionals with an overview of the theories of adult learning and how these theories fit within the built environment CPD.

Limitations

The research focus was limited to the area of project pre-planning, but recognized the importance of other topics. Additionally, the testing of the ACT Model had some limitations. Relative to the size of the construction industry, the sample sizes of the research tests were small ($n = 9$ and $n = 185$). Further, the professional association that the ACT Model was tested on limited the types and numbers of questions that the researchers could ask.

Future Research

To further advance and develop the field of construction CPD, additional research tests are needed. Testing of the ACT Model on additional topics, learner types, and other considerations should be tested. Both larger sample sizes of learners and diverse learners are needed to test the ACT Model further.

A better understanding of the informal construction CPD environment is needed, as this was not represented in the published literature. Programs, methods, and results of informal construction CPD should be measured.

The assessment of the results and impacts of construction CPD is a very large opportunity that warrants further study. This research pioneered the use of facilitator observations and rubrics, as an external view of results. Further research in the area of external measurement of the results and impacts of construction CPD is needed. The need for the quantified return on investment of construction CPD remains an unmet opportunity. To encourage companies seeking to develop construction CPD to invest, a proper return on investment analysis is needed. With all these opportunities, the field of construction CPD represents a still underdeveloped area with great future promise.

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APPENDIX A

QUESTIONNAIRE

Thank you in advance for taking the time to contribute to this industry research. It will take approximately 5 - 8 minutes to complete this survey. This survey is one step in a multi-university research effort to enhance contractors' and owners' abilities to optimize contractor planning processes and project performance in construction. Please answer all questions based on your experiences working for a contractor (either currently or previously) and, if possible, don't leave any blank.

Planning Process

Planning is a process of deciding what to do and how to do it before action is required. While planning is an ongoing process, for the purposes of this survey, we are analyzing the project planning that contractors perform prior to the start of the physical work (i.e. mobilization, NTP). Each plan consists of different parts or documents. For example, the major milestone schedule or safety plan are just parts within the entire plan.

Questions:

1. My organization has a process for project planning. (select one)
2. A formal process is written and provides guidelines that everyone must follow. My organization's planning process is very formal. (select one) - If Q1 = YES
3. What is your satisfaction with your organization's current planning processes/practices? (select one) - If Q1 = YES
4. My organization's planning documents increase project success / performance. (select one) - If Q1 = YES
5. My organization's planning process is implemented very well. (select one) - If Q1 = YES
6. A formal organizational planning process would increase our project success/performance. (select one) - If Q1 = NO
7. If my organization planned more, our projects would be more successful (on average). (select one)
8. Indicate your use of the following planning "parts" or "documents":
9. How did you learn to plan? (select all that apply)
10. Does your organization provide any training for employees in the area of project planning?
11. If yes, what is your satisfaction with your organization's current training/education?
12. If training was available in the area of project planning, which topics would you be interested in learning more about?
13. If training was available in the area of project planning, which training format would you be interested in? (select all that apply)
14. Please estimate your company's annual revenue in millions per year (USD).
15. Approximately how many full-time employees (including field & office staff) does your organization currently employ?

16. What is your organization's primary sector of business? (select all that apply)
17. Which of the following types of construction does your firm perform in-house? (select all that apply)
18. How many years of construction experience do you have?
19. What's the highest level of education you've attained? (select one)
20. What field was your highest level of education in (if applicable)?
21. Please list any technical certificates, professional designations/certificates, etc. you have:
22. What is your role in your current organization? (select one)
23. What is your generational affiliation?

