Learning Styles and Preferences of Field Managers in U.S. Non-residential Construction

by

Paul Wilson Holley

A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
December 10, 2016

Keywords: learning styles, construction, generation, superintendent, continuing education

Approved by

James E. Witte, Chair, Professor, Educational Foundations, Leadership & Technology
Maria M. Witte, Professor, Educational Foundations, Leadership & Technology
David C. DiRamio, Associate Professor, Educational Foundations, Leadership & Technology
Leslie A. Cordie, Assistant Professor, Educational Foundations, Leadership & Technology

Abstract

Construction is the largest U.S. industry, in which there are many current trends in the adoption of new project delivery strategies, management practices, and complex applications of information technology. As part of the management team on construction sites, superintendents are looked upon to provide leadership in the means and methods during construction, often taking responsibility for the coordination of labor, materials, equipment, and others resources. Many of these individuals are in the Baby Boomer generation and will soon retire, requiring construction firms to replace them with members of Generations X and Y. This shift will require consideration of properly training for and managing the dynamically changing advancements and technology in the industry.

To accomplish this, construction firms could benefit from a better understanding of the learning styles and preferences of the managerial workforce, so that continuing education and training can be optimally developed and delivered. This study investigated those preferences, targeting current superintendents, assistant superintendents, foremen, and related field managers of commercial construction firms in the southeastern U.S., whose representative employers were of size. Voluntary anonymous responses provided data for analysis to determine by what learning styles they prefer, and also for analysis based on independent variables of age, frequency of training, and level of education.

Acknowledgments

As with many who undertake an endeavor such as this, there is a long list of people by whom I have been influenced along the way, both directly and indirectly. From a broader perspective (and at the risk of being cliché), I would be remiss if I did not recognize my family, friends, and mentors who in the first half-century of my life helped shape whatever meaningful work ethic, tenacity, curiosity, and ability to communicate that I might humbly demonstrate. It is to these folks to whom I am most grateful in the holistic sense of things, and apologizing in advance for omissions, I would like to particularly thank my parents Don and Peggy, my wife Jacque, my children Lee Chapman and Yates (from whom I often learn the most), Rocky, John, Steve, and the Rootboys.

As for my doctoral education and this dissertation, I am very grateful for the encouragement, advice, and illumination from many people, and would like to express my sincere gratitude to several. I thank Drs. Maria and Jim Witte for their support and flexibility with me and for their encouragement perhaps undeservedly beyond my persistence and aggravation; Drs. Cordie, DiRamio, and Sattineni for their contributions as committee members and reader; Ben Farrow for his friendship and talking me into this whole thing against my will; my kids for their understanding when I was in the office on too many nights and weekends; and most importantly again, my wife, who has tolerated me for this and a long list of other forays and distractions for many years. Thanks, y'all.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

3D	Three Dimensional
ACCE	American Council for Construction Education
AEC	Architecture/Engineering/Construction
AIA	American Institute of Architects
ANOVA	Analysis of Variance
ASCE	American Society of Civil Engineers
BIM	Building Information Modeling
CAD	Computer Aided Design
CITI	Collaborative Institutional Training Initiative
CMAA	Construction Management Association of America
CMR	Construction Manager at Risk
FAA	Federal Aviation Authority
GMP	Guaranteed Maximum Price
ILS	Index of Learning Styles
IRB	Institutional Review Board
IP	Internet Protocol
IT	Information Technology
LEED	Leadership in Energy and Environmental Design
LiDAR	Light Detection and Ranging

LSD   Learning Style Dimension

LSI   Learning Style Inventory

LSQ   Learning Styles Questionnaire

QR Code Quick Response Code

RFID   Radio Frequency Identification

SPSS   Statistical Program for Social Science

STEM   Science Technology Engineering Math

UAS   Unmanned Aerial Systems

UAV   Unmanned Aerial Vehicles

U.S.   United States

VDC   Virtual Design and Construction

CHAPTER 1

INTRODUCTION

Construction is the largest industry in the United States, with a seasonally
adjusted annual rate reported in January of 2016 of $1.14 trillion dollars (U.S.
Department of Commerce, 2016). Its contribution to the U.S. Gross Domestic Product is
significant, and it is a compelling metric of the national economy.

Historically, the construction industry has been a notable presence in U.S. growth,
as well as worldwide. Since the Industrial Revolution, developments in methods of the
built environment have had great impact on its means, methods, skills, and leadership
needs (Thomsen and Sanders, 2011). The harnessing of electricity and subsequent
development of electric motors and pumps all gave way to the advent of power and
lighting in buildings, as well as air conditioning, elevators, and many other components
that are commonplace today. The development of steel as a structural component in
favor of iron as well as developments in reinforcing and forming systems in concrete
structures have also provided much more opportunity and breadth in design, and as such
impacting construction.

Collectively, these changes over the past roughly 130 years have presented
considerable complexities in the construction process. While the design team of
architects and consulting engineers may have developed a scheme for the finished
product that is to be built, the contractor has purview over how to actually construct the
physical asset. According to the American Institute of Architect's 'General Conditions,'

a document that is pervasive in its use in commercial construction contracts, "The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters" (American Institute of Architects, 2007). Whether a non-residential construction contract utilizes this document or one similar, it requires the builder's site leadership to be versed in the management of a broad range of components, equipment, scheduling and phasing, and overall strategic planning.

More recently, the advent of the use of information technology in building has added a layer of complexity to the site management process. There are more complex building components and systems being installed in construction projects, but there are also significant advances and adoption of data collection and management, software and interface platforms, handheld and mobile devices, virtual and augmented reality, and several other technologies. With the adoption of these technologies increasing at an increasing rate, it is critical for construction site leadership to be current and facile to stay competitive (Badger, Wiezel, Adams, & Bopp, 2012). Fingland notes that more predictable and profitable project delivery is a major motivation to utilize and leverage high tech advances, particularly with the advent of state of the art tools and systems such as LiDAR scanning and RFID tracking (2015).

Among a construction site's leaders, the project superintendent is primarily responsible for decision-making, strategizing, and oversight of the means and methods of the project. Given the scope and increasing complexities of this position, commercial contractors give significant effort in recruiting, developing, and retaining successful

superintendents within their organizations. This can often be a challenge on a variety of fronts. A significant issue is the source of these key individuals. Future superintendents come primarily from two places, either 'through the trades,' e.g. as a carpenter who shows promise in a management role, or, through more formal education or training such as a construction management academic curriculum. Compounding this issue is the fact that the superintendent position frequently requires the individual to relocate from project to project, often to different cities, states, or even regions.

Collectively, managing these human resources associated with the superintendent position is a priority for commercial builders. Today, there is also another facet to this issue - succession planning and generational proclivities associated with the impending shift in leadership from Baby Boomers to Generations X and Y, as the former retire. This poses some unique questions for commercial construction firms to ask themselves, as while the Baby Boomer population is decreasing and the Generation X population looks to replace them in many leadership positions, the Generation Y (or Millennial) population is actually larger than that of X (Fry, 2015). These generations often have different comfort levels in the use of information technology, and specifically in the construction industry they may also have a wider range of styles by which they prefer to earn best. This compound issue could have a significant impact on how construction firms strategize training and education as the information technology paradigm continues to shift, and plays an increasingly larger role in on-site management practices.

Statement of the Problem

With Baby Boomers retiring at a rate faster than Generation X can replace them, and with construction spending on a notable upward trend as the U.S. economy recovers,

the construction industry is facing some unique human resource challenges in site management. There have been several studies producing credible information on generational leadership shifts as well as on the adoption of information technology and its associated challenges, but there is little data investigating this convergence specifically for the construction industry and its superintendents.

With Baby Boomers in these positions retiring at an increasing rate, this has developed a need for construction companies to strategize and fill these positions with members of generations whose fundamental tastes, preferences, and general modi operadi are different. Given the scale of the industry and its current economic recovery and future projections, this presents major challenges for non-residential construction firms nationwide. They are reconsidering sourcing for these positions, in that not only do they desire individuals who are adaptive, technology-savvy, and nomadic, but they are seeking them in competition with other industries who are looking for similar skill sets.

While Generation X is widely considered to be more open to and fluent than Baby Boomers in the use of information technology and its associated advancements, many of its members have still not embraced some of these technologies, which will be of significant concern to construction firms. It would be reasonable to accept that Generation Y will bring expertise on the technology front, but at the moment many construction firms may believe them to collectively need to develop more leadership experience in construction means, methods, and sequencing, which may take some time.

Purpose of the Study

The primary purpose of this study is to give insight into what learning styles and preferences are most dominant among field managers in non-residential construction in

the Southeastern U.S., and to compare this data across age groups, frequency of formal training, and level of education.

By analyzing this data across multiple generations, this research can inform the industry so that they are able to better plan and manage relevant human resources. Understanding this demographic on a broader regional industry scale can potentially provide industry a set of benchmarks by which they can establish or improve succession planning, training, mentoring and reverse mentoring, and other andragogical efforts.

Significance of the Study

Given the construction industry's significance in the national economy, both public and private sectors can benefit from a better understanding of how to better staff and align site leadership positions. With the U.S. construction industry's scale and projected revenues climbing steadily, not only could this research usefully inform construction firms, but also their counterparts in architecture and engineering, as well as project owners and lenders. All of these parties are impacted by the efficiency, decision-making, and expertise of their associated builders, and a better understanding of how project leadership needs are changing can arm them with data, and better manage their expectations on future projects.

Research Questions

The following research questions were used to guide this study:

1. What are the learning styles and preferences of field managers in the non-residential U.S. construction industry?

2. What are the differences in learning styles and preferences based on age?

3. What are the differences in learning styles and preferences based on frequency of recent training or classroom instruction?

4. What are the differences in learning styles and preferences based on level of education?

5. Is there a relationship between level of education and frequency of recent training/instruction among field managers in the non-residential U.S. construction industry?

Assumptions

The following assumptions were made as part of the research:

A. That Felder and Soloman's index model is appropriate for measuring construction superintendents' learning styles.

B. That the demographic questions in the instrument were appropriate to determine independent variables and their respective categorization suitable for analysis.

C. That those who responded are representative of the full sample and the full demographic.

D. That respondents have done so with candor and accuracy, and did not temper answers based on external or internal factors.

Limitations

This study has certain limitations, many related to the design of the research, and others based on the nature of any similar research effort. The former are overtly part of the study in an effort to narrow the sample and bring depth to the results. The latter are knowingly inherent, and the methods were formulated in an effort to minimize any impact that they might cause.

The most significant limitation by design was that the sample of superintendents and foreman was solicited on a convenience basis, and not random. This could have an effect on generalizability, but was necessary to be able to reach the intended audience. Companies for whom these superintendents are employed were also limited, primarily based on the type of work they perform. This study is limited to non-residential contractors, purposely excluding residential construction firms given distinct differences between the sectors. Additionally, the representative companies selected were limited to firms whose annual revenues were $100MM or more, in an effort to focus on larger firms for whom the nature of their projects and their leadership needs were more similar. A related limitation is based on nomenclature and titles, as there may be inconsistencies among different non-residential firms based on how they define the roles of superintendent, assistant superintendent, general superintendent, and foreman. And finally, the representative companies selected were generally based in the southeastern United States. Their respective branch offices represent a geographical range between Texas to the Carolinas; however, their respective project site locations span coast to coast. Based on this, generalizability of the overall national industry could be impacted.

The study also included some limitations inherent to the nature of the type of research. Most notably are that the provision of responses was voluntary, and that the sample size is reasonably conducive for statistically valid representative data.

Definitions

Terms used within and throughout the study include:

1. Superintendent – Person who manages a construction project and located on site; is generally responsible for directing and coordinating workers, materials,

7

equipment, and subcontractors, and is also responsible for sequencing, phasing, means and methods, safety, management of unforeseen conditions, and overall building strategy. Related positions include general superintendent, assistant superintendent, and field superintendent.

2. Non-residential Construction – Construction, demolition, and/or renovation in the commercial, industrial, and civil sectors, including: retail, office, healthcare, hospitality, institutional, manufacturing, utilities, and other types of projects.

3. Information Technology – Collectively representing activities, devices, procedures, hardware and software, and other items driven by electronic formats in which data is captured and/or manipulated by computers and telecommunications.

4. Baby Boomer – Those individuals born in the U.S. during a markedly increased birthrate following WWII, generally between 1946 and 1965, characterized by having observed/experienced as a young person the landing on the moon and other significant space exploration, and what has also been called hippie counterculture.

5. Generation X – Those individuals born in the U.S. between1965 and 1981, characterized by having observed/experienced as a young person the end of the cold war, and the rise of mass media.

6. Generation Y – Those individuals born in the U.S. between 1981 and 2000, characterized by having observed/experienced as a young person the rise of the information age and internet, and in terrorism and its associated wars.

7. Construction Management – the industry role of many business entities who operate as general contractors or as large specialty contractors, who manage the process of delivering a new or renovated asset in the built environment.

8. Means and methods – those items, sequences, strategies, plans, equipment, temporary structures, and other items necessary to construct a building or other asset based on a design provided by others.

9. Virtual design and construction – the management and implementation of using data and information models in a multi-disciplinary fashion to support, digitally prototype, and improve efficiency in the construction of assets in the built environment.

10. LiDAR – Light Detection and Ranging - a laser-based technology that produces geospatial data, used in construction to capture location of existing components, and to lay out desired points of interest in the building process.

11. Project delivery - framework and/or system used by the owner or developer of a future capital asset to organize a project's design, construction, financing, and operation, and the contracts and bases of payment used to facilitate it.

12. Sustainability (in the built environment) – the development and creation of buildings, utilities, and places in an environmentally responsible manner, promoting health and minimizing carbon footprint and waste.

13. Learning styles – the preferences and tendencies toward the approach to learning, specific to an individual.

Organization of the Study

This study is organized into five chapters. The first chapter provides an introduction and context of the research undertaken, and provides basic information on the construction industry, superintendents and their role, the research questions that guided the study, as well as assumptions, limitations and definitions that are pertinent to the work.

Chapter two is a review of literature that provides data and perspective from a variety of vehicles that were useful, informative, and important to this study. These sources ranged from scholarly journals, other dissertations, publications from proceedings, relevant and credible professional publications, professional organizations, and others.

The third chapter describes the Methods used to conduct the study, illuminating the quantitative components of the research, the sample utilized, and the approach to the analysis of the data collected. It further describes the process of how the study dealt with human subjects, and what measures were taken to appropriately handle this aspect of the research. The instruments used in the study are also described, and give reference to these documents in the appendix.

Chapter four presents the data collected and the findings of the study. This is primarily in raw form, without opinion from the author. The data are formatted based on how it has been analyzed by the author to best respond to the research questions.

The fifth and final chapter presents the author's conclusions based on the analysis of the data, as well as proposed future research suggestions. These opinions and

conclusions are couched to give potential stakeholders and future researchers a

compelling point of view for consideration, and summarize the results of the study.

CHAPTER 2

REVIEW OF LITERATURE

Chapter 1 introduced the study and its purpose, articulated the research questions, and defined the problem statement, definitions, significance, organization, and limitations. Chapter two will present the review of literature, including a variety of relevant angles to give perspective on the construction industry, its history and projected future, and the nature of field managers within it. This chapter also presents findings in the literature relevant to generational characteristics and tendencies, as well as findings germane to adult education and learning styles to provide a context by which the research methods were employed. The review includes studies from a variety of disciplines, including education, construction, engineering, business, education, psychology, and others. Peer-reviewed journal articles and proceedings publications, other dissertations, books, periodicals, and other outlets were generally accessed through multiple databases, as well as through investigating references cited among relevant articles found, collectively presenting a thorough review to inform the study.

Purpose of the Study

The primary purpose of this study was to give insight into what learning styles and preferences are most dominant among field managers in non-residential construction in the Southeastern U.S., and to compare this data across age groups, frequency of formal training, and level of education.

Research Questions

The following research questions guided the study:

1. What are the learning styles and preferences of field managers in the non-residential U.S. construction industry?

2. What are the differences in learning styles and preferences based on age?

3. What are the differences in learning styles and preferences based on frequency of recent training or classroom instruction?

4. What are the differences in learning styles and preferences based on level of education?

5. Is there a relationship between level of education and frequency of recent training/instruction among field managers in the non-residential U.S. construction industry?

Master Builders and the Separation of Disciplines

It is important to understand the evolution of the related industries of the built environment and how the design and construction professional disciplines have behaved and changed over time. As this research was focused on learning styles of field managers in non-residential construction in the U.S., it is also necessary to better understand the target population, as well as how the need for continuing education defines its members as adult learners.

History and Background

Construction as an activity has roots and a history born of necessity, in its earliest forms a function of agriculture, shelter, and transportation. As societies developed over time, what would become the formal professions of architecture and construction today

can be traced back nearly four thousand years. In Babylonia, King Hammurabi reigned

from 1792 to 1750 B.C., and developed one of the earliest known codes to address

professional obligation for services to society related to design and construction (Beard,

Loulakis, & Wundram, 2001). The code addressed a variety of other disciplines,

including the military and agriculture, for all of which the penalties were harsh. Related

to construction, if the structure of a house was not proper such that it collapsed and killed

an occupant, the sentence for the builder was death (Foliente, 2000).

As the Roman Empire was developed, there were several historic milestones and

transitions that would impact the professions of the built environment. Around 40 B.C.,

Vitruvius is credited with the first documentation of design and construction processes

(Beard, et al, 2001). Conway and Roenish note that he "included a whole range of

examples of civil and military engineering in his influential ten-volume book, *De

Architectura*" (2005, p13). Vitruvius himself said that architects should have knowledge

in a wide range of subjects including geometry, history, philosophy, music, and others,

and that this knowledge should be a result of both theory and practice (1914).

After the collapse of the Roman Empire and near the end of the Middle Ages,

influence in design and construction resurged in the 15th and 16th centuries, most notably

in the context of cathedrals. Many of the most well known of these took decades and in

some cases centuries to build, and the concept of the designer – the architect – also being

responsible for construction was a matter of course. These master builders took on the

role of planner, artisan, architect, and engineer, and also were responsible for managing

falsework, manpower, materials, and many other resources (Beard, et al, 2001). One of

the most well known master builders was Filippo Brunelleschi, whose signature work in

the 1400's was the design and construction of the cupola of the Duomo, the cathedral in Florence, Italy (Diekmann, 2007). With original construction beginning in the late 13th century, the cathedral's cupola delivered by Brunelleschi featured what is recognized as the first full structural dome ever constructed; a monumental design and engineering accomplishment that still stands today.

At around the same time in the mid 15th century, Leon Battista Alberti, too, was an architect in Italy, and was also an accomplished sculptor, poet, author, and priest, among other things. From a design and construction professional perspective, however, he is most known for the intentional separation of the art from the craft, and establishing the communication of design primarily through drawings (Tavernor, 1998). While Alberti did not share the same passion for the construction aspect, the responsibility for both disciplines still remained with architects through the 18th century.

Separation of the design and construction disciplines is often credited to a movement in architectural education in Paris, at the École des Beaux-Arts in the mid-1700's. Not only did this have an influence in Europe, but would also be the beginnings of change in what would become the United States. Many American architects were educated there because formal university training in the field did not exist in the then colonies until the early 18th century (Thomson & Sanders, 2011). With support from the French government, the École des Beaux-Arts couched architecture as a fine art, which became an early impetus for the separation of design and construction with an impact far beyond its national borders.

By the mid-1800's, the United States had established itself as a leader in advancement and ingenuity. Although somewhat interrupted by and in some ways

compelled by the Civil War, the Industrial Revolution of the mid to late 19th century had a substantial impact on the design and construction industry. The associated entrepreneurism fostered task, labor, and skill specialization, allowing for much more complex buildings and other man-made developments in the built environment (Beard, et al, 2001). Electricity was soon harnessed, prompting new motors, pumps, elevators, and other devices by which buildings and civil projects were improved (Hughes, 1984).

Another major technical discovery around the same time was that which prompted the shift from the use of structural iron to carbon steel, enabling designers and builders to dramatically increase span and height, which had been historically limited. By the 1950's, air conditioning also became part of the scope of mechanical engineers in the building process. From a current point of view, Thomsen and Sanders note that "The past 150 years have seen breathtaking technological change and economic vitality driving ever-increasing specialization and fragmentation" (2011, p11).