APPENDIX B

CERTIFICATES & CREDENTIALS ATTAINED (TABLE 8 FULL)

Certificate/Credential	%	Count
Leadership in Energy and Environmental Design(LEED)	12%	14
OSHA	10%	11
Company Specific	9%	10
Software	9%	10
Misc.	8%	9
Registered Engineer	5%	6
Trade	5%	6
Project Management Professional (PMP)	5%	6
Licensed Architect (AIA)	4%	5
Certified Professional Constructor(CPC)	4%	4
PE	3%	3
EIT	3%	3
Safety	3%	3
DBIA	2%	2
ACE	2%	2
CPA	2%	2
GSC	2%	2
HCC	2%	2
CEC	2%	2
Licensed Contractor	2%	2
AIC-CPC	1%	1
AIC - Associate Constructor	1%	1
AGC STP	1%	1
ABA	1%	1
LEAN	1%	1
CHC	1%	1
Contract Admin	1%	1
MSHA	1%	1
SCMP	1%	1
Total	**100%**	**113**

APPENDIX C

TRAINING TOPICS OF MOST INTEREST (TABLE 10 FULL)

Topic	%
Scheduling	15%
General business/Construction management concepts	10%
Cost	8%
Software	7%
Communication	6%
LEAN	5%
Resource allocation - time, money, and labor/materials	5%
Risk	3%
Safety	3%
Developing company processes	3%
How to plan	3%
Project Management	3%
Quality	2%
Subcontractor management	2%
Business development	2%
Budget	2%
Contracts	2%
Estimating	2%
Pull/push planning	2%
Time Management	2%
Turnover	2%
What should be on a plan	2%
Contingency planning	2%
Design assist	1%
Field supervision	1%
Labor	1%
Leadership	1%
Logistics	1%
Negotiations	1%
Owner related	1%
Scope	1%
Space planning	1%
Setup	1%
Total	100%

APPENDIX D

SYMPOSIUM AGENDA

Start	End	Duration	Activity	Key Points
7:00am	8:00am	1 hour	Registration and Breakfast	
8:00am	8:30am	30 min	Welcome and Intro	Overview of past Symposiums, Phone Surveys, etc.
8:30am	9:30am	1 hour	Key Note #1	"The owner's perspective" in what you look for in a team and you select a high performing team
9:30am	9:45am	15 min	Break	
9:45am	12:00pm	2 hours	Break out Content #1	Team building, team charter, decision making exercise
12:00pm	1:00pm	1 hour	Lunch and Networking	
1:00pm	1:45pm	45 min	Key Note #2	Leadership vs. management: transforming high performers into a high performing team and laser guided team talent management
1:45pm	3:00pm	75 min	Break out Content #2	Team risk and value exercise
3:00pm	3:20pm	20 min	Break	
3:20pm	4:00pm	40 min	Break out Content #3	High performer exercise
4:00pm	5:00pm	1 hour	Wrap Up	
5:00pm	6:00pm	1 hour	Cocktails and Networking	

APPENDIX E

WORKSHOP FACILITATOR GUIDE

OVERVIEW
The purpose of this facilitator guide is to assist workshop facilitators in conducting the following 2 workshops:

- High Performers in Action (total time: 60 minutes)
    - The ability to identify and mitigate risk before it happens on a project is a key trait of high performing teams. Projects often struggle and may lead to failure due to the lack of these key skills sets and the ability of teams to execute and deliver projects. In this workshop, you will participate in a hands on exercise and practice these key skills sets in a team setting. A guided framework will be provided to optimize and encourage team performance.
        - **Learn** the tools to enhance these high performer skills sets and how to leverage individual abilities within a team setting
        - **Experience** what makes teams effective (and ineffective!)
        - **Test** your own collaborative and risk management skills sets in this workshop

- The Rise of High Performing Teams (total time: 50 minutes)
    - The purpose of this workshop is to expose the challenges with working as teams and create steps and solution to forming high-performing teams. Research has shown that every symptom of a low-performing team has a hidden root cause. Symptoms are easy to see, while root causes are often hidden. This presents a challenge as we make decisions based on what we can see.
        - **Learn** what barriers teams commonly face in becoming high performers
        - **Identify** challenges you have faced in assembling and working in teams
        - **Develop** an action plan to accelerate your team's competence/intelligence through various tools and strategies

To enable a workshop environment where participants can experience a true to industry team environment, a survey was distributed prior to the conference for participants to complete. This information was used to place participants into teams and create a simulated industry environment (based on the responses received). Preliminary team performance results will be shared at the end of the conference.