During the Industrial Revolution of the 19th century, another important development was the creation of professional societies and organizations related to the design and construction disciplines. The American Society of Civil Engineers was founded in 1852, and is the oldest engineering society in the country (ASCE, 2016). The American Institute of Architects was founded in the U.S. in 1857 to "promote the scientific and practical perfection of its members" and to "elevate the standing of the profession" (AIA, 2016a). These new organizations provided their members specialized knowledge, standards of practice, advocacy of markets, and the beginnings of endorsed contract language (Thomsen and Sanders, 2011), and in doing so continued and fostered the separation of the design and construction disciplines. Also contributing to this

disciplinary segregation around the same time, formal licensure began to emerge as part of the professional design disciplines, the first of which was for architects in 1897 (Beard, et al, 2001). Relative to this on the professional liability and negligence front, the design community developed what is known as the professional standard of care, acknowledging that design is imperfect, but that architects and engineers approach it with reasonable skill and judgment (Sapers & Merliss, 1988). While this had good intentions, it was one of the bases for what would become a significant shift of risk to the owner and the contractor.

A major legislative milestone that had a profound impact on the mounting separation between design and construction was the Miller Act of 1935. Among other things, the primary purpose of the act was to require distinct bonds for both payment and performance on federal construction projects, to protect the government as well as subcontractors and suppliers (Wallick & Stafford, 1964). In effect, this also underwrote and exacerbated the distinction between the disciplines, in that firms specializing in design did not or could not pursue the construction portion of the project. With substantial U.S. construction following WW II shortly afterwards, the most common delivery of public and private projects was that by which a firm was selected to provide design services, and after which another firm was chosen for construction on a price competitive basis (Beard, et al, 2001). This project delivery method was called Design-Bid-Build, referring to the linear nature in which the contractor, by now a fully separated discipline, was selected on a price-competitive basis only after the architect and/or engineer had completed the design. As a method, it continues to be used today.

Modern Shifts in Project Delivery

With the majority of U.S. construction projects being delivered Design-Bid-Build during the better part of the 20th century, as a method there was significant precedence in practice as well as in the judicial system which further normalized the separation of disciplines. While there were and continue to be a wide variety of available contracts for design and construction, those developed by the American Institute of Architects (AIA) are widely recognized and used. The first AIA contracts were developed in the late nineteenth century, and the first version of the standardized General Conditions for Construction, the AIA-A201, was published in 1911 (AIA, 2016b). The AIA has updated the A201 document many times, and since the 1950's, about every ten years. From the second half of the 20th century until present, the changes to the general conditions have often been a source of tension and disagreement among architects, owners, and contractors, as risk allocation between the parties has shifted away from the designers significantly over time (Sheak & Korzun, 1988; Maloney, 1990; and Lesser & Bacon, 2008). And at least for a substantial portion of the 1900's, this shift continued to intensify the segregation of the design and construction professions.

In the 1970's and early 1980's, multiple forces began to have an impact on the future of project delivery, not the least of which was the hyperinflation of construction lending rates. Owners as a community demanded new ways to deliver projects to meet budget, schedule, and quality expectations. Two delivery methods began to surface in mainstream non-residential U.S. construction: Construction Management at Risk, and Design-Build (Gordon, 1994; Teicholz, 2013; Beard et al, 2001), both of which featured involvement and contribution by the builder during the design phase. The Construction

Management Association of America (CMAA) defines Construction Management at Risk as "a delivery method that entails a commitment by the CMR [construction manager at risk] for construction performance to deliver the project within a defined schedule and price, either fixed or a Guaranteed Maximum Price (GMP). The CMR acts as a consultant to the owner in the development and design phases, but as the legal equivalent of a general contractor during the construction phase" (2012, pp 6-7). Similarly, the Design-Build Institute of America defines Design-Build as "a method of project delivery in which one entity – the design-build team – works under a single contract with the project owner to provide design and construction services" (2016). Both of these delivery methods quickly became established in the industry, and saw their employment as a method desirable for many project owners (Thomsen & Sanders, 2011; Hermann, Hermann, & McGlohn, 2015). Perhaps more importantly, both methods presented a manner in which the separated professions of architecture and construction could work together during the design phase of a project. These contractual frameworks continue today in a significant portion of non-residential construction in the U.S. (Hermann, et al, 2015).

Most recently, there has been another distinct arrangement and delivery method to surface called Integrated Project Delivery, which forms a team of specialized designers, builders, and the owner, all of whom execute a single contract document (Franks, Reyes, & Pittenger, 2015). Synonymous names include Multi-Party and Tri-Party contracts. While only having been utilized in the past ten years, this project delivery method has been shown to be effective for particular project owners who are comfortable with a

highly trust-dependent arrangement and the distinct difference in sharing mutual risk and reward among all parties (Pishdad-Bozorgi & Beliveau 2016; Hermann, et al, 2015).

Based on these relatively new developments in delivery strategy, along with dozens of nuances and hybridizations that are now commonly used, and coupled with the increasing complexities of buildings and other projects, the specialization among stakeholders and contractual parties in the related disciplines continues to evolve rapidly (Spence, 2006). Additionally, the information age of the late 20th century to the present has had an extraordinary and consequential impact on the industry and added to the fragmentation in spite of delivery methods' facilitating cooperation. It is based on the convergence of all of these forces that there is a need for today's builder to be educated and trained continuously (Thomsen & Sanders, 2011).

Training and Education in the Disciplines

The beginnings of education in architecture, engineering, and construction in the U.S. are an important part of history, and like other academic subjects such as language, philosophy, military strategy, and law, were influenced by other countries. In the eighteenth century, many colonial professionals were either educated elsewhere, or in several cases had more of a classical or liberal education, after which they migrated into a technical discipline. Many iconic buildings from early U.S. history were designed and overseen by such architects, including the U.S. Capitol and the White House.

England and France both have distinct histories in the development of formal building design training. In 1676, the Corps du génie was established for the French Army, and then later the École Nationale des ponts et chausses [School of roads and bridges] in 1757 (Schexnayder & Anderson, 2011). The French model was largely

theory based, and as such couched in formal educational programs. The English model, however, was largely apprenticeship based, much like for associated construction trades such as stonemasonry and the guilds that preceded them (Cardwell, 1972). U.S. education of the disciplines borrowed from each, and began to emerge quasi-formally during the time of the Revolutionary War.

At the university level, the first formal engineering school in the United States is considered the U.S. Military Academy at West Point, established in 1802 (Grayson, 1977). Although there was no formal curriculum for civil or related engineering in the Academy at the time, it did emerge about ten years later. Soon afterwards, there were many other U.S. institutions that soon developed civil engineering curriculums in the 19th century, including Rensselaer Polytechnic, MIT, and others. Later that century, curriculums dedicated to architecture also emerged, including the first at MIT in 1865 (Thomsen & Sanders, 2011). The Morrill Act of 1862 established state land grants for the purpose of advancing agriculture and the mechanical arts, which further prompted the development of many engineering and design-related programs nationwide. Many other events and milestones over the next century precipitated the need for more programs, one of the most substantial of which was the Federal Aid Highway Act of 1956 to support the interstate system (Willenbrock & Thomas, Jr., 2007).

Following the Morrill Act and as the disciplines of design and construction became mutually independent in the early 20th century, an educational demand surfaced recognizing the management of the construction process being distinct from architecture and engineering. The first university program dedicated to the discipline of building construction is generally credited to the University of Florida in 1935 (University of

Florida, 2016). Shortly afterwards, similar programs were developed at Auburn University, Michigan State, and others. Today, there are now 76 baccalaureate construction management programs representing 39 states in the U.S. that are accredited by the American Council for Construction Education (ACCE, 2016), and several others by the Accrediting Board for Engineering Technology. Today, university programs in construction feature student learning outcomes that speak to a wide range of subjects, including materials and methods, structures, building systems, project budgets and schedules, construction law, project delivery systems, and others (ACCE, 2016).

With the manifestation of more complex buildings and structures, hybridized project delivery systems, advancements in information technology, and a range of other burgeoning facets of the industry, construction firms of today must consider education, and perhaps more importantly continuing education differently. There are a number of different strategies employed, including jobsite-based, company-wide, partnerships with academia, or event-based efforts (Suh, Pearce, & Jeon, 2014). The question is whether these strategies are developed based on what is convenient to the firm, or what is best for the adult learner students.

Modern Advancements, Processes, and Employed Technology

Current Technologies in the Industry

The construction industry is changing rapidly, not only on the fronts of project delivery and design complexity, but also based on technology and innovation that are permeating the profession. These advancements are readily seen in the built projects themselves, but also are part of the means and methods of how the project is constructed. Most often in the position of superintendent, construction field managers of today and of

the future must be knowledgeable and in many cases facile with these technical tools. Their competency and leadership on a construction site has a direct link to success and profitability (Badger, Wiezel, Adams, & Bopp, 2012). Many of these innovations are now pervasive in the industry, with adoption increasing at an increasing rate, further ratifying the need for continued training and education for these adult learners.

Virtual Design and Construction

The origins of what is now commonly known in the industry as virtual design and construction (VDC) had at its modern beginnings a base process called Building Information Modeling (BIM). While there were several individuals developing BIM's early parametric framework in the late 1970's and early 1980's, most notably were those at Stanford and Georgia Tech. The early research concepts were implemented in Computer Aided Design (CAD) platforms, although only until the late 1990's and early 2000's was BIM considered a developing standard in the industry (Migilinskas, Popov, Juocevicius, & Ustinovichius, 2013). Mainstream publication and use is considered by many as around 2006-2007, with adoption in the construction industry quickly leading to similar transition in the architecture and engineering professions (Woo, 2007; Gier, Loftin, & Coogan, 2006; Azhar, Hein, & Sketo, 2008).

Today, BIM and related VDC software platforms have a variety of applications in the design and construction industries, including 3, 4, and 5-dimensional modeling, coordination and clash detection, sequencing and time studies, constructability, safety, and others (Farnsworth, Beveridge, Miller, Christofferson, 2014). It has also found several practical uses in the measurement, evaluation, and implementation of sustainability in construction projects by modeling not only the physical site conditions

and components, but also the weather and environment (Azhar & Brown, 2009; Pandey & Shahbodaghlou, 2015; Cidik, Boyd, Hill, & Thurairajah, 2014). Its use now spans much of the private and public sectors of projects in the industry, in some cases as far down as small scale K-12 work in several states (Feng, Olbina, Issa, 2014).

From an educational perspective, training and coursework is also prevalent (Ghosh, Chasey, & Root, 2013; Lee & Hollar, 2013). There are also increasing high expectations of understanding and ability in the industry (Windapo, Odediran, & Akintona, 2015; Chae & Kang, 2015; Langar & Pearce, 2014), furthering the need for superintendents and other field managers at all stages of their careers to be educated.

Light Detection and Ranging (LiDAR)

Similar to BIM, LiDAR is a technology that was developed some time ago, but is now becoming common in its use in construction. The process of high-definition laser scanning allows for the relatively fast collection of millions of points, all of which can be spatially accurate to around 3mm. These point clouds can then be used to model and capture dimensions of conditions, including topography, buildings, equipment, and any other physical component within a line of sight (Meadati, Irizzary, & Liou, 2013). The technology is now being used on a variety of fronts, including longitudinal comparisons for scheduling progress measurement (Shin & Wang, 2004), structural damage assessment (Olsen, Kuester, Chang, & Hutchison, 2010), and civil infrastructure projects (Jaselskis, Gao, & Walters, 2005; Gordon & Slattery, 2008). With the technology's size and cost quickly decreasing, and its accuracy and applications quickly increasing, LiDAR presents another vehicle in which construction field managers need education and training.

Radio-frequency Identification (RFID) and Codes

RFID, barcoding, and QR coding have also provided new applications for technology in the construction process. One of the primary ways in which they are being employed is through supply chain management, inventory, and progress monitoring in construction (Jung & Jeong, 2015; Nasr, Shehab, & Vlad, 2013). Much like other advancements mentioned earlier, these technologies were developed several years ago, but are just now emerging in their use and application in the construction industry. Bar codes as a concept were actually developed as far back as the 1930's for the grocery industry (Cooper, 1989). Today, the range of uses in construction is wide, including outside of commercial and civil work by being employed in the residential construction sector for framing inspections and quality control (Gravitt, 2005).

Unmanned Aerial Systems (UAS) and Photogrammetry

One of the most recent technologies emerging in its use in construction is UAS, also referred to unmanned aerial vehicles (UAV), and drones. The adoption of UAS use in construction is quickly increasing, even with the current pilot constraints by the Federal Aviation Authority (FAA). A new set of regulations for pilots and procedures has been ratified to be effectuated in late 2016, which will likely result in an exponential increase in their use (Liu, Holley, & Jennesse, 2016). In the current infancy of their use, UAS are being flown for inspections of bridges and other civil projects (Cunningham, Lattanzi, Dell'Andrea, Riley, Huettte, Goetz, & Wilson, 2015; Gillins, Gillins, & Parrish, 2016). They are also being used for progress imagery, building skin and waterproofing inspection, safety hazard identification, and other applications in vertical construction (Liu, et al, 2016; Gheisar, Irizarry, & Walker, 2014). As managers, construction field

managers will utilize UAS more and more frequently, and will need education and training on their use, regulations, and applications of imagery output.

Related to UAS is yet another technology that was developed in the 20th century but is just now garnering mainstream use in construction. Photogrammetry is a process by which software recognizes common points in multiple images, and creates a 3-dimensional environment in which all of the images are stitched together in a mosaic. These models can then be a source by which to export a point cloud similar to that produced by LiDAR, but far more economically, based on the cost of equipment (Karan, Sivakumar, Irizzary, & Guhathakurta, 2014). The potential applications for photogrammetry and the point clouds they produce are substantial, including terrain, conditions assessment for structures, facades, and equipment, and many others (Dai & Lu, 2013). At the moment, however, the primary impediment to this technology being pervasive in the construction industry is accuracy. While image-gathering by hand or via UAS is relatively very inexpensive, the tolerance of measurement in the geospatial data for construction is currently tighter than what most photogrammetrically generated point clouds produce (Dai, Rashidi, Brilakis, & Vela, 2013; Dai & Lu, 2010).

Other Innovation

There are many other recent and emerging technologies that are impacting the construction industry, and as such providing impetus for its field managers to need additional and continuous education. In the context of safety, hazard identification is being improved using real-time data (Luo, Li, Huang, & Skitmore, 2016), and eye tracking devices are being used to improve reaction time for equipment operators and proximal workers (Mohammadpour, Karan, Asadi, & Rothrock, 2015). Assessment of

26

worker productivity is being improved using 3-dimensional imagery (Khosrowpour, Niebles, Golparvar-Fard, 2014). One unique project featured the utilization of Amazon Mechanical Turk as a way to analyze productivity through crowdsourcing (Liu, Golparvar-Fard, 2015). And 3D printing is showing promise on a variety of fronts in making transformational change in the industry by affording the ability to print components, connection hardware, and reinforcing for composite structural systems (Foy & Shahbodaghlou, 2015). All of which reiterate the need for field managers of the future to be current in technologies that can improve means, methods, safety, and productivity.

Advancements in Processes

In addition to changes and improvements in technology, superintendents and other field managers also find themselves amidst noteworthy shifts in processes affecting design and construction. Transformational shifts that are reinventing the role are prompting a need for a much broader base of knowledge and expertise beyond traditional trades and techniques.

Sustainability

The environmental impact of construction has been well documented, and according to the U.S. Energy Information Administration, as of 2014 buildings are responsible for 41% of all U.S. energy consumption (2016), and up to 75% of U.S. electricity consumption (Mazria, 2003). "What we need is a paradigm shift in the way we view energy consumption in this country. It's architecture – residential, commercial and industrial buildings and their construction materials - that account for half of all energy used in this country each year" (Mazria, 2003, p49). And while there have been many efforts to illuminate waste and energy consumption in the U.S. and worldwide over

the past 40 years, only in the past fifteen has there been mainstream movement toward shifting the paradigm. Today, efforts associated with green building are changing the approach of builders, architects, and owners, transforming the design and construction process in response to energy consumption (Nobe & Greenwell, 2016; Ahn & Pearce, 2007). Even so, the U.S. General Services Administration reports that energy consumption by buildings and those who occupy them is projected to increase over the next twenty years (2011). One of the early drivers of the green building movement was the Leadership in Energy and Environmental Design (LEED®) rating system developed by the U.S. Green Building Council in the 1990's, which continues to provide certifications for building projects as well as accreditation for individuals.

Aside from sustainable design strategies such as insulation quality, energy conscious heating and cooling systems, and water reclamation, there are also many sustainable practices that are now often expected in the construction process. The protection of ductwork interiors during construction, the sorting and recycling of waste, and the procurement of proximal materials to decrease transportation-related emissions are all examples of the many processes with which field managers must be versed (Keeler, Clevenger, & Atadero, 2013; Trujillo & Spencer-Workman, 2015). Many contractors also engage in assisting with life cycle costing analyses during the design process (Ozcan-Deniz & Zhu, 2014; Switala-Elmhurst & Udo-Inyang, 2014), all of which are now frequently part of the contractual requirements of a building project that necessitate the builder being knowledgeable in these facets (Taylor & Olsen, 2012). There are also several tangential impacts, such as those related to the financial implications of adaptive re-use projects (Farrow, Emig, Maloney, & Glenboski, 2011), as

28

well as the implication of information technology used in process management (Yip, 2010). Based on the overall process shift in the industry, field managers need a particularly firm grasp of the requirements and protocol, which often required training and continuing education.

Lean Processes

Another substantial process shift that has presented itself fairly recently in construction is that of lean practices, which was iterated from Toyota in the 1950's (Forbes, Ahmed, Yaris & Batie , 2014). There are a variety of practices in construction that have been adapted for which their aims are to systematically reduce wasted resources. One of the most common in the industry is pull-planning scheduling practices, in which planning is not just limited to managers, but also includes subcontractors, tradesmen, suppliers, and other stakeholders know as last planners (Mehany, 2015; Ghosh & Robson, 2014). Lean principles and practices in construction have also made their way into university curriculums, suggesting a wider need to make training and education available industry-wide (Leathem, 2014; Forbes, et al, 2014).

Prefabrication

One of the major tenets of lean practices is another major shift in construction process that is increasing in its employment in the building process is prefabrication. Often in construction, the installation of work in place is custom to a non-prototypical building, and as such has several inefficiencies. Today there are several uses of historically non-prefabricated building components that are being used in the construction process (Lu, Liska, 2008). Several current projects are pioneering the use of modularized bathrooms in institutional buildings, patient room headwalls in in-patient healthcare

29

buildings, and many others. Related research shows that stick-built wood framed

buildings in the non-residential and residential sectors can also be good candidates for the

use of prefabricated structural and envelope components (Azhar, Lukkad, & Ahmad,

2012), and that doing so can also contribute to reducing emissions thereby earning

LEED© credits (Adams, Sattineni, & Thompson, 2014). And as prefabrication continues

to grow in its use, BIM and other VDC technologies can be leveraged in the design and

construction processes to assist in maximizing project efficiency (Lu & Korman, 2010).

Industry Leadership and the Need for Understanding

In the past fifteen years, the industry has seen substantial changes at an increasing

rate in technology, project delivery, and intricacy of design. The use of information

technology in building, along with the advent of sustainability and the implementation of

lean strategies adopted from manufacturing, have added layers of complexity to the site

management process. With their adoption growing rapidly, it is critical for construction

site leadership to be current and facile to stay competitive (Gunderson & Gloeckner,

2011; Gunderson, 2011; Zhao, McCoy, Bulbul, Fiori, & Nikkhoo, 2015). In that

construction management professionals will be expected to keep pace with these rapid

changes, the need for effective continuous training and education throughout their careers

is inevitable, and a better understanding of their learning styles could help properly shape

these efforts.

Further complicating the issue is the retirement of Baby Boomers and the shortage

of potential superintendents who are qualified and interested in the nature of the position

to replace them (Perrenoud & Sullivan 2013). Not only does the position require a broad

knowledge base and planning skills, but operating outdoors in the elements, and in many

cases doing so far from home, make succession planning very challenging. The changes

in skillset requirements are prompting the source of future superintendents from

tradesmen who worked up through the ranks to those who were educated in construction

management or civil engineering programs (Gunderson & Gloeckner, 2011). While the

latter present academic competencies, they are often short on experience, and often lose

interest in the peripatetic lifestyle. This circumstance is also prevalent in the industrial

and other sectors of construction, although there is more of a tendency to promote from

tradesmen given the nature of the often self-performed scope of work in the contract

(Bowers & Clark, 2013).

In addition to the impending field management shortage, the industry recognizes

that there are shortcomings in effective continuous training and education (Koch &

Benhart, 2010). Many companies struggle with selection of the best delivery methods:

classroom, on-line, synchronous vs. asynchronous, etc. Each strategy has distinct

benefits, but all have drawbacks as well. Not the least of which is the resource of time,

particularly given the demanding nature of a superintendent's daily duties (Koch,

Benhart, & Jenkins, 2015).