HIGH PERFORMERS IN ACTION

SETUP

- Ensure that every table has one set of worksheets, extra blank sheets of paper, and writing utensils.

STEP #1 – INTRODUCTION …… 2 minutes

- Welcome all participants and state your name.
- Have participants check to make sure they are sitting at the correct table (i.e. table number matches the number on their name badge).
- Let participants know that they have all materials they need at their table.
- Remind them that they are to work with their group members sitting at their table.
- At the end of the workshop, each group will need to turn in their completed worksheets.
- Results of this workshop and the next will be shared at the end of the conference.
- Have fun!

STEP #2 – BACKGROUND …… 10 minutes

- Explain the purpose of this workshop
    - The ability to identify and mitigate risk before it happens on a project is a key trait of high performing teams. Projects often struggle and may lead to failure due to the lack of these key skills sets and the ability of teams to execute and deliver projects. In this workshop, you will participate in a hands on exercise and practice these key skills sets in a team setting.
    - For the purposes of this exercise, you were assigned to vendor teams and will act as the service provided for the project scope.
- Read the Project Scope
    - The scope of this project/service is to provide laundry service for a single family home consisting of two adults and three children in the Portland, Oregon metropolitan area. The children are 15 (male), 13 (male), and 9 (female).
    - It is expected that at a minimum the vendor will:
        - Take clothes from the hampers throughout the house (a total of three).
        - Using the owner provided washer, dryer, and detergent, complete the laundry as required to maintain a reasonable number of clean clothes
        - Folded clothes placed in the proper dresser drawers for each of the house occupants.
    - Your team will assume the role of a vendor/service provider.
- Discuss the activity

    - Create your vendor execution plan. For the purposes of this workshop, your plan will have the following structure: a Risk Assessment Plan, a Value Assessment Plan, and a Client Action Item List.
    - 3 worksheets have been provided to you on your tables.
    - Your team is to complete each plan for the project scope of laundry services.
    - You have 30 minutes to complete all 3 plans.
- Discuss the worksheets
    - The first plan, the Risk Assessment Plan, should contain your top 3-6 potential issues or items that could prevent you from being successful in executing this service. In addition to identifying the risk, explain why it is a risk and your plan to mitigate or solve the issue. The goal is to identify these up front so they do not become roadblocks to success during the execution of this service.
    - The second plan, the Value Assessment, should contain your main 3-6 ideas or innovations that you see can improve the scope of this service beyond what the client identified. The goal is to achieve one or more of the following: increased client satisfaction, cost savings, and/or overall improvements to the execution of this service.
    - The third plan, the Client Action Items Plan, should contain your critical 3-6 items that the client will need to do or execute. It is the client's expectation that the contracted vendor will manage this service and the client assumes that nothing is needed from them aside from anything specifically identified as being a client action item outlined in the scope of work. The purpose here is to identify any actions needed up front so the client is aware of what is needed from them prior to the service start (and it does not become a risk item).
    - Let's get started!

STEP #3 ACTIVITY……..……...……30 minutes

- Teams will begin the activity.
- Walk around the room and complete your Observation Checklist
- Remind everyone that each team will need to turn in all 3 completed worksheets at the end of the 30 minutes.
- Remind everyone of the time constraint when 10 minutes are left
- Collect all worksheets.
- Give worksheets to Dr. Sullivan/Jeff.

STEP #4 – DEBRIEFING ……..……15 minutes

- Distribute separate handouts with previous seminar examples
    - Given the timing, examples of other participants have been provided.
    - The goal is to see if your team identified similar items in your plans.
    - Risk Assessment

1. Mixing light colored clothes with dark colored clothes
2. Putting the wrong clothes in the wrong dressers
3. Running out of client-provided detergent
4. Client-provided equipment breaks down

   Notice how risks #1 & 2 are more vendor-driven, while #3 & 4 are more client focused. Which is better to identify if you're the vendor? (client) Which represents more of an "uncontrollable" risk? (client)