In particular, the construction industry has struggled with providing field

managers effective continuing education and training related to technology. There are a

variety of cultural issues associated with information technology training in the

construction industry, although research on this topic is scarce. As an industry,

construction has historically also been very slow to adopt technology, further aggravating

the issue (Mitropoulos & Tatum, 2000; Thorpe, & Mead, 2001). More specifically,

within the design and construction industry as a whole there is resistance to change,

particularly toward information technology (Davis, 2004). Davis notes that demographic groups within the Architecture-Engineering-Construction (AEC) industry "were different in their likelihood of resistance, including profession, gender, computer understanding and experience, and awareness of past of future IT changes occurring in their company" (2010, p135). This suggests that not only is there resistance toward change and adoption of information technology, but that identifying how and with whom to best address the need may be challenging.

Generational Differences and Trends

"Today's generation of learners are quite different from past generations of learners" (Coates, 2007, pp38-39). Because of swiftly approaching changes in the rate of retirements, it is important to understand generations themselves, as well as differences and likely trends in how their demographic shifts will impact the workplace. There are copious amounts of findings in the literature on generational investigations, for which this study presents a broad overview as well as relevant information and data particular to the context. Coates further suggests that generational learning styles represent the characteristics unique to a particular cohort, and how they may have been shaped by shared or similar experiences along the way (2007).

There have been many studies and much debate on how generations as a concept were defined and developed. Pendergast notes that they are defined primarily based upon the way a particular age-based cohort responds to social change (2007). Stets and Burke further that members of the cohort develop a social identity, and ultimately belong to the group because of similar behaviors (2000). This would seem to be an obvious contention, questioning whether the group defines the social characteristics, or whether

the social responses and reactions define the group. Several studies have illuminated that the differences in the generational traits create conflict that are not easy to define, and as such more difficult to make hard boundaries (Joshi, Dencker, Franz, & Martocchio, 2010). Other studies suggest there is not enough empirical evidence to even establish legitimate boundaries in the first place, as there are too many other factors that impact behavior (Deal, Altman, & Rogelberg, 2010).

There is general agreement that there are five generations currently represented in the U.S., although only three are generally considered part of the workforce (Lambert, 2015). The Greatest/Silent Generation is generally retired, and Generation Z is presently about to enter the workforce, leaving Baby Boomers, Generation X, and Generation Y to comprise the demographic of working adults. Across these cohorts, generations tend to represent those born in about a 20 to 25 year span. There is, however, a fair amount of disagreement on exactly which birth years are included in each, which is predictable given that social characteristics and tendencies may be subjective at thresholds between the groups (Lambert, 2015). For purposes of this study, generations will be defined based on findings in the literature: Baby Boomers are those born from 1946 to 1964 (Rodriquez, Green, & Ree, 2003). Generation X includes those born between 1965 and 1981, and Generation Y defined as those born between 1982 and 2000 (Lancaster & Stillman, 2010).

According to the Pew Research Center, there were 76 million Americans born into the Baby Boomer generation, 55 million into Generation X, and 66 million into Generation Y (Fry, 2015). Fry continues that in 2015, the number of Americans in Generation Y, also now known as Millennials (Kaifi, Nafei, Khanfar, & Kiafi, 2012),

33

overtook the Baby Boomer generation based on the latter's decline, and that as the

Boomers pass, there will be more members of Generation X than Boomers by 2028

(2015). According to Catalyst, the Millennials will comprise over half of the worldwide

workforce, and that in the U.S., by 2025 they will represent three quarters of working

aged adults (2015). All of which suggests that as Boomers continue to quickly retire

from the workforce, and succeeded by the smallest of the current working generations,

that shortfalls in management capacity would be predictable.

Baby Boomers

Although until 2014 they were the largest generation represented in the

workplace, Baby Boomers are quickly retiring. As the fastest shrinking cohort in the

working U.S. population, this trend suggests a substantial need for succession planning.

As a group, Boomers are largely considered traditionalists who are disciplined and driven

having grown up shortly after World War II (Cepero & Williams, 2009). Eisner notes

that they are loyal first to the organization, and many are workaholics who will likely not

retire at 65, which could have an impact on the rate at which the generational shift

transpires (2005). Boomers are generally the parents of Generation X, with most

Boomers having witnessed the moon landing, the cold war, Vietnam, the Civil Rights

movement, and Watergate, reshaping their point of view on authority (Curran, 2001). As

hard workers, they are generally polite, and prefer not to offend (Marilyn, 2000).

Generation X

The cohort of Generation X collectively represents a somewhat different social

context, ironically in many ways as brought upon by having been born to Boomers.

Their parents encouraged creativity, and taught Generation X to speak up and question

authority (Wesner & Miller, 2008). Generation X tends to have more confidence in themselves than in the organization, and are resourceful in counting on themselves and peers (Lancaster & Stillman, 2002). This generation also saw a substantial increase in divorce rates and economic change, leaving many to be raised by one parent or in some ways even themselves (Meredith, Schewe, & Karlovich, 2002). Unlike the Boomers, Generation X is said to be much more independent and individualistic, more entrepreneurial with a better ability to adapt to change (Eisner, 2005).

Generation Y, also known as Millennials

With the continued emergence of new information technology, shifts in political and economic climate, and general social change, those growing up in the 1980's and 1990's are said to have an even different set of characteristics that are now increasingly impacting the workplace. As a group, they are extremely computer literate, smart and quick, and unlike older generations not afraid to try things and fail (Lancaster & Stillman, 2002). Because the birth years defining Generation X are relatively short, Millennials' parents are from either of the preceding two generations, perhaps contributing to hybridization based on parental influence. Millennials are optimistic, globally minded, and more categorically support diversity and tolerance (Andert, 2011). This open-mindedness also has an impact on the workplace in that they also prefer to not have too many regulations and rules (Kaifi, et al, 2012). In an effort to provide, in many cases their parents paved their way, often enabling or creating a sense of entitlement. On the other hand, by a much earlier age they have seen more violence, school shootings, and availability of drugs, often requiring more social maturity with which to cope. They are big believers in education, and as of 2008 almost 90% of them in the workforce had a

Bachelor's Degree, and 35% had a Master's degree (Wesner & Miller, 2008). In the

work environment, they prefer to operate in groups, collaborating with peers and others

(Lyons, 2004), and that family and community come before work obligations (Ng,

Schweitzer, & Lyons, 2010).

Intergenerational Nuances and Impact on the Workplace

In the workplace, Boomers are primarily driven and motivated by the attainment

of set goals, and are willing to reach them at the expense of personal life or recreation.

They tend to micro-manage, and at the same time be consensus builders (Eisner, 2005),

which can cause friction particularly with Generation X (O'Bannon, 2001). For the many

companies run by Boomers, younger generations, particularly Millennials, feel as if they

are not acknowledged until they have paid their professional dues (Kunreuther, 2003).

Given Millennials' attitude toward rigidity and rules, this also can create disharmony and

a lack of mutual trust and understanding. While valuable to progress, changes in

technology occurring at an increasing rate are also a source of differences in professional

opinion, particularly given the dichotomy of older generations' general experience and

wisdom versus younger generations' facility with computers (Swiggard, 2011). More

particularly in the construction industry, this data and information technology-driven

divide between generations presents potential for both opportunity and crisis (Cekada,

2012; Farrow, Liu, & Tatum, 2010).

Workplace Learning Style Differences

Collectively, these generational differences present a need to better understand

how industry can better prepare to educate and train its workforce by matching learning

styles and preferences to appropriate activities and information delivery. Johnson &

Romanello note that Boomers' discipline and goal setting mentality equates to a preference for contact with instructors in lecture environments, while Generation X may learn more quickly but on their own flexible terms (2005). They further that Millennials prefer creative group activities, employing technology whenever they can, with little tolerance for not having access to information (2005). FIT suggests that Generation X prefers real life context learning on an individual bases, while Millennials prefer virtual multimedia platforms in groups (2016). Ware, Craft, & Kerschenbaum state that often employers may need to utilize a more blended strategy, particularly if the subject at hand spans multiple generations. They continue that one-size fits all approaches are generally not successful (2007).

Adult Education

The convergence of changes in project delivery and technology, demographic shifts, and generational differences presents a need for the construction industry to consider how field managers will continually be educated. As students for life, it will be increasingly important to provide effective platforms for learning and engagement. When considering successful attributes and factors for such effective educational programs for these adult learners, it is important to understand the general background and history of adult education.

In perhaps some of its earliest forms in the U.S., adult education can be seen in the mid-nineteenth century on a variety of fronts. One of the earliest is through lyceums, a form of adult education through group study aimed at improving quality of life across multiple social levels. Lyceums date back to the early 1800's, including the American Lyceum Society began in Massachusetts (Gutek, 1991). Later that century, another

important part of the history of adult education was formed at Chautauqua Lake in New York State. This development was unique in that it was aimed at adults who wanted to essentially combine cultural education with recreational activities (Simpson, 1999). Into the twentieth century, the adult educational movement took on a more practical role in the U.S., through industrial-related training associated with manufacturing via the Industrial Revolution, followed by that associated with World Wars I & II (Gray & Herr, 1998). These developments along with many others helped shape the beginnings of what would become today's studies and research of the formally recognized academic field.

It was during this part of the early twentieth century that adult education was defined by Bryson (1936) as "All activities with an educational purpose that are carried on by people engaged in the ordinary business of life" (pp. 3-4). Later in the mid-1900's, several others surfaced as early investigators in the developing discipline. Cyril Houle was a central figure in education during this time, with his book *The Inquiring Mind* influencing many others to investigate the developing field of adult education. Houle's foci included self-directed learning, in which he developed a typology of three learners: goal-oriented, activity-oriented, and learning-oriented (Houle, 1961).

Other figures of note are Lindeman and Knowles. Eduard Lindeman was one of the first proponents of needs-based education (Lindeman, 1989), and whose research centered around adults' motivation to learn and the notion of life-long learning. Perhaps more widely known is Malcolm Knowles, who was influenced by both Houle and Lindeman. Knowles was not only another pioneer in the field, but also who formally distinguished between *pedagogy* being the "art and science of teaching children", and *andragogy* being the "art and science of helping adults learn" (Knowles, 1977, p. 38).

This was an important distinction, in that it suggests not only a difference in the audience, but that pedagogy is teacher-centered, whereas andragogy is self-directed.

It is through all of these efforts by which modern strategies for the development of adult education programs have manifested, and by which there is an increasing amount of research in the discipline.

Learning Styles and Instruments of Measure

Learning styles and associated preferences have been studied for quite some time, although with somewhat of a deliberated history. Studies on this front within or related to the construction industry and its professionals are few in number, hence the need for research. As compared to their counterparts in other traditional disciplines such as engineering, medicine, and law, construction management is a relatively new profession. As such, it is not surprising that that the literature on the subject is limited. While there has been little if any research on learning styles directly related to professionals in the construction industry, there have, however, been at least a few studies that focus on students in the discipline (Holt, 2015). Holt notes that there have been a variety of studies on the learning styles of students in other disciplines such as engineering, management, chemistry, nursing, and others (2015), but a rather short list related to construction management. Of the very limited studies of learning styles among construction students that were found, one utilized the Index of Learning Styles (ILS) as its instrument (Abdelhamid, 2003), and the other employed the Productivity Environmental Preference Survey (Harfield et al., 2007). The third was that of Holt, whose recent study was compelling in that the sample size was over 1200 students nationwide (2015).

While these student-based studies are quasi-relevant, the fact that studies on learning styles among construction professionals are fairly non-existent prompts a need to review the literature more broadly. An understanding of the iterative history of learning styles and their instruments, and the need for investigation in the construction profession could help inform a study as how to best structure research questions, methods, and experiments.

Learning Styles and Preferences

The early history of learning styles has somewhat of a debated history for decades. Differences in human personalities and thinking styles have been studied for some time, including widely accepted theories as far back as Jung in the early twentieth century. Jung's early work provided a prelude to learning styles as he investigated attitudes and thinking among introverted and extroverted psychological types (Jung, 1923). As to when the actual term learning style was first used, the literature is not consistent (Zhang, Sternberg & Raynor, 2012). They note that Sternberg and Grigorenko (2001) found the first use by Riessman in 1964, whereas they also illuminate that Riding and Cheema (1991) suggest the term was first used in the 1970's, although without a source or citation. Zhang et al also note that Keefe (1987) stated that Thelen probably used the term first in 1954. An extensive electronic search by Zhang et al, however, found that indeed the first use was by Riessman, but rather in 1962.

Based on the earlier work of Jung, Dewey, Piaget and others, Kolb was one of several pioneers in the identification of learning styles, as well as in the development of their measurement (1981, 1984). His experiential learning theory (ELT) and other early work in the 1980's has been the basis of the investigations of many others, and is cited in

a wide range of studies. Kolb states that "learners, if they are to be effective, need four different kinds of abilities: *Concrete Experience* abilities (CE), *Reflective Observation* abilities (RO), *Abstract Conceptualization* abilities (AC), and *Active Experimentation* (AE) abilities" (1981, pp. 235-236). Upon this basis, Kolb developed the Learning Style Inventory (LSI) to determine differences on two dimensions: abstract-concrete and active-reflective. While Kolb's work was largely focused on students, there are many professional applications that utilize his theories as their basis.

Around the same time period, Gregorc developed a model of learning styles, primarily in adults, based on perceptual quality and ordering ability. In his Mind Styles model that centers on paired dimensions of concrete vs. abstract, and sequential vs. random, individuals could be described in one of four categories: concrete-sequential, concrete-random, abstract-sequential, or abstract-random (Gregorc, 1982, 1984). Gregorc has continued this thread of research well into the twenty-first century, and his *Style Delineator* instrument is widely utilized in studying populations on the dimension of creativity, among adults as well as students. This part of the literature has relevance to the construction industry, in that Gregorc's model and measurement instruments are often used to discern creative ability. Professionals in the design and construction industries often display tendencies as visual learners, which could have a type of association with creativity. More recently on this front, as measured with the ILS instrument, Holt notes that construction management students have a very strong tendency and preference toward visual learning (2015).

Since the 1980's, there has been a wide range of research on learning styles and preferences, including a variety of classifications, dimensions, and measurement

instruments. Often, learning styles are compared to other related human styles. Zhang and Sternberg developed a taxonomy of seven styles, including learning, thinking, cognitive, teaching, mind, intellectual, and mode of thinking (2005). There have also been several expansions of related research into styles defined by personality differences, particularly those that are explained by generation and age (Felder & Brent, 2005; Kolb & Kolb, 2005; Rodgers, Runyon, Starrett, & Von Holzen, 2006). There continues to be much investigation of learning styles, and as of 2015 over 1,000 scholarly articles published alone containing the term in the title (Zhang et al., 2012).

Contention in the Literature

As with many research subjects, the literature also presents published opposing findings and counter positions. In scholarly investigations, it is important to consider these perspectives, in that both viewpoints contribute to holistically defining the subject. There are a variety of opinions by educational psychologists and fairly recent findings in the literature that question learning style research, most of which seem to be rooted in studies involving the learning styles of students.

Some investigators argue broadly that learning styles as a concept need more substantial research to be validated, including some studies that suggest that in the meantime, the concept should be ignored altogether. "The opponents, who are mainly those who espouse qualitative rather than quantitative research methods, dispute the objectivity of the [learning style] test scores derived from the instruments" (Coffield, Moseley, Hall, & Ecclestone, 2004, p. 126). These opponents argue that the measurement of learning styles of students come from the subjects themselves, for which the inherent subjectivity greatly questions both reliability as well as validity.

42

There are others who are not fundamentally opposed to the concept of learning styles in general, but rather more opposed to the notion of classification, suggesting that such compartmentalization is not practical in academic environments, and that it may even alter pedagogy (Pashler, McDaniel, Rohrer, & Bjork, 2008). They state that "even if a study of a particular learning-style classification and its corresponding instruction methods was to reveal the necessary evidence, such a finding would provide support for that particular learning-style classification only – and only then if its benefits surpass the high costs of student assessments and tailored instruction" (2008, p. 116). Other researchers have similar concerns and skepticism, suggesting that there may even be a disconnect between learning styles and achievement (Bhatti & Bart, 2013; Santally & Senteni 2013).

Perhaps the most contentious positions are those that suggest learning style classification is not only questionable, but in fact could be harmful. Scott pointedly states that "Rather than being of no particular consequence, the continuing endorsement of 'learning styles' wastes teaching and learning time, promotes damaging stereotypes about individuals and interferes with the development of evidence-based best practice" (2010, p. 14).

Instruments and Measure

There are dozens of published measurement instruments related to learning styles, including many that have been widely used for several decades and others only in more targeted instances. While each of them may have been utilized or studied in certain contexts, the literature suggests that there are a select number that have been employed much more frequently than others (Hall & Mosely, 2005). Several have been further

studied through their employment to investigate reliability and validity, providing compelling cases for continuation of use. Some of these instruments such as the earlier mentioned Kolb's LSI are largely aimed at academic environments, while others are aimed primarily towards industry. Several were initially developed for one or the other, but have migrated over time to be employed in both environments. A brief description of some of the more widely used instruments follows.

One of the most commonly recognized instruments was developed by Dunn and Dunn, which centers around student responses based on different instructional material stimuli (Dunn & Dunn, 1978). It is divided into five dimensions, each of which contains elements that are measured in the assessment. Allen, Scheve, & Nieter state that this instrument is possibly the most widely used model in learning style assessment (2011). It was originally developed for use in pedagogy, although use of the instrument has made its way into adult education in some areas.

Based on Kolb's early model, Honey and Mumford developed one of the first learning style assessments aimed primarily at managers in business/practice, the Learning Styles Questionnaire (LSQ). Their model centers on the identification of four preferences: activist, theorist, pragmatist, and reflector (Honey & Mumford, 1986). Gregorc's Mind Styles model and associated Style Delineator mentioned earlier are also widely utilized in industry for adults.

Felder and Silverman developed a learning style model in 1988, which had five classifications and was originally targeted toward engineering students (Felder & Silverman, 1988). A revised version called the Index of Learning Styles (ILS) was later developed by Felder and Soloman, and was shortened to four style dimensions:

active/reflective, sensing/intuitive, visual/verbal, and sequential/global. The ILS is used frequently in STEM academic disciplines, although ILS has also been used in a wide variety of other academic disciplines as well as in industry. As with other instruments, there have also been a variety of follow up studies on the ILS to assess its reliability and validity. And also as with other instruments, there have been a range of results. In general, the research on this front with respect to the ILS shows that the instrument's reliability and validity are suitable (Zwyno, 2003; Litzinger, Lee, Wise, & Felder, 2007; Felder & Spurlin, 2005.) Zwyno's research investigation on test-retest reliability showed no significant difference in three of the four dimensions, with the other marginal, $p = .049$. Her study investigated construct validity by comparing differences in results based on settings, participant groups, and the passage of time, for which ANOVA showed no significant differences between means (Zwyno, 2003).

Summary

This chapter presented relevant findings in the literature on the construction industry, its history and trajectory, and the generational and demographic-driven need for understanding adult education in the discipline. Understanding the separation and shifts in the design and construction professional disciplines and project delivery systems is critical to framing the need for continuing management education in the industries of the built environment. The review further addressed how understanding learning styles and preferences is important in the transitional preparation as Baby Boomers retire at an increasing rate, illuminating the need for proper andragogical strategies as the collective industry prepares for continued changes in technology and other facets of the business at an increasing rate. And finally, the review also presented findings on potential

instruments by which to measure learning styles and preferences, including rationale on

which could be appropriate for the study. Felder and Soloman's Index of Learning Styles

was presented as a potential instrument to be employed, including evidence of follow up

studies suggesting acceptable validity and reliability.

CHAPTER 3

METHODS

While there have been a substantial number of studies of learning styles across a

variety of sample populations, few have been directed specifically toward the

professional discipline of construction management. Even fewer, if any, have been found

that were aimed directly at construction field managers. With project delivery methods,

technologies, and processes systematically changing at an increasing rate, these

superintendents and foremen will need education and training that will likely be very

different than that experienced historically.

Chapter 1 presented the purpose of the study, the problem statement, the research

questions guiding the study, definitions, limitations, assumptions, and a general overview

of the investigation. Next, the review of literature in Chapter 2 addressed the evolution

of the design and construction professions, the range of new advancements and changes

taking place in the construction industry, and how stakeholders are starting to respond.

The review continued with a comparison of generational characteristics and a selective

historical review of adult education and learning styles, to better understand how to plan

for educating U.S. non-residential field management construction professionals of the

future. And finally, the literature review presented a discussion and comparison of

instruments of measure for learning styles, including follow up findings on reliability and

validity for the Index of Learning Styles (ILS). Chapter 3 presents the research methods,

specifically including the design of the study, variables used for comparison, the

47

mechanics of the instrumentation, information on the population, the pilot study and its findings, data collection strategies, and planned analysis of the data.

Purpose of the Study

The primary purpose of this study was to give insight into what learning styles and preferences are most dominant among field managers in non-residential construction in the Southeastern U.S., and to compare this data across age groups, frequency of formal training, and level of education.

Research Questions

The following research questions guided the study:

1. What are the learning styles and preferences of field managers in the non-residential U.S. construction industry?

2. What are the differences in learning styles and preferences based on age?

3. What are the differences in learning styles and preferences based on frequency of recent training or classroom instruction?

4. What are the differences in learning styles and preferences based on level of education?

5. Is there a relationship between level of education and frequency of recent training/instruction among field managers in the non-residential U.S. construction industry?

Overall Design of the Study

The investigation utilized a quasi-experimental quantitative approach, employing an existing instrument of measure in the Index of Learning Styles (ILS) to determine learning styles and preferences of field managers in U.S. non-residential construction.

48

Prior to the full study, a mixed-methods pilot effort was used to inform the overall investigation as to what independent variables would be practical and useful by which to compare the results of the ILS. Think-aloud sessions were conducted qualitatively with executives from commercial construction firms in the region to discuss relevant indicators and metrics. These types of qualitative efforts have been shown to provide rich preliminary insight into a planned protocol of a study (Fonteyn, Kulpers, and Grobe, 1993). Additionally, a quantitative pilot survey was administered to ascertain potential issues with the electronic collection strategy. Participants in the quantitative pilot were members of the construction industry, but not of the planned pool of field management participants.

Following refinement of the survey based on the pilot study, and after the appropriate approval by the university's Institutional Review Board (IRB), the full ILS survey was then delivered electronically to the targeted population of field managers, accompanied by demographic-based questions as determined in the think-aloud sessions in order to provide independent variables for comparison and analysis. The latter included questions to determine age, level of education, and frequency of recent professional classroom training/education (Appendix A), for which descriptive statistics of the dependent variables were determined, and then were compared against the ILS results using ANOVA.

<p align="center">**Population and Sample**</p>

The research sought to determine learning styles among field managers in U.S. non-residential construction, which required the particular identification of and access to participants. A fundamental assumption of the methods within the General Linear Model

is that participants are engaged at random, in order to assert generalizability. However, like most educational studies involving human subjects, this assumption is rarely met, based on the methods required to connect with participants in the first place (Strunk, 2016). As such, the sample for this study was purposive and of convenience, but which has been regular practice in a wide range of learning style investigations (Felder & Silverman, 1988; Abdelhamid, 2003; Holt, 2015).

This study included participants who were employed at the time of the investigation by non-residential construction firms, and who serve in field management positions including those of superintendent, general superintendent, assistant superintendent, foreman, and others as relevant. By way of contrast, the study did not include participants who were project managers, estimators, or others in the industry whose responsibilities would generally not include managing field operations on a non-residential construction site. The representative employer firms were all sizeable, with annual revenues at the time of the study between $100MM and $2.5BB. While there are many non-residential firms whose revenues are outside of this range, these parameters were set as to provide homogeneity in the general type of construction work performed, skillsets required of its field managers, and a broad age range of those in the related positions.

There was no constraint on sector of construction other than being non-residential. Representative employers undertake regular work in commercial, institutional, civil, and utility sectors, further contributing to an appropriate overall embodiment of the non-residential construction community.

And finally, the representative companies were also solicited based on their

location, as a function of relationships with the investigator. While this could be considered a limitation given that home and satellite offices were generally found in the Southeastern U.S., many of the projects undertaken by the firms are located nationwide.

Instrumentation

As revealed in the literature review, there have been dozens of instruments developed to measure learning styles and preferences, but with a limited number that have been utilized more frequently than others (Hall & Mosely, 2005). Reliability and validity play a key part in an instrument's continued use. Many of the compelling and regularly used instruments measuring learning styles are directed toward academic environments, while others were developed for more professional investigations. Several have since crossed this threshold in one direction or the other, hybridizing their respective use in both academia and industry.

For this study, the Felder-Soloman Index of Learning Styles (ILS) was chosen, primarily based on its development being targeted to an audience of some technical proficiency. Originally developed by Felder and Silverman in 1988 for engineering students, it was later revised by Felder and Soloman, shortening the instrument to measure four style dimensions instead of five, and formally naming it the ILS. Still used in many STEM related academic environments today, it has also migrated in its use into professional disciplines, particularly those relevant to science, math, and other related subjects. Based on the technical nature of heavy structures and complex mechanical/electrical systems in non-residential construction, the Felder-Soloman ILS was selected as an appropriate instrument for the study of field managers. Permission from its primary author, Dr. Richard Felder, was given in writing prior to its being

administered (Appendix B).

The Index of Learning Styles

The ILS measures learning styles and preferences based on eight characteristics, each of which is paired with another, producing four dichotomous dimensional scales. There are 44 questions, each with only two possible answers relevant to one of the four dimensional scales. Consistent with prior research (Holt, 2015), this study sequentially labels the four dimensions as follows, and is reflective of the work of Frazoni and Assar (2009), who assigned the order based the progression of the learning process: Learning Style Dimension One (LSD1) measures entry channel, with 11 questions related to a preference of visual versus verbal learning. LSD2 measures processing, with 11 questions related to a preference of active learning versus reflective learning. LSD3 measures learner perception, with 11 questions related to a preference of sensing style versus intuitive style. And LSD4 measures understanding, with 11 questions related to a preference of sequential versus global learning (Felder & Silverman, 1988; Holt, 2015).

Based on participants' responses to the 44 questions, the ILS plots preferences on the four dimensional scales, each indicating where on the scale the participant scored. Based on the 11 questions directed at each dimensional scale, participants could score more toward one extreme or the other or could be considered more balanced were the score more toward the middle. Each of these scales is framed as an absolute value of one to eleven in opposite directions. See Figure 1 for an example of individual ILS results.

```
Results for: Paul W Holley


ACT             X                                       REF
        11  9   7   5   3   1   1   3   5   7   9   11
                            <-- -->


SEN                             X                       INT
        11  9   7   5   3   1   1   3   5   7   9   11
                            <-- -->


VIS         X                                           VRB
        11  9   7   5   3   1   1   3   5   7   9   11
                            <-- -->


SEQ                             X                       GLO
        11  9   7   5   3   1   1   3   5   7   9   11
                            <-- -->
```

Figure 1. *Sample Results of ILS Dimensions*

Validity and Reliability

Since the development of the ILS instrument, there have been many follow up

studies into its reliability and validity. The entry channel and perception channel

dimensions have each been shown to have a reliability coefficient of 0.70, the processing

dimension one of 0.61, and the understanding dimension at 0.55 (Litzinger, et al., 2007;

Tuckman, 1999). Holt reiterates that "Each section within the ILS has been proven to

have an internal consistency reliability coefficient greater than the 0.50 minimum

coefficient set for assessments of preferences and attitudes" (2015, p. 33). Other studies

suggest suitable construct validity, demonstrating compelling correlation via test and re-

test (Zwyno, 2003; Felder & Spurlin, 2005, Litzinger, 2007).

Pilot Study

A mixed method pilot study was employed prior to the full study to investigate

potential independent variables by which to measure and compare results of the ILS. The

pilot study also sought to determine whether its electronic delivery was reasonable, and if

there were any electronic formatting issues that could negatively impact the data and

results.

Think-Aloud Sessions

Seven executives from three potential firms whose field managers might participate were recruited to engage in think-aloud sessions to inform the study. All expressed interest in the investigation, and acknowledged that the issue of continuing education and training for field managers based on industry change as well as generational shift was perceived as a real challenge to their respective firms. As such, there was unanimous interest in a comparison of learning styles based upon age. Several indicated that they were curious if level of education might correlate to particular tendencies in learning style preferences. Others suggested that field managers who regularly participate in formal classroom education environments as adult learners might demonstrate different style preferences than those who had not recently participated in such activity. All of which were helpful in developing demographic-based questions to accompany the ILS, by which independent variables could be developed for useful analysis.

Pilot ILS Survey

A complimentary component of the preliminary study was to administer the ILS in a pilot effort, to determine if the electronic delivery was well received, and if there were logistics issues with the electronic format. The other goal of the pilot was to determine if there were natural breaks in age ranges based on the pool, so that categorization in the full study could be validated.

Seventy-five potential participants were identified, representing an age range of 21 to 62 years. The pool represented a range of years of field management experience of

1 to 35+ years, and also a range of companies/institutions represented. Given that the

research questions were aimed at understanding not only learning styles, but how those of

different generations compare, it was important to ensure an appropriate sample on these

fronts. Representative firms of those participating in the pilot study have home and

regional offices located from coast to coast, although with a concentration in the

Southeast (Figure 2).

Figure 2. *Location Map of Home and Regional Offices of Representative Pilot Study*
*Employers*

The targeted pilot study pool was sent an introductory email and request to

participate in the pilot study on a Tuesday morning at approximately 9am. A follow up

email was sent two days later to encourage those who had not yet taken the survey to

participate. The software platform employed in the pilot study was Qualtrics©, used

commonly in academic research.

As of one week after the initial solicitation, 44 participants initiated the survey. Of these, 35 completed the survey, although only 32 answered all of the ILS questions. This represented a net response rate of 42.6%, and an overall sample size that was compelling for a pilot study. The response rate indicated a likelihood of participation in the full future study, as well as the length of the survey being reasonable with most participants who initiated the instrument completing it. The length of time each respondent took to complete the survey was not analyzed in the pilot study, since the response rate was favorable.

Pilot ILS Results

Data from the survey were collected through exported Qualtrics© reporting mechanisms. While the survey was administered anonymously, the Qualtrics© report did include IP addresses for respondents. These were immediately deleted from the reports, with only a randomly generated respondent identifier of alphanumeric characters remaining to distinguish responses from one participant to the next.

For each respondent, their individual ILS results were calculated for all four dimensional scales: Active vs. Reflective, Sensing vs. Intuitive, Visual vs. Verbal, and Sequential vs. Global. From these results, an overall average of all four ILS scales for all participants was determined, yielding the results shown in Figure 3.
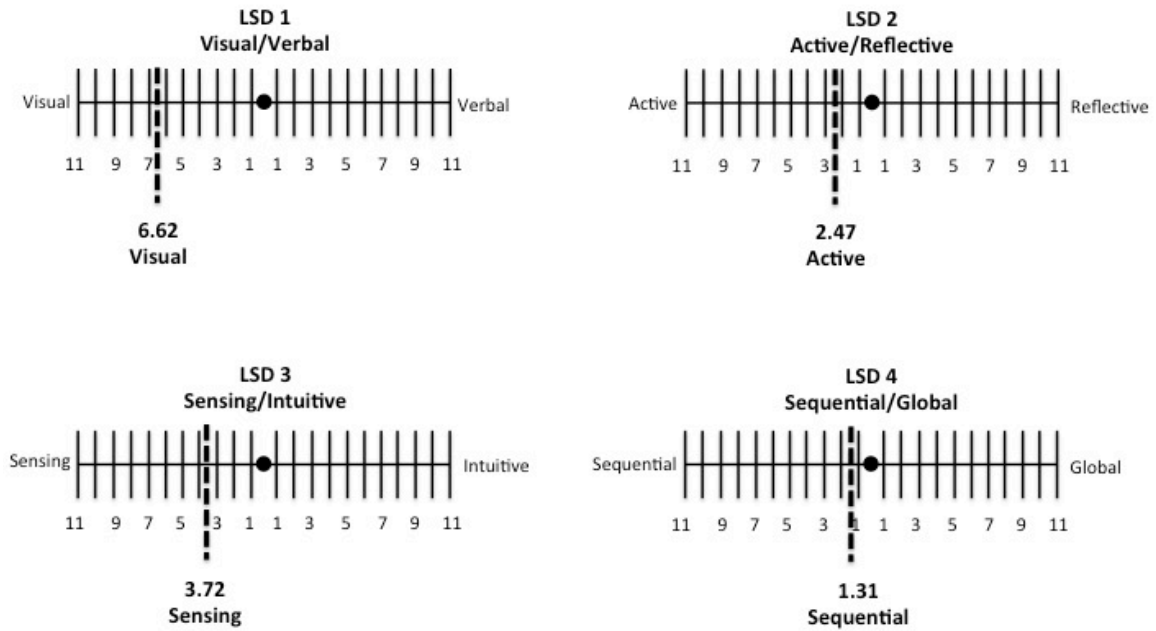
Figure 3. *Pilot Study ILS Results Among Construction Managers and Executives*

While the purpose of the pilot study was primarily to assess the format and delivery of the survey instrument, the investigator also segregated the results based on three ranges of age. This was done to determine whether there were early indicators as to differences in learning styles among a target population similar to the one to be used in the full study. Based on the pilot study sample, age can be articulated into nominal format in three ranges with reasonably similar sized populations: twenties ($N = 11$), thirties ($N = 10$), and forties-plus ($N = 11$). The results are shown in Figure 4.

Age 21 - 29 (*N*=11)

	11	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	
Active	11	10	9	8	7	6	5	4	3	2	1.00	1	2	3	4	5	6	7	8	9	10	11	Reflective
Sensing	11	10	9	8	7	6	5	4.33	3	2	1	1	2	3	4	5	6	7	8	9	10	11	Intuitive
Visual	11	10	9	8	7	6.36	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	Verbal
Sequential	11	10	9	8	7	6	5	4	3	2.09	1	1	2	3	4	5	6	7	8	9	10	11	Global

Age 30 - 39 (*N*=10)

	11	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	
Active	11	10	9	8	7	6	4.6	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	Reflective
Sensing	11	10	9	8	7	6	5	4	3	2.3	1	1	2	3	4	5	6	7	8	9	10	11	Intuitive
Visual	11	10	9	8	7.2	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	Verbal
Sequential	11	10	9	8	7	6	5	4	3	2	1	0.6	2	3	4	5	6	7	8	9	10	11	Global

Age 40+ (*N*=11)

	11	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	
Active	11	10	9	8	7	6	5	4	3	2.0	1	1	2	3	4	5	6	7	8	9	10	11	Reflective
Sensing	11	10	9	8	7	6	5	4.0	3	2	1	1	2	3	4	5	6	7	8	9	10	11	Intuitive
Visual	11	10	9	8	7	6.36	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11	Verbal
Sequential	11	10	9	8	7	6	5	4	3	2	1.34	1	2	3	4	5	6	7	8	9	10	11	Global

Figure 4. *Pilot Study Age Range Groupings to Validate Homogeneity of Representation*

The pilot study illuminated several important things. From a formatting perspective, it was determined to be imperative to set up the web-based instrument such that respondents answer all of the questions. Not requiring each question to be answered before moving forward resulted in a few incomplete responses. Given the nature of the ILS scoring, participants' feedback with even one missing response resulted in the inability to score one of the dimensional scales properly, so the entire response set for that participant had to be eliminated. The follow-up emails appeared to be essential in helping populate the results, as approximately 20% of the participants did so after the reminders were sent. And finally, the results of the pilot effort suggested age ranges by which to compare the ILS results in the full study.

Implementation of the Full Study Survey

The instrument was submitted to the university's Institutional Review Board (IRB) for an expedited approval, given that the potential risk for participants was

minimal. Appendices to the proposal included copies of the investigator's and advisor's

Collaborative Institutional Training Initiative (CITI) certificates; a copy of the survey as

would be seen by participants on a computer screen, phone, or other mobile device; a

copy of sample language soliciting participation; and representative permission and

confirmation of interest from construction firms whose employees were potential

participants. The proposal was approved by the IRB in May of 2016 (Appendix C).

The survey including the demographic questions and the ILS, and was

administered from May until July of 2016 through the Qualtrics© platform. The pilot

study think-alouds suggested that solicitation would be better received if through a

company executive as opposed to the investigator. Participating firms were given

prescriptive language to use in an email correspondence to the target pool of field

management participants in their respective company. The correspondence clearly

articulated the purpose of the study, that participation was voluntary, that responses

would be anonymous, and that there was no compensation for engagement. In addition to

the link to the Qualtrics© based survey, a copy of the IRB language and the assigned

number of the study were also included. As a function of the pilot study, reminder

correspondence was also sent within two to three days of the original solicitation.

Participants could access the survey based on any fixed or portable device that

had an internet connection. The survey format required participants to answer each

question before progressing to the next, minimizing the number of incomplete responses

as illuminated by the pilot study. The survey access was closed in July of 2016 so that

data analysis could commence.

Data Analysis

After the survey access window was closed, data were exported from Qualtrics into Excel and IP addresses and location data were deleted. Responses to the ILS questions were coded on a scale of 1 – 22, representing the dichotomous ILS scales of 11 in each direction, so that scores would be on an interval basis for analysis. By way of example, a participant whose score on the entry channel dimension was a 7.5 in the direction of visual over verbal preference would be coded as 4.5 on an interval scale of 1 – 22 (Figure 5).
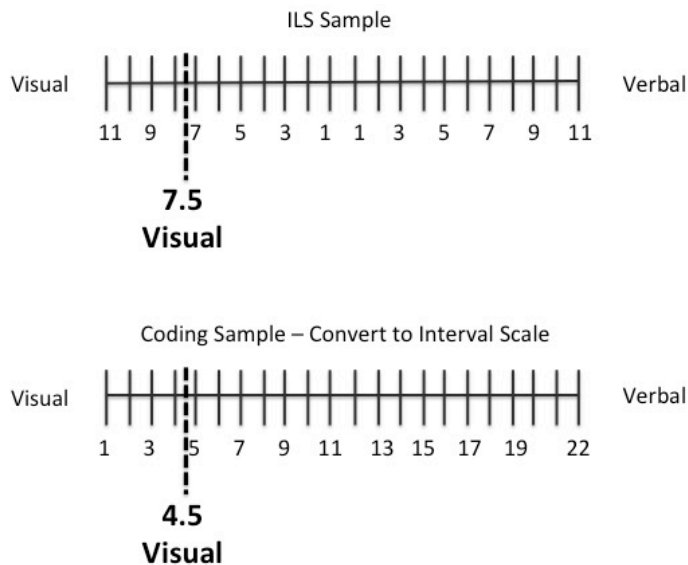
Figure 5. *Sample ILS Score, Coded to Interval Scale*

Descriptive statistics were analyzed using SPSS© for Windows, reporting means and standard deviations, as well as results for skew and kurtosis to address normal distribution and central tendency. Based on the research questions, the appropriate omnibus test to compare ILS results to participant age, education level, and frequency of classroom training was determined to be ANOVA. To determine if there was interaction between level of education and frequency of training based on ILS results, a Chi-Square

analysis was used. Whether the assumptions of ANOVA were met or not were also analyzed, including independence of observation, randomness of the sample, distribution normality, measurement basis of the dependent variables, and homogeneity of variance. The latter was analyzed using Levene's test. In addition to the determination of p values, effect sizes were also analyzed using ω^2, to better understand the scale of the impact of the independent variables based on the ILS results. For the ANOVA analyses, post hoc Tukey pairwise comparisons were utilized where there were significant differences found in the dependent variables.

Summary

This chapter re-stated the purpose of the study and the research questions, and presented the design of the research and its pilot study, the population and sample, the instrumentation utilized and its reliability and validity, data collection procedures, and strategies for data analysis. The survey instrument and data collection procedures were pre-approved by the university's Institutional Review Board (IRB).

CHAPTER 4

FINDINGS

The findings of the study and their associated data for each of the research

questions are presented in Chapter 4. Descriptive statistics based on the responses to the

Index of Learning Styles (ILS), demographic data, and analyses of variance in ILS results

based on independent variables were developed using the Statistical Program for Social

Science (SPSS©).

Purpose of the Study

The primary purpose of this study was to give insight into what learning styles

and preferences are most dominant among field managers in non-residential construction

in the Southeastern U.S., and to compare this data across age groups, frequency of formal

training, and level of education.

Research Questions

The following research questions guided the study:

1. What are the learning styles and preferences of field managers in the non-

   residential U.S. construction industry?

2. What are the differences in learning styles and preferences based on age?

3. What are the differences in learning styles and preferences based on frequency of

   recent training or classroom instruction?

4. What are the differences in learning styles and preferences based on level of

   education?

5. Is there a relationship between level of education and frequency of recent training/instruction among field managers in the non-residential U.S. construction industry?