- Value Assessment
  1. Addition of dry cleaning services to scope of work
  2. Addition of other laundry items, such as sheets and towels to scope of work
  3. Let us buy the detergent – we get a wholesale discount
  4. Let us use our commercial-grade equipment – save your utility costs

     Notice that the goal here is to execute the intent of the scope of services, which is to provide clean laundry vs. "just wash these 5 items."
- Client Action Items
  1. Identify what is a "reasonable number of clothes" – quantify this
  2. Identify or label which dresser drawers should contain which items for each client
  3. Share each clients' monthly schedule, including any sports events or those that would require specific clothing items

     Notice with Client Action Items that they are meant to mitigate "uncontrollable" type risks and gain buy-in from the client prior to starting or encountering any associated risks.

THE RISE OF HIGH PERFORMING TEAMS

SETUP

- Ensure that every table has one set of worksheets, extra blank sheets of paper, and writing utensils.

STEP #1 – INTRODUCTION ……...2 minutes

- Welcome all participants and state your name.
- Have participants check to make sure they are sitting at the correct table (i.e. table number matches the number on their name badge).
- Let participants know that they have all materials they need at their table.
- Remind them that they are to work with their group members sitting at their table.
- At the end of the workshop, each group will need to turn in their completed worksheets.
- Results of this workshop and the next will be shared at the end of the conference.
- Have fun!

STEP #2 – BACKGROUND ……..……10 minutes

- Explain the purpose of this workshop
    - The purpose of this workshop is to expose the challenges with working as teams and create steps and solution to forming high-performing teams. Research has shown that every symptom of a low-performing team has a hidden root cause. Symptoms are easy to see, while root causes are often hidden. This presents a challenge as we make decisions based on what we can see.
- Discuss the activity
    - Discuss and list several hassles in working with teams you have experienced as Project Managers, Engineers, Designers, Clients, etc.
    - The Team will follow this 5-Step Improvement Model:
        - Step 1 – Identify hassles and prioritize
        - Step 2 – "Condensed Root Cause Analysis"
        - Step 3 – Barriers preventing the problem from being solved
        - Step 4 – Goals for the solution
        - Step 5 – Action plan
    - 5 worksheets have been provided to you on your tables.
    - You have 25 minutes to complete this activity.
- Let's get started!

STEP #3 – ACTIVITY……..……25 minutes

- Teams will begin the activity.
- Walk around the room and complete your Observation Checklist

- Remind everyone that each team will need to turn in all 5 completed worksheets at the end of the 25 minutes.
- Collect all worksheets.
- Remind everyone of the time constraint when 10 minutes are left
- Give worksheets to Dr. Sullivan/Jeff.

STEP #4 – DEBRIEFING ……..……..10 minutes

- Review and discuss
    - Select a spokesperson from your team to give one example of a lesson learned from this workshop – can be within any of the 5 steps (allow 2 minutes per team)
        1. Step 1 – Identify hassles and prioritize
        2. Step 2 – "Condensed Root Cause Analysis"
        3. Step 3 – Barriers preventing the problem from being solved
        4. Step 4 – Goals for the problem solving
        5. Step 5 – Action plan
    - Summarize drawing on similarities and differences at the end

OBSERVATION CHECKLIST

Facilitator Name:	
Room #:	

INSTRUCTIONS

Please complete the observation checklist below by inserting your ratings for each team on a scale of 1-5; with the following meanings:

1. Strongly disagree
2. Disagree
3. Neither agree/nor disagree
4. Agree
5. Strongly agree

HIGH PERFORMERS IN ACTION

No.	Question	Insert Team Codes/Number Below
1	A single leader emerged:	
2	All group members engaged equally in discussions:	
3	All group members seemed to have a positive team experience:	
4	The group experienced conflicts or differences among the members:	
5	The group was efficient with their time and didn't spend time multi-tasking on their cell phones, computers, etc.:	
6	The group divided the work up among individuals and did not work together:	
7	The team laid out a sequence of activities/overall plan before addressing the risks and value plans:	
8	Your overall rating of how well the team performed ("1" = low performing & "5" = high performing):	