Data Collection and Overall Information

Potential participants were contacted via email through their respective employers within the non-residential U.S. construction industry, and offered the opportunity to participate. The solicitation emphasized that participation was voluntary, and included a copy of the approval by the university's Institutional Review Board (IRB). The survey was administered through Qualtrics©, and data were retrieved through this platform's exportation to Excel©. Once in Excel©, IP addresses and location data were deleted, removing the only potential identifiers of participants in accordance with the IRB-approved protocol. Next, results were coded into the appropriate ILS Learning Style Dimensions based on instructions from the instrument's author, Dr. Richard Felder, from whom permission to use the vehicle was obtained. Any incomplete or otherwise non-responsive survey results were removed. Data were then collated and sorted appropriately so that overall descriptive statistics and analyses of variance could commence.

For research question 1, descriptive statistics were analyzed to determine response means, standard deviation, and indications of normality including skewness and kurtosis. For research questions 2 – 4, analyses of variance data were analyzed to determine if basic assumptions of the omnibus tests within the General Linear Model were met, including:

- Independence of observation

- Randomness of sampling

- Normality of distribution

- Interval-basis measurement of the dependent variables

- Homogeneity of variance

Effect sizes measured by ω^2 were also calculated for ANOVA where significant differences were found. Tukey post-hoc pairwise comparisons were also employed where appropriate, if significant differences were found in the ANOVA. For research question 5, data were analyzed using a Chi-Square test for independence to determine if there was a relationship between the independent variables of level of education and frequency of classroom training.

In this chapter, descriptive statistics, ANOVA results, and Chi-Square results are reported based on the coded interval scale as described in Chapter 3 and as shown in Figure 6, but corresponding scores in the format of the original instrument's dichotomous scale are also described and shown in complimenting figures. An alpha value of .05 was used throughout for ANOVA and Chi-square analysis ($\alpha = .05$).
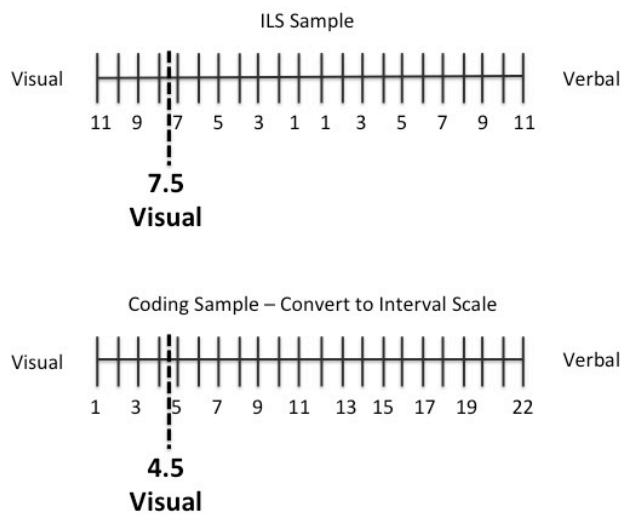
Figure 6. *Sample ILS Score, Coded to Interval Scale*

Overall, 510 potential participants were solicited, of which 296 began the survey. Of these respondents, 270 completed the instrument ($N = 270$), yielding an 8.78% dropout rate and a net response rate of 52.94%. All participants were over the age of 18 in accordance with IRB protocol. To illustrate the geographic reach of the study, a map of representative home offices and project sites of those solicited at the time of the study is shown in Figure 7.

★ = Office locations of participants' representative firms

● = Jobsite locations of participants' representative firms
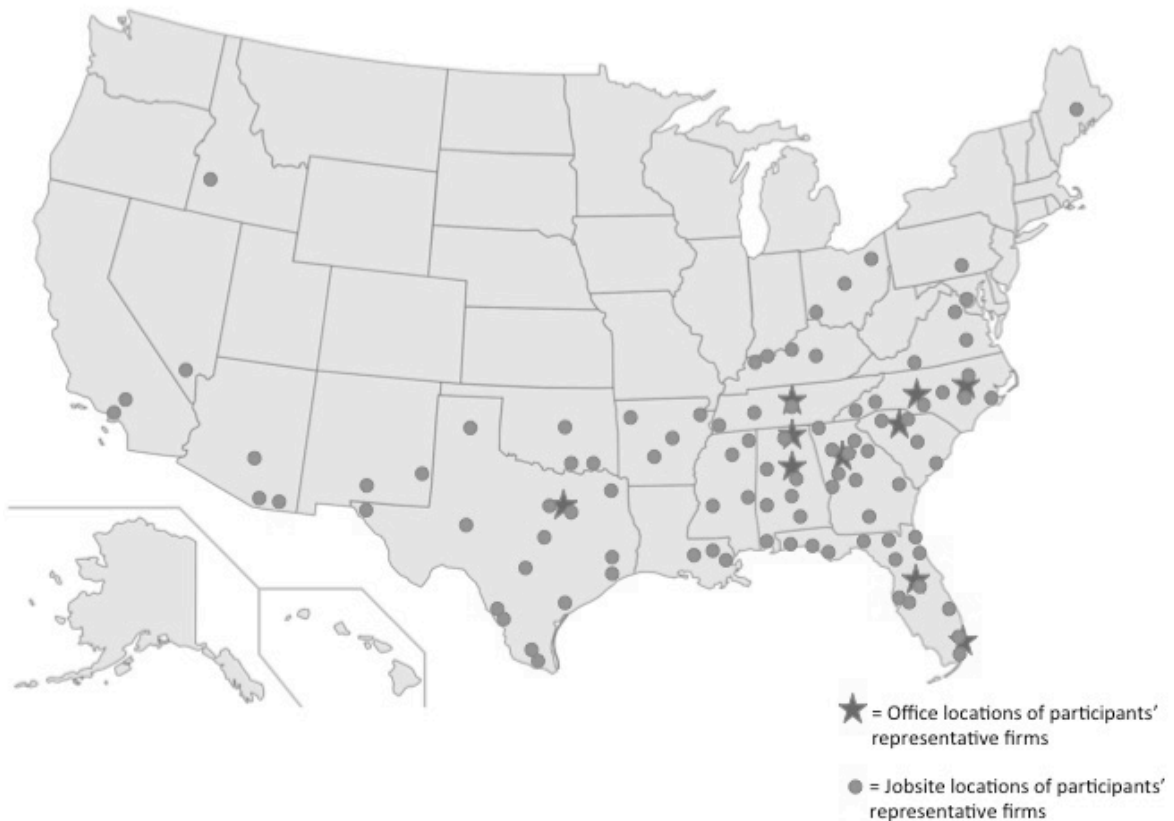
Figure 7. *Representative Home Offices and Jobsites of Those Solicited at the Time of the Study*

Results of the ILS

Results of the ILS and their respective analyses are presented in the context of each research question. Corresponding demographics and descriptive statistics are also

presented as appropriate to the independent variables associated with specific research
questions.

**Learning Styles and Preferences - Non-residential U.S. Construction Site Managers**

Research Question #1: What are the learning styles and preferences of field
managers in the non-residential U.S. construction industry? For Learning Style
Dimension One (LSD1-Visual/Verbal), respondents had a mean score of 5.45 ($M = 5.45$),
corresponding to a 6.55 in preference of visual over verbal learning on the ILS scale. For
LSD2 – Active/Reflective, respondents had a mean score of 11.01 ($M = 11.01$),
corresponding to a 0.99 preferring active over reflective learning on the ILS scale. For
LSD3 – Sensing/Intuitive, the group reflected a mean of 7.23 ($M = 7.23$), corresponding
to a 4.77 preferring sensing learning over intuitive on the ILS scale. And for LSD4 –
Sequential/Global, they showed a mean preference of 10.46 ($M = 10.46$), corresponding
to a 1.54 in favor of sequential learning over global on the ILS. Descriptive statistics can
be found in Table 1, and a summary of preferences as reported via the ILS is shown in
Figure 8.

Table 1

*Descriptive Statistics of Learning Style Dimensions Among Non-Residential U.S.*

Construction Field Managers Reported in Interval Scale (N = 270)

| Learning Style Dimension	*M*	*SD*	Skewness	*SE* of Skewness	Kurtosis	*SE* of Kurtosis
LSD1 – Visual/Verbal	5.45	3.25	.900	.148	1.19	.295
LSD2 – Active/Reflective	11.01	4.00	.000	.148	-.215	.295
LSD3 – Sensing/Intuitive	7.23	4.35	.792	.148	.475	.295
LSD4 – Sequential/Global	10.46	3.79	.202	.148	-.007	.295
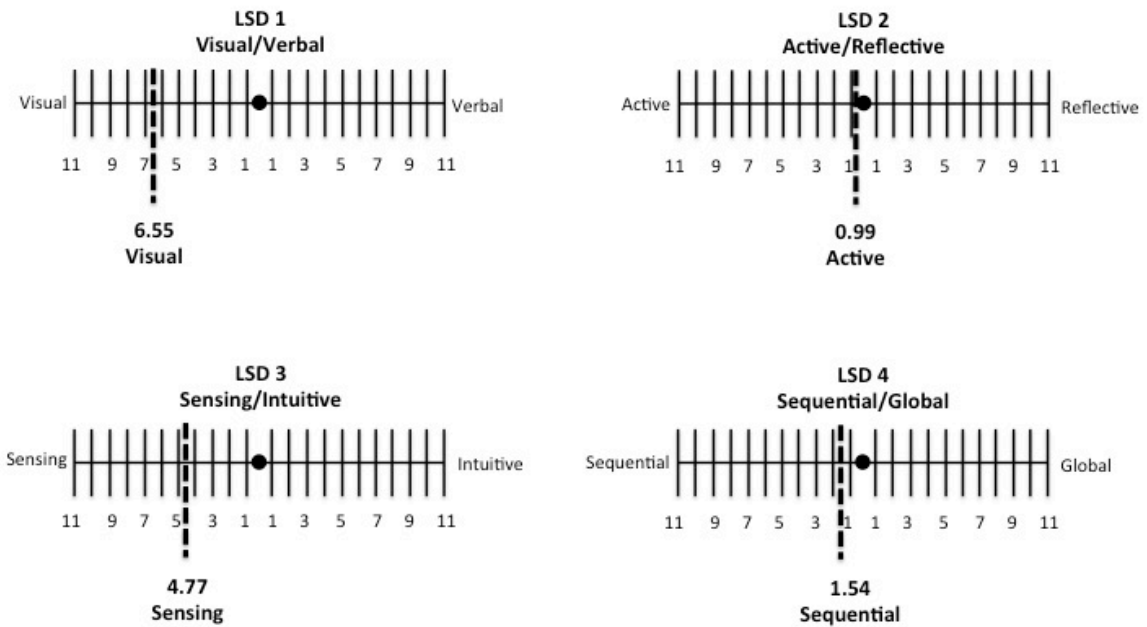
Figure 8. *Mean ILS Results Among the Sample of Non-Residential U.S. Construction*

Field Managers

For LSD1 Visual/Verbal, the analysis shows a positive skew and a leptokurtic

distribution, however, the nature of field managers in the construction industry may

explain this given their strong propensity to work with images, graphics, blueprints, and

virtual models on a daily basis (Figure 9).   LSD3 Sensing/Intuitive shows normal

kurtosis, but also a positive skew, which may be explained by the nature of the

construction industry, in which field managers may tend to employ proven practical

strategies as opposed to abstract or conceptual solutions (Figure 10).
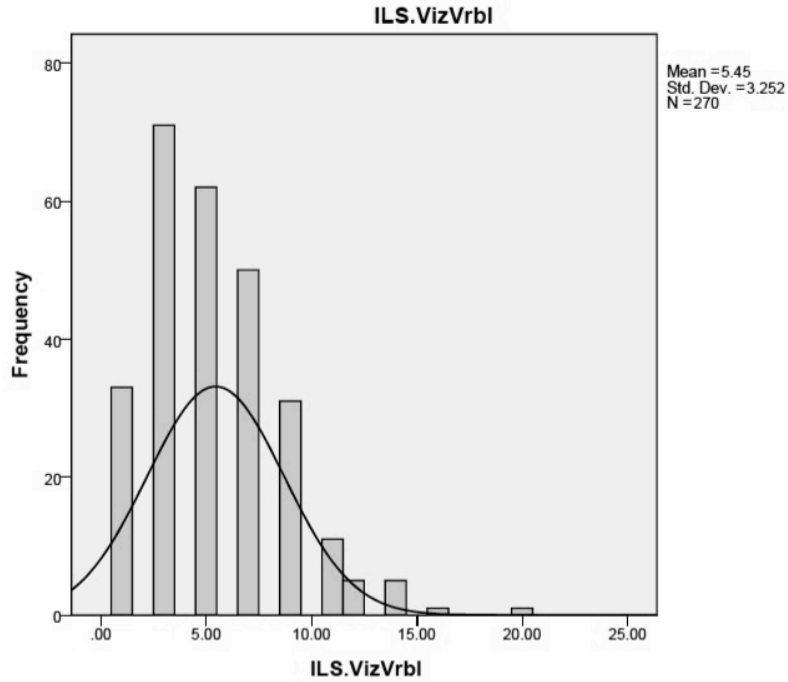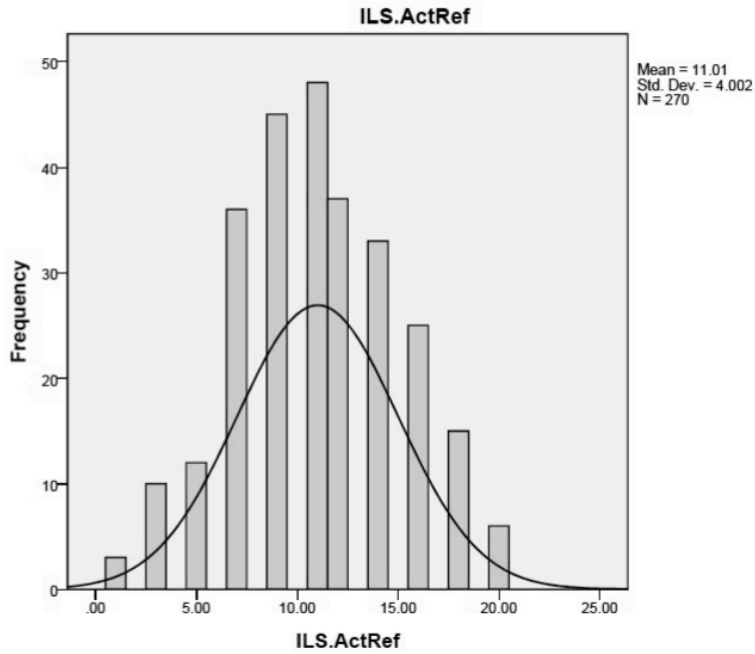
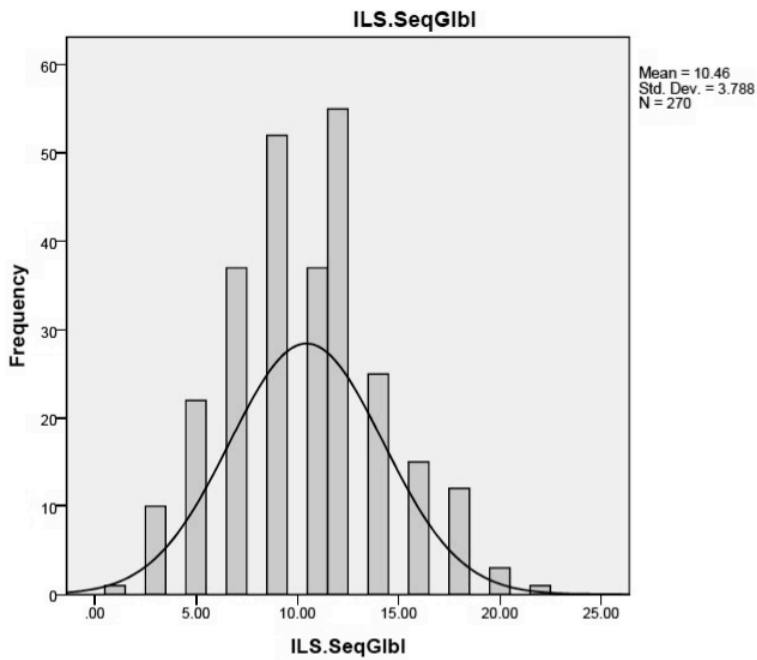**Figure 9.** *LSD1- Visual/Verbal Distribution with Normal Curve Shown*
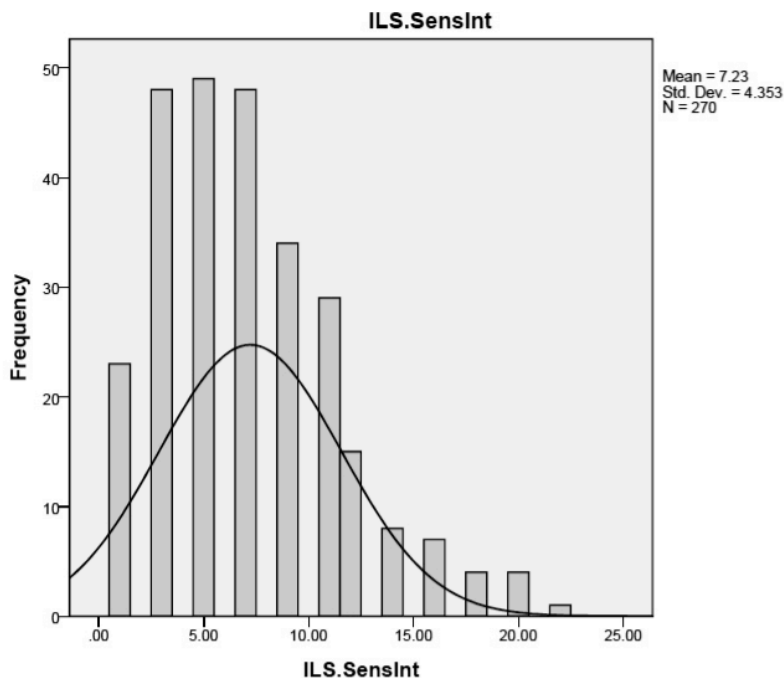
Figure 10. *LSD3 - Sensing/Intuitive Distribution with Normal Curve Shown*

LSD2 Active/Reflective and LSD 4 Sequential/Global both demonstrate normal

distributions with respect to skew and kurtosis (Figures 11 and 12).

Figure 11. *LSD2 – Active/Reflective Distribution with Normal Curve Shown*

Figure 12. *LSD4 – Sequential/Global Distribution with Normal Curve Shown*
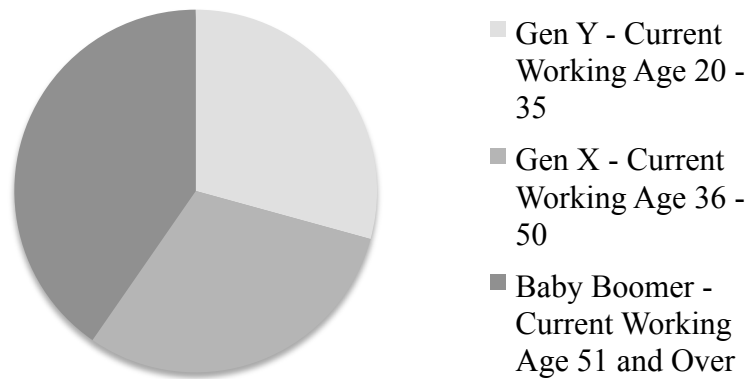
Learning Styles and Preferences Based on Age

Research Question #2: What are the differences in learning styles and preferences based on age? The first of three demographic questions asked of respondents was their age at the time of the survey. Participants ranged in age from 22 to 70, with an average of 45.17 years ($M = 45.17$).

To appropriately respond to the question, this investigation looked to its pilot study to determine a suitable categorization of age. Distribution in this study suggested that ranges of 20 – 30, 31 – 40, and 41+ would yield relative equity in the distribution. However, given that the pilot effort was aimed at non-field managers as to not impose upon the potential pool of respondents for the full survey, it was expected that the distribution of age in the full study sample would be somewhat different. For purposes of studying field managers in non-residential construction, categorization of age as a function of generations as socially and behaviorally defined resulted in a much more equitable distribution and relevant to the research. The taxonomy of these generations used in this study and their corresponding sample representation is shown in Table 2, and graphically depicted in Figure 13 to illustrate relative equity among the categories.

Table 2

Age Categorization and Frequency (Total N = 270)

Generation	Frequency	Percent Representation
Gen Y – Current Age 20 – 35	79	29.3
Gen X – Current Age 36 – 50	82	30.4
Baby Boomers – Current Age 51+	109	40.4

Gen Y - Current Working Age 20 - 35

Gen X - Current Working Age 36 - 50

Baby Boomer - Current Working Age 51 and Over

**Figure 13.** *Age Distribution of Participants by Generational Category*

Learning Styles and Preferences Within the Gen Y Age Group 20 – 35

For Learning Style Dimension One (LSD1), Gen Y respondents had a mean score of 4.25 ($M = 4.25$), corresponding to a 7.75 in preference of visual over verbal learning on the ILS scale. For LSD2, respondents had a mean score of 9.44 ($M = 9.44$), corresponding to a 2.56 preferring active over reflective learning on the ILS scale. For LSD3, the group reflected a mean of 6.35 ($M = 6.35$), corresponding to a 5.65 preferring sensing learning over intuitive on the ILS scale. And for LSD4, they showed a mean preference of 10.43 ($M = 10.43$), corresponding to a 1.57 in favor of sequential learning over global on the ILS. Descriptive statistics can be found in Table 3, and summary of preferences as reported via the ILS is shown in Figure 14.

Table 3

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, Age 20-35 (N = 79)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	4.25	2.68
LSD2 – Active/Reflective	9.44	4.03
LSD3 – Sensing/Intuitive	6.35	4.00
LSD4 – Sequential/Global	10.43	4.10
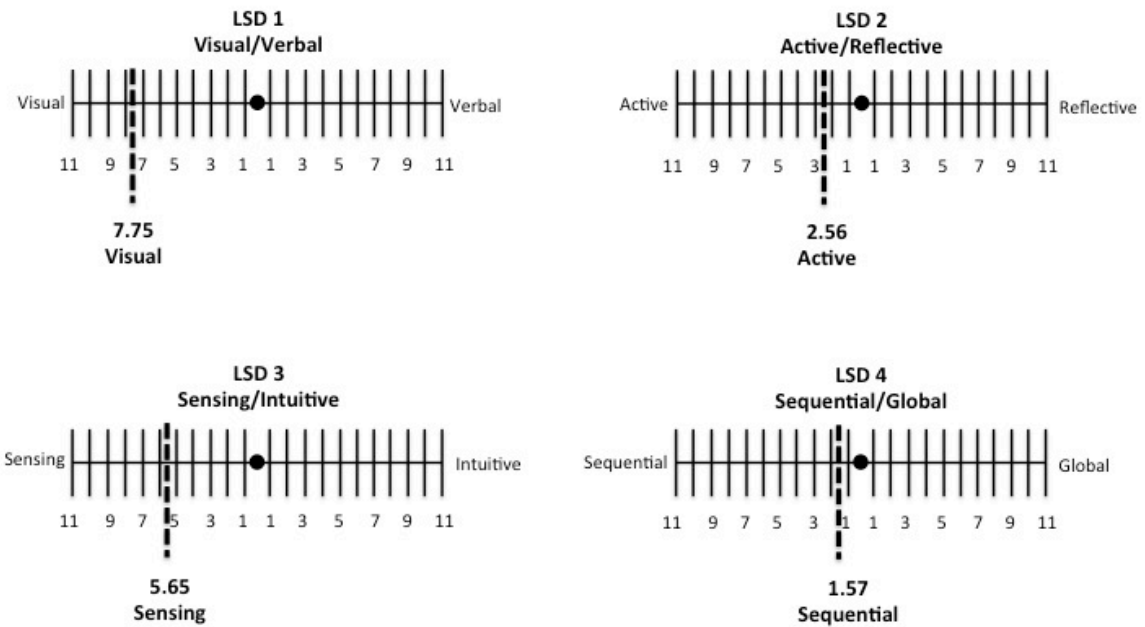
Figure 14. *Mean ILS Results Among Non-Residential U.S. Construction Field*
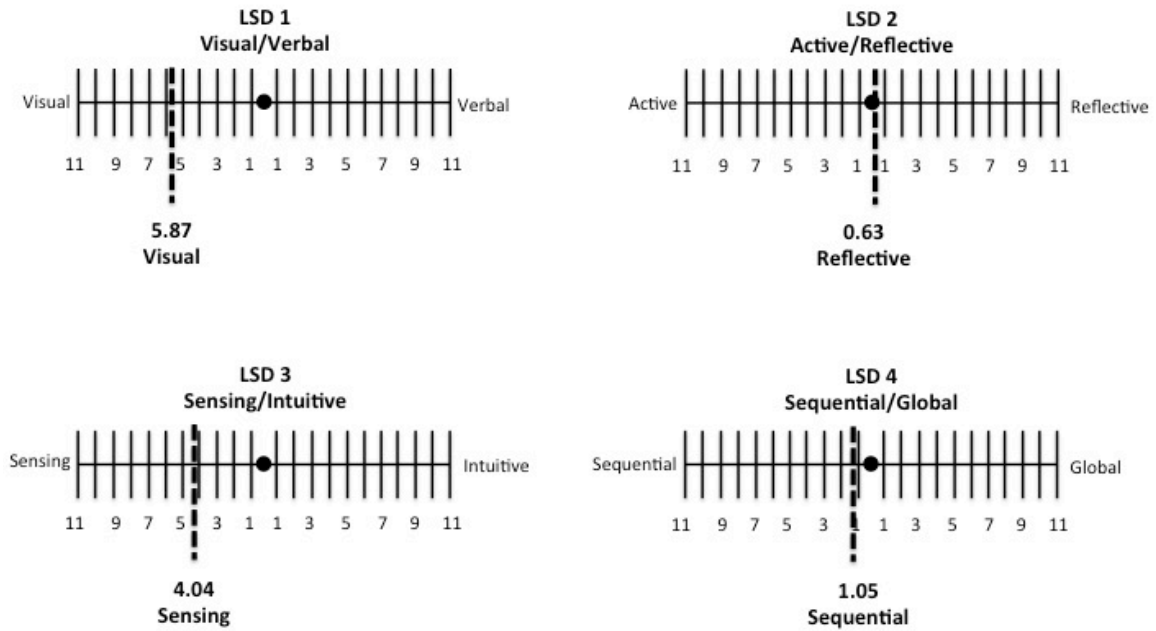
Managers, Age 20 – 35

Learning Styles and Preferences Within the Gen X Age Group 36 – 50

For Learning Style Dimension One (LSD1), Gen X respondents had a mean score of 6.13 ($M = 6.13$), corresponding to a 5.87 in preference of visual over verbal learning on the ILS scale. For LSD2, respondents had a mean score of 11.63 ($M = 11.63$), corresponding to a 0.63 preferring reflective over active learning on the ILS scale. For LSD3, the group reflected a mean of 7.96 ($M = 7.96$), corresponding to a 4.04 preferring sensing learning over intuition the ILS scale. And for LSD4, they showed a mean preference of 10.95 ($M = 10.95$), corresponding to a 1.05 in favor of sequential learning over global on the ILS. Descriptive statistics can be found in Table 4, and summary of preferences as reported via the ILS is shown in Figure 15.

Table 4

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, Age 36-50   (N = 82)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	6.13	3.36
LSD2 – Active/Reflective	11.63	3.90
LSD3 – Sensing/Intuitive	7.96	4.82
LSD4 – Sequential/Global	10.95	3.90

Figure 15. *Mean ILS Results Among Non-Residential U.S. Construction Field*
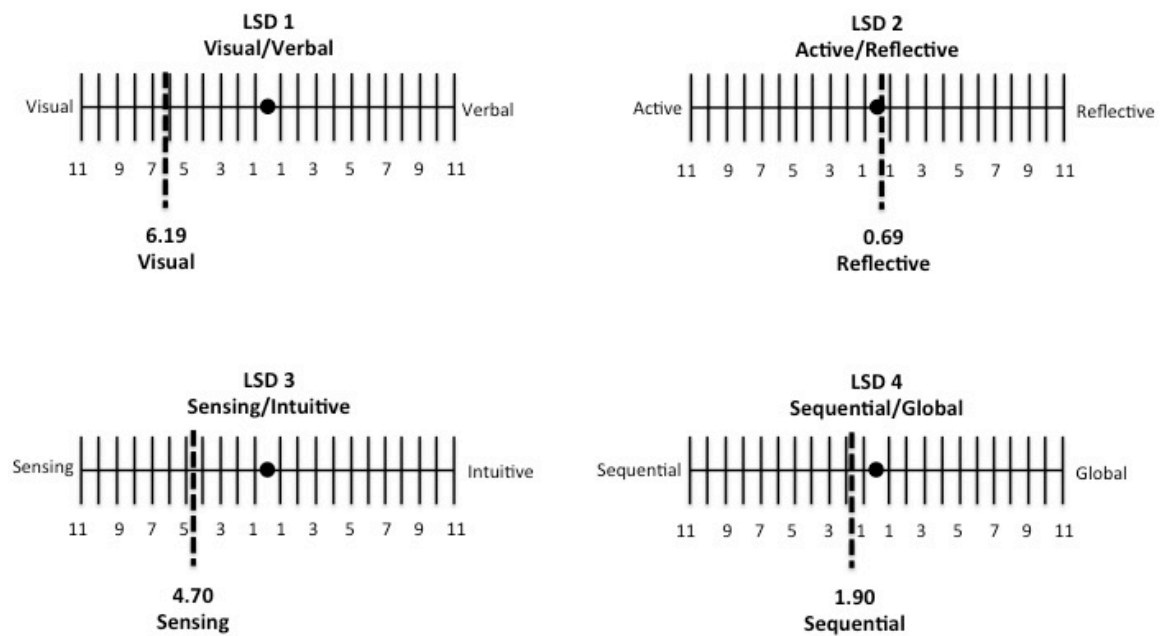
Managers, Age 36 – 50

Learning Styles and Preferences Within the Baby Boomer Age Group 51 and Over

For Learning Style Dimension One (LSD1), Baby Boomer respondents had a

mean score of 5.81 (*M* = 5.81), corresponding to a 6.19 in preference of visual over

verbal learning on the ILS scale. For LSD2, respondents had a mean score of 11.69 (*M* =

11.69), corresponding to a 0.69 preferring reflective over active learning on the ILS scale.

For LSD3, the group reflected a mean of 7.30 (*M* = 7.30), corresponding to a 4.70

preferring sensing learning over intuitive on the ILS scale. And for LSD4, they showed a

mean preference of 10.10 (*M* = 10.10), corresponding to a 1.90 in favor of sequential

learning over global on the ILS. Descriptive statistics can be found in Table 5, and

summary of preferences as reported via the ILS is shown in Figure 16.

Table 5

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, Age 51 and Over   (N = 109)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	5.81	3.34
LSD2 – Active/Reflective	11.69	3.77
LSD3 – Sensing/Intuitive	7.30	4.15
LSD4 – Sequential/Global	10.10	3.44

Figure 16. *Mean ILS Results Among Non-Residential U.S. Construction Field*

Managers, Age 51 and Over

To respond to research question number 2, one way ANOVA was used as the appropriate omnibus test. Assumptions of this test include independent observations, random sampling, normal distribution, dependent variables measured on an interval basis, and homogeneity of variance. Evaluating these:

- Observations were assumed to be independent, with no collusion or group participation based on the nature of the delivery of the survey instrument.

- As discussed in Chapter 3, the sampling was not random, which could limit generalizability.

- Distributions were generally normal, with the exceptions of skewness and kurtosis as described earlier in this chapter.

- The coded values for the ILS scale are reported on an interval basis.

- Levene's test for homogeneity passed for all four dependent variables ($p = .083$, .679, .071, and .162 across the four ILS dimensions, respectively).

The one way ANOVA for LSD1 Visual/Verbal shows a statistically significant difference ($F_{269} = 8.24$, $p < .001$), and similarly for LSD2 Active/Reflective ($F_{269} = 9.14$, $p < .001$). LSD3 Sensing/Intuitive shows no statistically significant difference ($F_{269} = 2.82$, $p = .062$), nor does LSD4 Sequential/Global ($F_{269} = 1.18$, $p = .308$). For LSD1, the effect size was .0569 ($\omega^2 = .0569$), and for LSD2, effect size was also .0569 ($\omega^2 = .0569$). Tukey post-hoc pairwise comparisons for LSD1 Visual/Verbal show significant differences between Gen Y and Gen X ($p = .001$) and between Gen Y and Baby Boomers ($p = .003$), but not between Gen X and Baby Boomers ($p = .760$). For LSD2 Active/Reflective, pairwise comparisons show significant differences between Gen Y and

Gen X ($p = .001$) and between Gen Y and Baby Boomers ($p < .001$), but not between Gen

X and Baby Boomers ($p = .995$).

Learning Styles and Preferences Based on Frequency of Training

Research Question #3: What are the differences in learning styles and preferences

based on frequency of recent training or classroom instruction? The second of three

demographic questions asked respondents to indicate the frequency of formal classroom

training within the past year of when they undertook the survey. Based on a desire for

categorical data, the survey offered the following potential selections:

1. None

2. 1 – 5 hours

3. 6 – 20 hours

4. 20 hours or more

Based on overall responses, the number of participants representing responses 1

and 2 were under-populated, posing a threat to the reliability of the analysis. To correct

this, dependent variables in categories 1 and 2 were merged to yield a more balanced

distribution (Table 6).

Table 6

Frequency of Training Categorization and Frequency (N = 270)

| Classroom Training Within the Past Year	Frequency	Percent Representation
Zero to 5 Hours	76	28.15
6 to 20 Hours	115	42.59
21 Hours or More	79	29.26

Learning Styles and Preferences for Training Frequency 0–5 Hours (TF 0-5)

For Learning Style Dimension One (LSD1), TF 0-5 respondents had a mean score of 5.68 ($M = 5.68$), corresponding to a 6.32 in preference of visual over verbal learning on the ILS scale. For LSD2, respondents had a mean score of 12.16 ($M = 12.16$), corresponding to a 1.16 preferring reflective over active learning on the ILS scale. For LSD3, the group reflected a mean of 6.61 ($M = 6.61$), corresponding to a 5.39 preferring sensing learning over intuitive on the ILS scale. And for LSD4, they showed a mean preference of 10.80 ($M = 10.80$), corresponding to a 1.20 in favor of sequential learning over global on the ILS. Descriptive statistics can be found in Table 7, and summary of preferences as reported via the ILS is shown in Figure 17.

Table 7

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, TF 0-5   (N = 76)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	5.68	3.61
LSD2 – Active/Reflective	12.16	3.87
LSD3 – Sensing/Intuitive	6.61	4.34
LSD4 – Sequential/Global	10.80	3.81
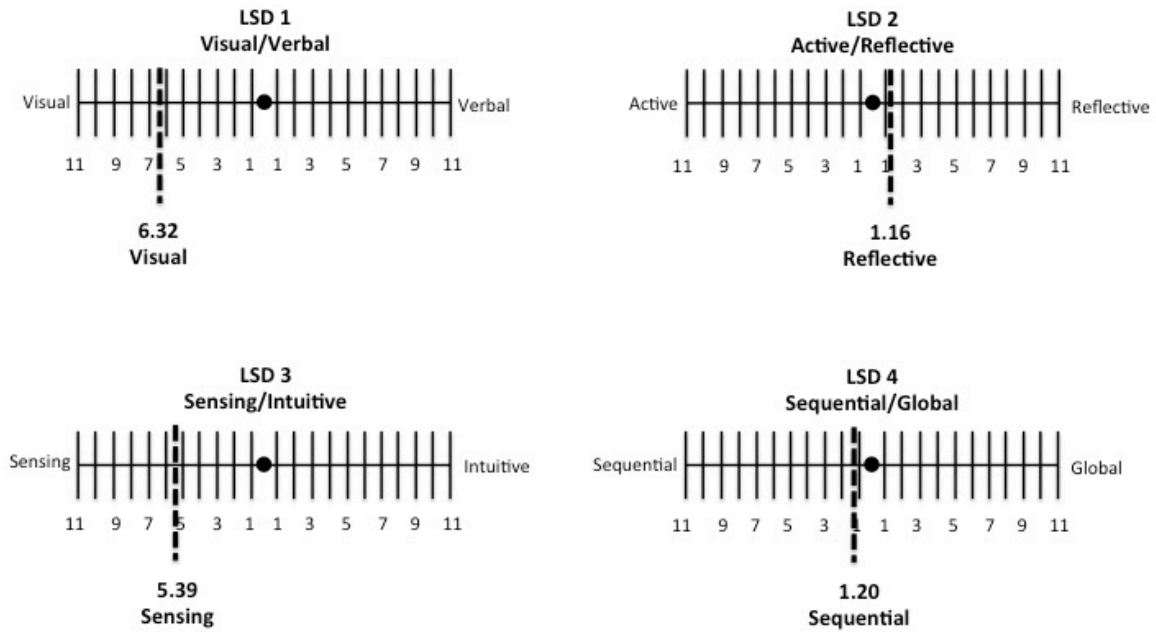
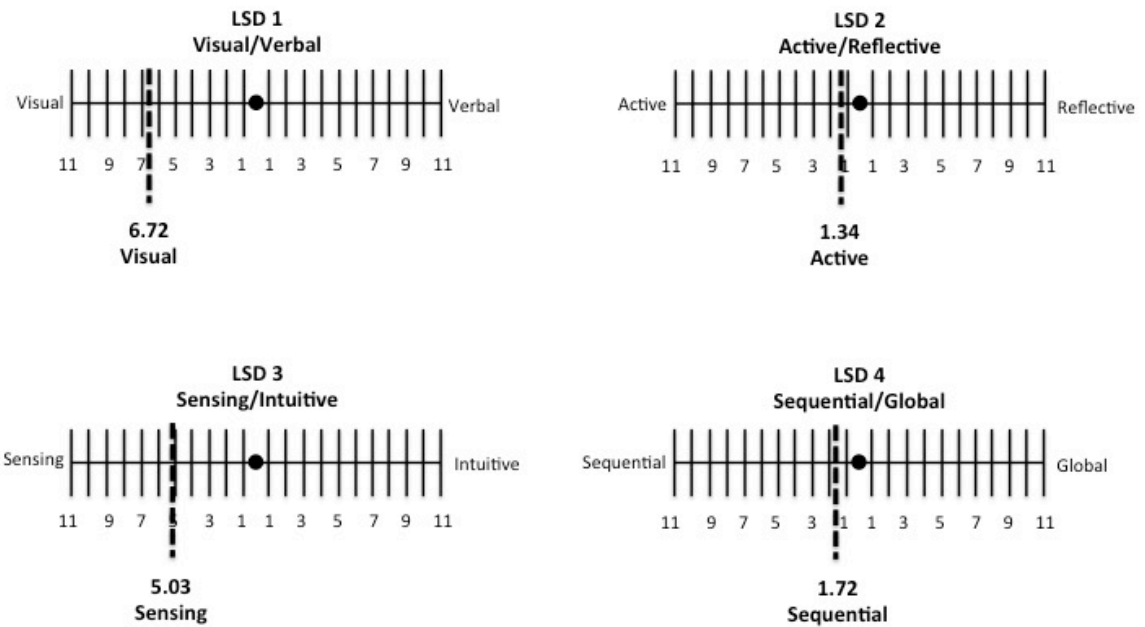**Figure 17.** *Mean ILS Results Among Non-Residential U.S. Construction Field Managers, TF 0-5*

Learning Styles and Preferences - Training Frequency 6–20 Hours (TF 6-20)

For Learning Style Dimension One (LSD1), TF 6-20 respondents had a mean score of 5.28 ($M = 5.28$), corresponding to a 6.72 in preference of visual over verbal learning on the ILS scale. For LSD2, respondents had a mean score of 10.66 ($M = 10.66$), corresponding to a 1.34 preferring active over reflective learning on the ILS scale. For LSD3, the group reflected a mean of 6.97 ($M = 6.97$), corresponding to a 5.03 preferring sensing over intuitive learning on the ILS scale. And for LSD4, they showed a mean preference of 10.28 ($M = 10.28$), corresponding to a 1.72 in favor of sequential learning over global on the ILS. Descriptive statistics can be found in Table 8, and summary of preferences as reported via the ILS is shown in Figure 18.