THE RISE OF HIGH PERFORMING TEAMS

No.	Question	Insert Team Codes/Number Below
1	A single leader emerged:	
2	All group members engaged equally in discussions:	
3	All group members seemed to have a positive team experience:	
4	The group experienced conflicts or differences among the members:	

5	The group was efficient with their time and didn't spend time multi-tasking on their cell phones, computers, etc.:	
6	The group divided the work up among individuals and did not work together:	
7	Your overall rating of how well the team performed ("1" = low performing & "5" = high performing):	

APPENDIX F

FACILITATOR-LED DEBRIEFING GUIDE

(to be distributed after completion of the workshop as part of feedback/debriefing purposes)

The goal is to see if your team identified similar items in your plans.

RISK ASSESSMENT PLAN

Risk 1:	Mixing dark clothes with whites
Why is it a Risk?	The colors in dark clothing can run and stain white clothing if washed together in a single load of laundry. This is especially a risk with newer dark clothes.
Solution:	Our technicians are provided with a transportable hamper to sort clothes into two separate containers, each clearly marked as “Dark Clothing” and “White Clothing”. Using this practice, our Company-wide rate of loads impacted by color mixing is less than 0.01% over the past 5 years.

Risk 2:	Sorting and returning clothes to the proper room and owner
Why is it a Risk?	The most efficient method for washing clothes is to combine dirty laundry from all occupants into “dark” and “light” loads. Mixing occupants clothes in the wash raises the potential for disorganization when returning clothes to the correct rooms.
Solution:	• During Pre Award, our team will meet with each occupant to catalogue their individual articles of clothing. • This catalogue is stored in a central online database that our technicians can access remotely should any confusion arise. • We also assign specific technicians to the household and we find that our technicians become familiar with the clothing within 1-month after service-initiation. • However, our on-site technicians will also have hard copy printouts of the catalogue on site as backup.

Risk 3:	Clothes are not in the hamper
Why is it a Risk?	Clothes are often “thrown” to the hamper but might not make it in, and we have seen this especially with teenage boys.
Solution:	We will pick up the clothes around the hamper in the immediate area. Clothes that are obviously dirty will also be picked up.

Risk 4:	Owner-provided equipment
Why is it a Risk?	Owner-provided washer or dryer not working
Solution:	We will notify the client as soon as the issue is known. See VA#1 for potential remedy (to provide off-site cleaning service)

Risk 5:	Owner-provided supplies
Why is it a Risk?	Owner-provided detergent is empty
Solution:	• We will notify the client when new detergent should be purchases (1-week prior). • We will also stock our service provider's vehicle with the client's preferred detergent product to eliminate any interruption in service (in case of emergency)

VALUE ASSESSMENT PLAN

Item 1:	Owner provided washer or dryer not working. If the owner equipment is not working the clothes can be taken to an off-site cleaner with owner approval. All costs for washer and dryer will be charged back to the client (receipt will be provided). Transportation will be paid for by the vendor.	
Impact:	Cost ($): $5/load (estimate)	Schedule (Days) +1 Day Delay

Item 2:	Emergency wash – We have found in the past that the client may require an emergency wash outside of the regularly established washing schedule (e.g. special shirt for a party of jersey that needs to be cleaned for game). We offer emergency wash services with 30 min pick up of an item and 3 hours turn around with the completed washing / drying.	
Impact:	Cost ($): $20/load or $5/ occurrence	Schedule (Days) 0 .

Item 3:	Dry cleaning – we don't perform dry cleaning services in-house. However, we can take all appropriate items to a dry cleaner for service. The direct cost will be charged back to the client (receipt will be provided), plus a $5 service fee for delivery and pickup	
Impact:	Cost ($): direct cost +$5	Schedule (Days) 1 week

Item 4:	Ironing – our firm can provide ironing services for all dress shirts, slacks/pants, blouses, and appropriate items.	
Impact:	Cost ($): $25/month	Schedule (Days) +2 day delay

CLIENT ACTION ITEMS

Client Action Item 1:	Clarify scope of work.
Specific Action(s) Needed by the Client:	Identify what is a "reasonable number of clothes" – quantify this.
Timeline and regularity of Action(s) Needed:	Prior to the start of the services.