Table 8

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, TF 6-20   (N = 115)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	5.28	3.14
LSD2 – Active/Reflective	10.66	4.04
LSD3 – Sensing/Intuitive	6.97	4.03
LSD4 – Sequential/Global	10.28	3.64

Figure 18. *Mean ILS Results Among Non-Residential U.S. Construction Field*
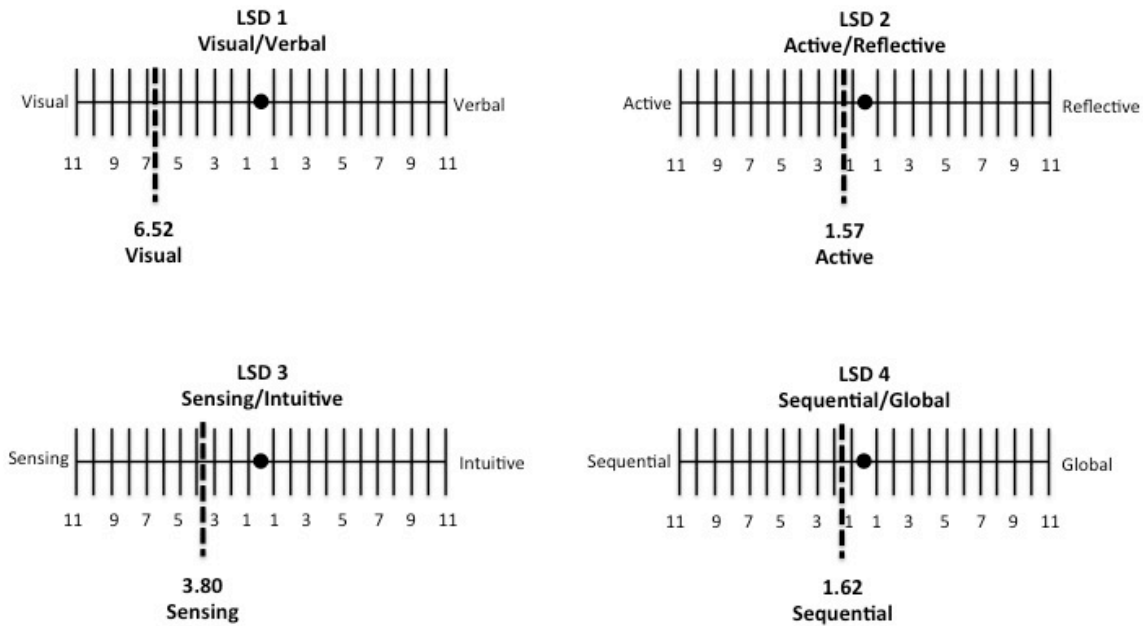
Managers, TF 6-20

Learning Styles and Preferences - Training Frequency 20+ Hours (TF 20+)

For Learning Style Dimension One (LSD1), TF 20+ respondents had a mean score of 5.48 (M = 5.48), corresponding to a 6.52 in preference of visual over verbal learning on the ILS scale. For LSD2, respondents had a mean score of 10.43 (M = 10.43), corresponding to a 1.57 preferring active over reflective learning on the ILS scale. For LSD3, the group reflected a mean of 8.20 (M = 8.20), corresponding to a 3.80 preferring sensing learning over intuitive on the ILS scale. And for LSD4, they showed a mean preference of 10.38 (M = 10.38), corresponding to a 1.62 in favor of sequential learning over global on the ILS. Descriptive statistics can be found in Table 9, and summary of preferences as reported via the ILS is shown in Figure 19.

Table 9

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers Reported in Interval Scale, TF 20+   (N = 79)

Learning Style Dimension	M	SD
LSD1 – Visual/Verbal	5.48	3.08
LSD2 – Active/Reflective	10.43	3.89
LSD3 – Sensing/Intuitive	8.20	4.70
LSD4 – Sequential/Global	10.38	4.00

Figure 19. *Mean ILS Results Among Non-Residential U.S. Construction Field Managers, TF 20+*

To respond to research question number 3, one way ANOVA was used as the appropriate omnibus test. Assumptions of this test were similar to those as enumerated in the comparison by age, with Levene's test for homogeneity of variance based on training frequency data passing for all four dependent variables (p = .429, .899, .210, and .598 across the four ILS dimensions, respectively).

The one way ANOVA for LSD2 Active/Reflective shows a statistically significant difference (F_{269} = 4.51, p = .012). LSD3 Sensing/Intuitive was marginal, however statistically was not significant (F_{269} = 3.01, p = .051). LSD1 Visual/Verbal shows no statistically significant difference (F_{269} = 0.36, p = .699), nor does LSD4 Sequential/Global (F_{269} = 0.46, p = .632). The effect size for LSD2 Active/Reflective was .0253 (ω^2 = .0253). Tukey post-hoc pairwise comparisons for LSD2 show significant differences between TF 0-5 and TF 6-20 (p = .029) and between TF 0-5 and TF 20+ (p = .019), but not between TF 6-20 and TF 20+ (p = .916).

Learning Styles and Preferences Based on Level of Education

Research Question #4: What are the differences in learning styles and preferences based on level of education? The third and final demographic question asked respondents to indicate their respective level of education. Based on a desire for categorical data, the survey offered the following potential selections:

1. High School Diploma or GED Equivalent

2. Some College, but No Degree

3. Trade or Vocational Certificate or Degree

4. Associates Degree (AA)

5. Bachelors Degree

6. Other

Based on overall responses, the number of participants representing responses 3, 4, and 6 were under-populated, posing a threat to the reliability of the analysis. To address this, dependent variables in categories 3 and 4 were merged based on their similarity to yield a more balanced distribution. Given that category 6 *Other* could not reasonably be merged based on its lack of definition, it was left alone with the understanding that analysis of its representative data might be inconclusive based on the number of respondents (Table 10). Descriptive statistics and ANOVA are not reported for category 6 *Other* given its small representative size.

Table 10

Level of Education Categorization and Frequency (N = 270)

Level of Education	Frequency	Percent Representation
High School or GED	48	17.78
Some College, No Degree	62	22.96
Trade/Vocational Certificate or AA Degree	48	17.78
Bachelors Degree	100	37.04
Other	12	4.44

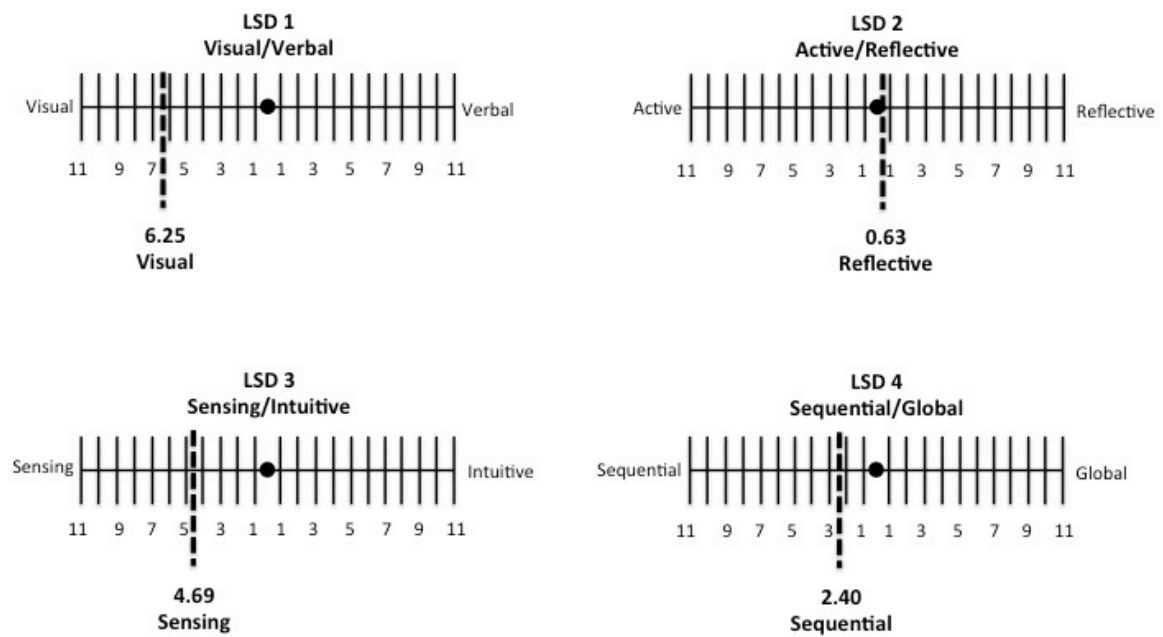**Learning Styles and Preferences based on Level of Education – High School/GED (LE-HS)**

For Learning Style Dimension One (LSD1), LE-HS respondents had a mean score of 5.75 ($M = 5.75$), corresponding to a 6.25 in preference of visual over verbal learning on the ILS scale. For LSD2, respondents had a mean score of 11.63 ($M = 11.63$), corresponding to a 0.63 preferring reflective over active learning on the ILS scale. For LSD3, the group reflected a mean of 7.31 ($M = 7.31$), corresponding to a 4.69 preferring sensing learning over intuitive on the ILS scale. And for LSD4, they showed a mean preference of 9.60 ($M = 9.60$), corresponding to a 2.40 in favor of sequential learning over global on the ILS. Descriptive statistics can be found in Table 11, and summary of preferences as reported via the ILS is shown in Figure 20.

Table 11

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, LE-HS   (N = 48)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual over Verbal	5.75	3.10
LSD2 – Active over Reflective	11.63	3.89
LSD3 – Sensing over Intuitive	7.31	4.48
LSD4 – Sequential over Global	9.60	3.94

Figure 20. *Mean ILS Results Among Non-Residential U.S. Construction Field*
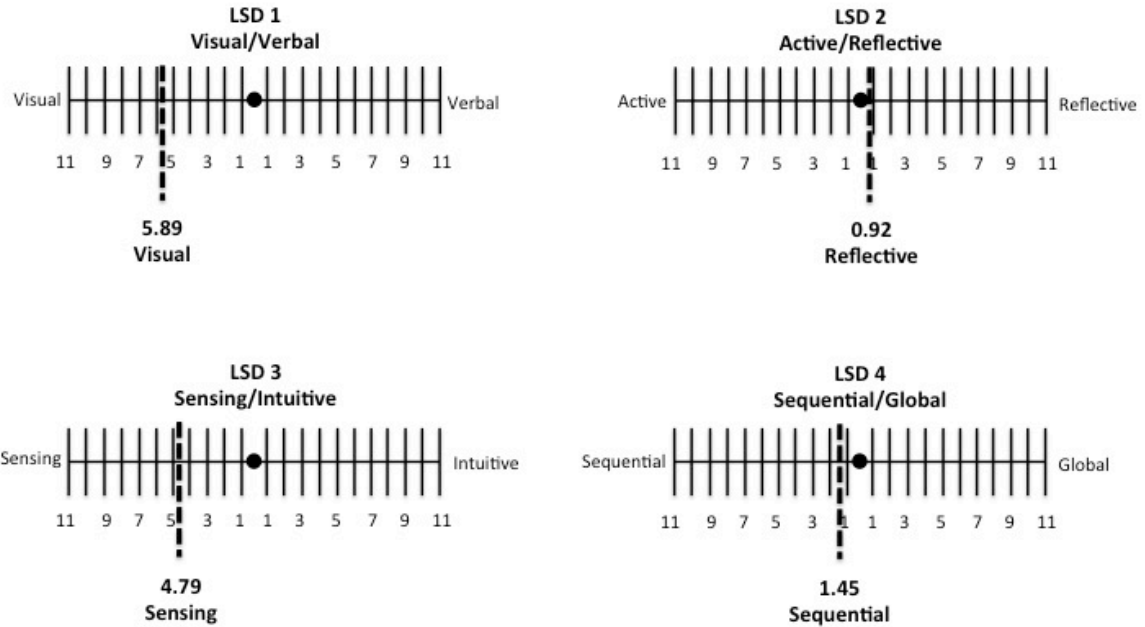
Managers, LE-HS

Learning Styles and Preferences for Level of Education – Some College, No

Degree (LE-SC)

For Learning Style Dimension One (LSD1), LE-SC respondents had a mean score

of 6.11 ($M = 6.1$), corresponding to a 5.89 in preference of visual over verbal learning on

the ILS scale. For LSD2, respondents had a mean score of 11.92 ($M = 11.92$),

corresponding to a 0.92 preferring reflective over active learning on the ILS scale. For

LSD3, the group reflected a mean of 7.21 ($M = 7.21$), corresponding to a 4.79 preferring

sensing over intuitive learning on the ILS scale. And for LSD4, they showed a mean

preference of 10.55 ($M = 10.55$), corresponding to a 1.45 in favor of sequential learning

over global on the ILS. Descriptive statistics can be found in Table 12, and summary of

preferences as reported via the ILS is shown in Figure 21.

Table 12

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, LE-SC   (N = 62)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	6.11	3.75
LSD2 – Active/Reflective	11.92	4.07
LSD3 – Sensing/Intuitive	7.21	4.30
LSD4 – Sequential/Global	10.55	3.93

Figure 21. *Mean ILS Results Among Non-Residential U.S. Construction Field*

Managers, LE-SC

Learning Styles and Preferences for Level of Education – Trade/Vocational
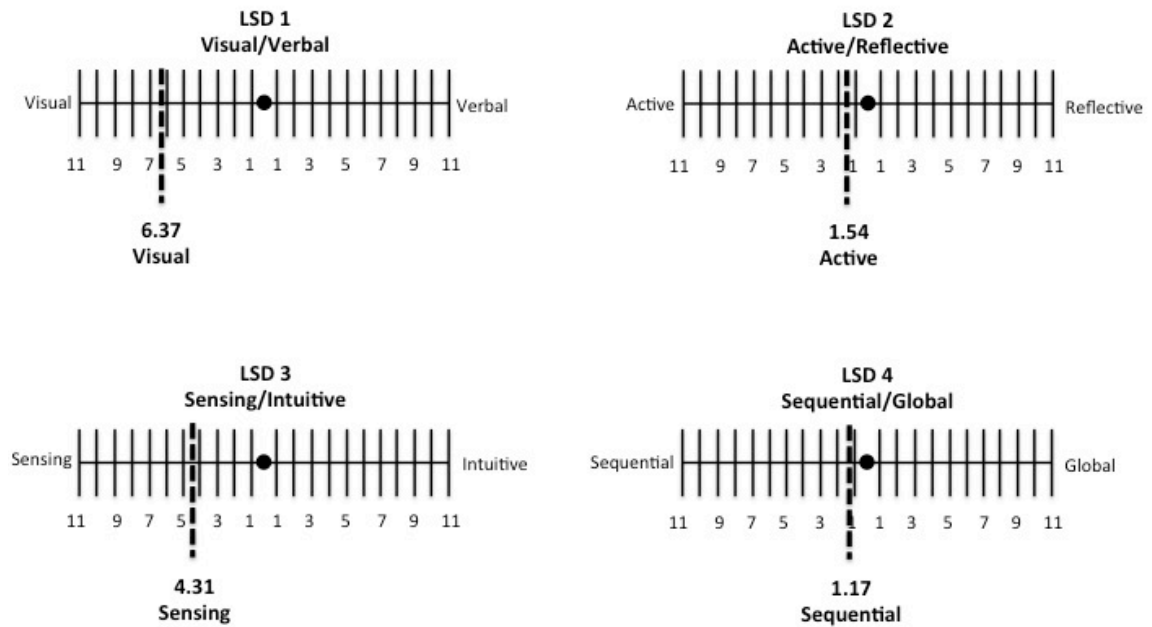
and Associates Degree (LE-VAA)

For Learning Style Dimension One (LSD1), LE-VAA respondents had a mean

score of 5.63 (*M* = 5.63), corresponding to a 6.37 in preference of visual over verbal

learning on the ILS scale. For LSD2, respondents had a mean score of 10.46 (*M* =

10.46), corresponding to a 1.54 preferring active over reflective learning on the ILS scale.

For LSD3, the group reflected a mean of 7.69 (*M* = 7.69), corresponding to a 4.31

preferring sensing learning over intuitive on the ILS scale. And for LSD4, they showed a

mean preference of 10.83 (*M* = 10.83), corresponding to a 1.17 in favor of sequential

learning over global on the ILS. Descriptive statistics can be found in Table 13, and

summary of preferences as reported via the ILS is shown in Figure 22.

Table 13

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers

Reported in Interval Scale, LE-VAA   (N = 48)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	5.63	3.35
LSD2 – Active/Reflective	10.46	3.45
LSD3 – Sensing/Intuitive	7.69	4.08
LSD4 – Sequential/Global	10.83	3.30

Figure 22. *Mean ILS Results Among Non-Residential U.S. Construction Field*
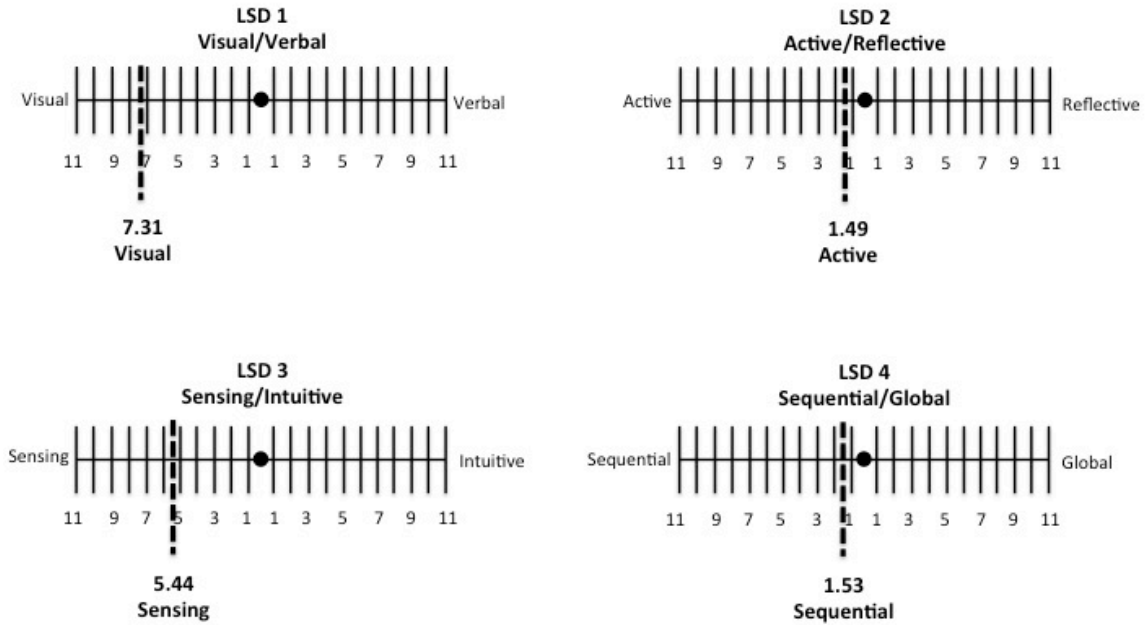
Managers, LE-VAA

Learning Styles and Preferences for Level of Education – Bachelors Degree (LE-BS)

For Learning Style Dimension One (LSD1), LE-BS respondents had a mean score of 4.69 ($M = 4.69$), corresponding to a 7.31 in preference of visual over verbal learning on the ILS scale. For LSD2, respondents had a mean score of 10.51 ($M = 10.51$), corresponding to a 1.49 preferring active over reflective learning on the ILS scale. For LSD3, the group reflected a mean of 6.56 ($M = 6.56$), corresponding to a 5.44 preferring sensing learning over intuitive on the ILS scale. And for LSD4, they showed a mean preference of 10.47 ($M = 10.47$), corresponding to a 1.53 in favor of sequential learning over global on the ILS. Descriptive statistics can be found in Table 14, and summary of preferences as reported via the ILS is shown in Figure 23.

Table 14

Learning Style Preferences Among Non-Residential U.S. Construction Field Managers Reported in Interval Scale, LE-BS   (N = 100)

Learning Style Dimension	*M*	*SD*
LSD1 – Visual/Verbal	4.69	2.71
LSD2 – Active/Reflective	10.51	4.15
LSD3 – Sensing/Intuitive	6.56	4.25
LSD4 – Sequential/Global	10.47	3.92

Figure 23. *Mean ILS Results Among Non-Residential U.S. Construction Field Managers, LE-BS*

To respond to research question number 4, one way ANOVA was used as the appropriate omnibus test. Assumptions of this test were similar to those as enumerated in the comparison by age and frequency of training, with Levene's test for homogeneity of variance based on level of education data passing for all four dependent variables (p = .058, .489, .964, and .200 across the four ILS dimensions, respectively).

The one way ANOVA for LSD1 Visual/Verbal shows a statistically significant difference (F_{269} = 2.51, p = .042) as does LSD3 Sensing/Intuitive (F_{269} = 2.66, p = .033). LSD2 Active/Reflective shows no statistically significant difference (F_{269} = 1.801, p = .127), nor does LSD4 Sequential/Global (F_{269} = 1.09, p = .363). The effect size for LSD1 Visual/Verbal was .0219 (ω^2 = .0219), and for LSD3 Sensing/Intuitive was .0079 (ω^2 = .0079). For LSD1, even though the ANOVA indicates a significant difference (p = .042), Tukey post-hoc pairwise comparisons show no significant differences between LE

90

groups. And pairwise comparisons for LSD3 show significant differences only between LE groups 'Some College' and 'Other' (p = .017), although the latter of this pair is excluded from this study based on its low number of respondents for this independent variable.