Client Action Item 2:	Clarify scope of work.
Specific Action(s) Needed by the Client:	Identify or label which dresser drawers should contain which items for each client
Timeline and regularity of Action(s) Needed:	Prior to the start of the services.

Client Action Item 3:	Clarify scope of work.
Specific Action(s) Needed by the Client:	Share each clients' monthly schedule, including any sports events or those that would require specific clothing items
Timeline and regularity of Action(s) Needed:	By the 1st date of each month.

APPENDIX G

DEMOGRAPHICS SURVEY

1. Which category best describes your current organization? (select one)
    a. Client/owner
    b. Developer
    c. General Contractor
    d. Subcontractor
    e. Design/Engineering
    f. Other
2. What is your role in your current organization? (select one)
    a. Project Manager
    b. Site Superintendent
    c. Preconstruction Manager
    d. Field Engineer
    e. Designer/Engineer
    f. Owner/Developer
    g. Business Development
    h. President/Senior Executive
    i. Other
3. What's the highest level of education you've attained?
    a. Less than a high school diploma
    b. High school graduate, not college
    c. Some college, no degree
    d. Associate’s degree
    e. Bachelor’s degree
    f. Master's degree
    g. PhD or Other Doctorate
4. What field was your highest level of education in (if applicable)?
    a. Construction Management
    b. Engineering
    c. Science
    d. Business
    e. Education
    f. Arts & Humanities
    g. Architecture
    h. Social Science
    i. Other
5. Please list any technical certificates, professional designations/credentials, etc. you have.
6. How many years of A/E/C experience do you have?
7. How many years have you been at your current organization?
8. What is your generational affiliation?
    a. Silent Generation (born prior to 1946)
    b. Baby Boomer (born 1946 – 1964)
    c. Generation X (born 1965 – 1978)
    d. Generation Y (born 1979 – 1997)
    e. Generation Z (born 1998 – present)

9. What is your gender?
    a. Male
    b. Female
    c. Other
    d. Prefer not to specify

APPENDIX H

TECHNICAL CERTIFICATES AND PROFESSIONAL DESIGNATIONS

No.	Technical certificates, professional designations/credentials, etc.	%	#
1	AIA	20.3%	24
2	LEED AP	13.6%	16
3	PE	9.3%	11
4	NCARB	6.8%	8
5	LEED GA	5.1%	6
6	CHC	2.5%	3
7	CMIT	2.5%	3
8	IIDA	2.5%	3
9	LEAN certified	2.5%	3
10	LEED	2.5%	3
11	LEED AP BD + C	2.5%	3
12	PMP	2.5%	3
13	ASHE	1.7%	2
14	DBIA	1.7%	2
15	EIT	1.7%	2
16	LEED AP ID+C	1.7%	2
17	NCIDQ	1.7%	2
18	ACHA	0.8%	1
19	ACTCP (ADA Cert)	0.8%	1
20	Carpenters Apprenticeship	0.8%	1
21	CCB License	0.8%	1
22	CCM / HCC	0.8%	1
23	Certified Healthcare Constructor	0.8%	1
24	Certified Sustainable Building Advisor	0.8%	1
25	EDAC	0.8%	1
26	Emergency Management Certification	0.8%	1
27	FAIA	0.8%	1
28	HCC	0.8%	1
29	Health Care Construction Certificate	0.8%	1
30	LC	0.8%	1
31	LEED BD+C	0.8%	1
32	Licensed Electrician	0.8%	1
33	Licensed General Contractor	0.8%	1
34	MS	0.8%	1
35	OSHA 30	0.8%	1
36	OSHA 40	0.8%	1
37	Professional Land Surveyor	0.8%	1
38	Quality Control Manager	0.8%	1