Relationship Between Frequency of Training and Level of Education

Research Question #5: Is there a relationship between level of education and frequency of recent training/instruction among field managers in the non-residential U.S. construction industry? To respond to this question, a Chi-Square test for independence was used to determine if there was a relationship between these two independent variables. Assumptions for this test included independence of the variable, a nominal nature of the data, mutual exclusivity of the categories for both variables, and no cell with less than five. With category "Other" being excluded, all assumptions were met. The Chi-Square test showed that the there was no relationship between the two independent variables (p = .096).

Summary

In Chapter 4, findings and statistical analysis were presented for the study. Data analyzed included responses from 270 participants completing the Index of Learning Styles (ILS) instrument, as well as demographic questions to establish independent variables. Participants were field managers in U.S. non-residential construction, and all self-reported being over the age of 18, in accordance with the university's Institutional Review Board (IRB). Ages of participants ranged from 22 to 70, with a generally equitable distribution between groups as defined by social generations including Gen Y, Gen X, and Baby Boomers. Participants were also categorized nominally based on

frequency of formal classroom training in the past year, as well as by level of education. Each of the latter two classifications resulted in under-populated categories, for which relevant mergers were made to better evaluate the data.

Research question 1 asked what are the learning styles and preferences of field managers in construction. There was generally normal distribution around a balanced preference on the dimensions of Active/Reflective and Sequential/Global, however there was a clear positive skew in the distribution on the dimensions of Visual/Verbal and Sensing/Intuitive. This could be explained based on the nature of the participants and the construction industry. Research questions 2, 3, and 4 asked whether there were differences in learning styles and preferences among the population based on age, frequency of training, and level of education. For most dimensions compared across the independent variables, ANOVA showed that there were no statistically significant differences. For the limited number where there were significant differences reported, in each case the effect size (ω^2) was less than 6%. Research question 5 asked whether there was a relationship between the independent variables of frequency of training and level of education; a Chi-square test for independence indicated that there was not. Chapter 5 will present conclusions from the study, discussion, recommendations for future research, and industry impact.

CHAPTER 5

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

This study investigated learning styles and preferences of superintendents, foremen, and other field managers in the non-residential sectors of construction in the United States. The first chapter presented an introduction and context of the investigation, providing general information on the construction industry and the roles of superintendents and other field managers within it. This chapter also articulated the research questions guiding the study, as well as assumptions, limitations, and definitions that were meaningful to the research. Chapter 2 presented a review of relevant literature providing perspective from a variety of facets to better inform the study. This included history of the evolution of the construction industry and its leadership and management, shifts in industry technology and delivery systems in the past three decades, as well as learning style research and adult education in general. This chapter also presented an overview of the wide range of instruments of learning style measurement, in particular the Index of Learning Styles (ILS) utilized in this study. The third chapter described the methods used to implement the research, enumerating the quantitative components of the investigation, the sample that was targeted, and how the data analysis was conducted. It also included how the study dealt with human subjects, and what measures were taken to comply with the university's Institutional Review Board (IRB) protocol. Chapter 3 also defined the instrument used in the study including the ILS and demographic questions,

which is shown in Appendix A. Chapter 4 presented the findings of the study, including data collected and their statistical results. These results were presented in order of the research questions, including descriptive statistics, analysis of variance across three independent variables, and a chi-square test for independence of two of the independent variables.

Chapter 5 summarizes the findings, and presents the author's conclusions based on the analysis of the data, as well as potential industry impact and suggestions for future research. These conclusions are presented in the order of the research questions, and also provide insight on each individual learning style dimension as defined by the ILS.

Purpose of the Study

The primary purpose of this study was to give insight into what learning styles and preferences are most dominant among field managers in non-residential construction in the Southeastern U.S., and to compare this data across age groups, frequency of formal training, and level of education.

Research Questions

The following research questions guided the study:

1. What are the learning styles and preferences of field managers in the non-residential U.S. construction industry?

2. What are the differences in learning styles and preferences based on age?

3. What are the differences in learning styles and preferences based on frequency of recent training or classroom instruction?

4. What are the differences in learning styles and preferences based on level of education?

5. Is there a relationship between level of education and frequency of recent training/instruction among field managers in the non-residential U.S. construction industry?

Summary

Construction is the largest U.S. industry, and has a significant impact on the domestic and worldwide economy. As of 2016, its annual spending in the U.S. was $1.14 trillion (U.S. Department of Commerce, 2016). The convergence of technological advancement at an increasing rate with impending shifts in age and preferences of the managerial workforce presents the industry with a need to judiciously consider future continuing education and training. Baby Boomers are retiring at a rapid rate, and their successors in Generation X are much smaller in number. Alternatively, Generation Y is larger than Gen X (Fry, 2015), suggesting that the construction industry must deal with human resource leveling issues for some time. Within this consideration is how the industry will continue managerial education and training based on the current and future technological, strategic, legal, and social changes that are eminent (Thomsen & Sanders, 2011).

Based on this impending need, this study sought to determine the learning styles of field managers in construction, in particular superintendents, assistant superintendents, general superintendents, foremen, and others in similar roles. These individuals operate daily at the forefront of the construction process, tasked with administering manpower, equipment, materials, and subcontractors, as well as engaging with architects, engineers, owners, lenders, inspectors, and others involved with the rapidly changing process of delivering capital assets in the built environment. To target this population, general

contractors across a range of sizes were solicited to access their managers serving in these roles. A preliminary pilot study helped to inform what independent variables might be useful to analyze, as well as how the electronic delivery of the survey instrument would function. In the full study, 510 potential participants in the representative roles were given the opportunity to participate voluntarily and anonymously, with 270 completing the survey representing a response rate of almost 53%. Once data were collected and values properly coded, SPSS© was used to generate statistical analysis. For statistically significant differences found, pairwise comparisons were conducted using Tukey tests, and then effect sizes calculated. Consideration of effect sizes was important to further define the impact of any statistically significant differences, as only using objective *p*-value thresholds as a determinant of statistical significance is the subject of much debate. Kyriacou (2016) asserts that simply assuming the null hypothesis must be true if $p > .05$ (and vice versa) are egregious misconceptions, and that effect sizes can be more informative in discerning outcomes and conclusions from statistical analysis.

Descriptive Statistics

For research question #1, data reflected a mean preference in Learning Style Dimension One (LSD1) for visual learning over verbal, ($M = 5.45$, $ILS_{Visual} = 6.55$). For LSD 2, the mean preference was slightly in favor of active over reflective learning, ($M = 11.01$, $ILS_{Active} = 0.99$). LSD 3 showed a preferred style of sensing over intuitive, ($M = 7.23$, $ILS_{Sensing} = 4.77$), and LSD 4 indicated a small preference for sequential style over global, ($M = 10.46$, $ILS_{Sequential} = 1.54$). The distinct preference for visual over verbal learning resulted in a noticeable positive statistical skew and a leptokurtic distribution, although perhaps predictably so based on the nature of the construction industry and its

heavy reliance on graphic representation. Similarly, the stronger preference for sequential over intuitive learning styles also resulted in a distribution with positive skew, likely demonstrative of the construction industry and its tendency to operate in a proven, linear fashion. All other distributions were statistically normal, and with *SD* for each being 4.35 or less.

Differences in Learning Styles

For research questions 2 – 4, ANOVA was used to determine if there were statistically significant differences in learning styles based on three independent variables: age category as a function of social/cultural generation, frequency of recent classroom training, and level of education. All assumptions of the omnibus test (including homogeneity of variance) were met, with the exception of the sample being random. Based on how the participants needed to be recruited, this assumption would be difficult if even possible to meet, which could somewhat limit generalizability.

LSD 1

Findings showed statistical differences in LSD1 Visual/Verbal based on age (F_{269} = 8.24, $p < .001$), and level of education ($F_{269} = 2.51$, $p = .042$), with Tukey pairwise comparisons showing the significant difference based on age between Gen Y and the other two generations. However, the effect size for this difference was only about 5.7%, suggesting that over 94% of the variance (plus the error) is unexplained by the relationship between ILS scores and age. For the statistical difference found based on level of education, pairwise comparisons showed no significant difference, suggesting that the differences across the set were large enough to result in a significant omnibus test, but too small to be detected in pairwise comparisons.

LSD 2

The analysis for LSD 2 Active/Reflective showed significant differences based on age, ($F_{269} = 9.14$, $p < .001$), and on frequency of recent training, ($F_{269} = 4.51$, $p = .012$), with pairwise comparisons showing differences between Gen Y and the other two generations, similar to LSD 1. The effect size for differences in age, however, was less than 6%. Pairwise comparisons for frequency of training suggest differences between those who had little to no time in the classroom in the past year, and those who had any amount more than 5 hours; however, the effect size based on training frequency was only 2.53%.

LSD 3

LSD 3 Sensing/Intuitive showed a statistically significant difference only based on level of education, ($F_{269} = 2.66$, $p = .033$); however, pairwise comparisons indicated that this difference was between those categorized as *Some College* and *Other*, the latter of which was excluded from the study based on its low number of respondents.

LSD 4

For the dimension of Sequential/Global, LSD 4 findings showed no statistically significant differences across any of the independent variables.

Relationship between Frequency of Training and Level of Education

For research question #5, a Chi-Square test for independence showed no relationship between the independent variables of training frequency and level of education amongst the sample.

Conclusions and Industry Impact

Research Question #1

The statistical findings show that superintendents have fairly strong tendencies with respect to learning visually and to sensing learning preferences. Alternatively, they have a more balanced learning style preference based on learning actively versus reflectively, and on learning sequentially versus globally.

As authors of the ILS instrument, Felder and Soloman (1993) categorize style preferences as follows for each of the learning style dimensions:

- Scores of 3 or less indicate being fairly well balanced on the two dimensions of that scale.

- Scores of 5 – 7 indicate a moderate preference for one dimension, and would likely learn more easily in a teaching environment that favors that dimension.

- Scores of 9 or more indicate a very strong preference for one dimension, for which there may be difficulty learning in an environment that does not support that preference.

Based on this, the population's preferences could be generalized as moderate for Visual and Sensing styles, and fairly well balanced for Active/Reflective and Sequential/Global (Figure 24).
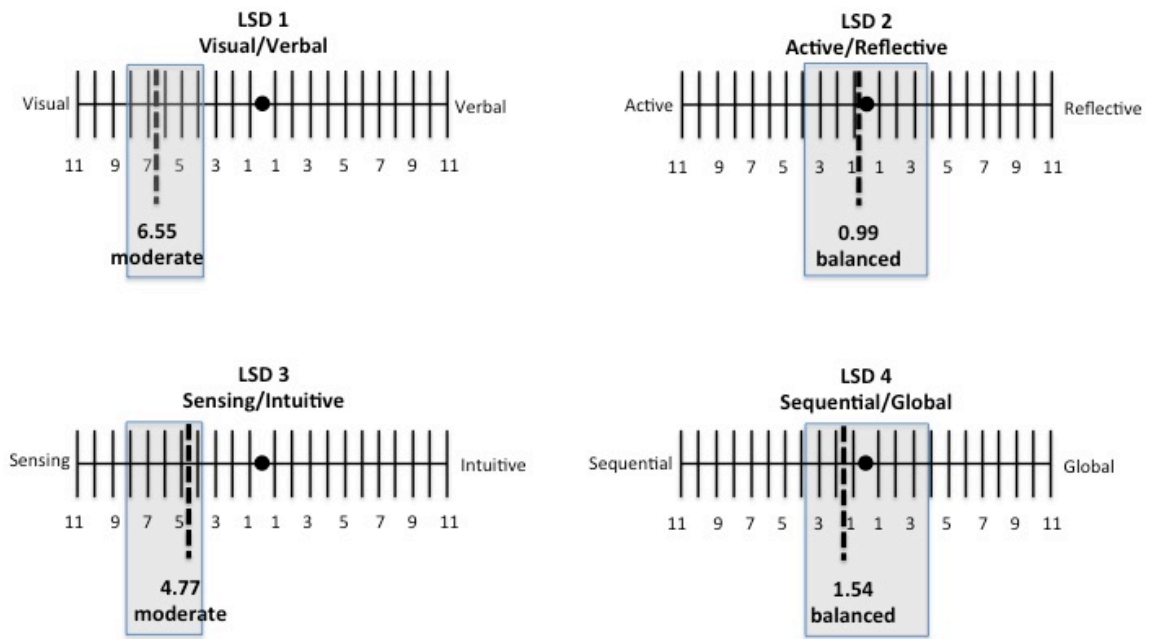
Figure 24. *Categorization of Mean Learning Style Preferences for Field Managers in U.S. Non-residential Construction (N=270)*

The graphical and pragmatic nature of the industry supports the moderate imbalance in LSD 1 and LSD 3, although there are many facets and components in non-residential construction that could be better communicated more toward the other end of the respective dimension. Employers and providers of training may want to consider how finding better balance on these fronts might be useful, but at the same time should acknowledge the tendencies and preferences so that continuing education and training is effective. A potential pitfall in developing educational material and its delivery is to target a one-size-fits-all approach, and ending up with a one-size-fits-none, instead. An understanding of how to cater to the moderate preferences and how to leverage the balanced preferences will be very useful in developing effective educational delivery strategies.

For example, technology on the jobsite is increasing in both its capacity and complexity at a rapidly increasing rate. LSD 1 suggests making sure educational materials and their delivery are fairly visual in nature as opposed to manuals and resources that are largely presented in prose. LSD 2, however, suggests that the inclusion of activities (perhaps in groups) would be effective, but that making sure there is time for individual reflection and digestion is equally as important. For LSD 3, employers should acknowledge the tendency toward proven, logical, and practical learning strategies, but perhaps could also present the value of considering things more abstractly with iterative solutions. And for LSD 4, the population appreciates a balance between understanding the bigger picture and the sequential steps necessary to reach the end goal. Clear objectives and overall perspective are important, but providing clear chronological actions and steps to get there is equally as vital.

Research questions #2 – 4

The findings show that there are some statistical differences in subgroups based on independent variables, although none are explained very convincingly based on effect sizes. Most notably were the clear statistical differences in learning style dimensions 1 and 2 based on age/generation, specifically between those under and those over 35 years old (Figure 25), however less than 6% of these differences can be explained by age as a variable. In all but the Sequential/Global learning style dimension, in each case Gen Y scored above the mean and furthest from balanced, and Gen X scored less than the mean and closest to balanced. This could indicate that the youngest working generation tends to be more passionate about the way they choose to learn, while middle to upper managers represented by Gen X have developed more balanced preferences. On these

same three dimensions, Baby Boomers are in between and closest to the mean, which

could be explained by their social tendency to be disciplined traditionalists (Cepero &

Williams, 2009).
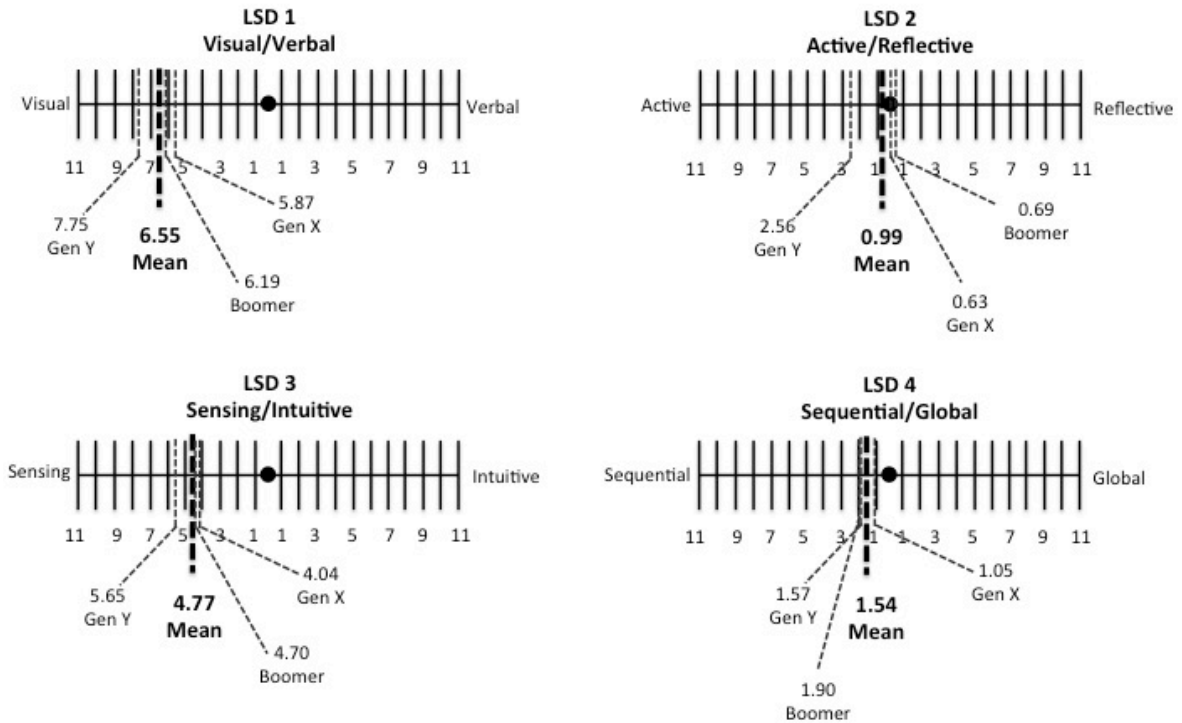
Figure 25. *Collated Mean ILS Results by Age*

From a statistical perspective, we reject the null hypothesis ($H_0 = M_{GenY} = M_{GenX} =$

$M_{BabyBoomer}$) that the ILS means of each age/generational subgroup are equal, however the

effect sizes are so small, that this may impact how construction employers should react

and/or modify their approach to continuing education and training. That is, while there is

much in the literature that suggests significant social and cultural differences between the

generations, this study suggests that for the population of field managers in non-

residential construction, the statistical difference may be so small that segregating or

customizing educational materials may not be warranted. On the other hand,

understanding the overall social tendencies between generations may provide some

insight as to effective strategies in implementation. Continuing in the context of technological advancement in the construction industry, employers may find that active group work on this front could include peer learning and reverse mentoring from Gen Y to the other generations as a compelling and practical approach.

Based on the understanding of the audience's learning style, instructional and assessment material can be better catered to align with student preference. For example, given the strong preference among the field management population for visual learning, delivery strategies including graphics, slideshows, video clips, and live or recorded events would be better received than audio-only media, printed material, or slides with few images (Franzoni & Assar, 2009).

Regardless of the strategies that construction firms choose to evaluate needs and delivery for continuing education and training for managers, it would appear certain that the dynamics will change over time. A firm's ability to be forward-thinking, adaptive, and nimble in this regard would position them to be successful in better training their professional human resources to remain competitive in the industries of the built environment.

Research question #5

The hypothesis that there may be a relationship between frequency of training and level of education was generated in the pilot study focus groups, and was based on the notion that those who had spent more time in a formal education environment might have a tendency to participate more frequently in continuing professional education. Statistical results suggest that this is not the case for this population.

Recommendations for Future Research

As this study was conducted in a largely un-researched industry discipline, there are several opportunities for recommended future investigation based on this investigation's limitations as well as its findings. In non-prioritized order, these include:

- Longitudinal studies to determine if learning style preferences change over time

- Comparing ILS analysis metrics from different studies on a consistent scale of measurement (e.g., mean interval values versus majority/minority means)

- Measurement of learning styles among counterpart professionals within the construction industry, such as Project Managers, Executives, and Pre-construction Managers, to determine if there are differences across managerial roles within the same industry

- Measurement of learning styles among professional counterparts in the larger industry, such as architects and engineers, to determine if there are differences across professional roles within the singular industry serving the built environment

- Measurement of training effectiveness between multiple control groups, including traditional continuing education strategies versus those strategically generated based on the findings of this study

- Comparisons of learning styles of this same population based on different instruments of measure

- A similar study but with a more geographically diverse sample

As one of the largest, most economically impactful industries in our society, there is much opportunity to continue meaningful research in the construction discipline and related to the built environment in general. Many of these opportunities lie at the convergence of research growth in construction management as an academic discipline, and the desire of industry to develop more informed strategies regarding competitiveness, effectiveness, and the reduction of waste. While there is noteworthy depth in industry-relevant literature on the fronts of materials testing, structural and environmental performance, contractual implications, and others, there is much opportunity to continue rich investigation of what may be the most valuable of resources in the construction industry, and that is of its people.

References

Abdelhamid, T. S. (2003). Evaluation of Teacher-Student Learning Style Disparity in
Construction Management Education. *Journal of Construction Education*, 8(3),
124-145.

Adams, D., Sattineni, A., & Thompson, J. (2014). Using Prefabricated Building
Components to Obtain LEED Credits. *ASC Proceedings of the 50ᵗʰ Annual
Conference*, Washington, D.C.

Ahn, Y.H., & Pearce, A.R. (2007). Green Construction: Contractor Experiences,
Expectations, and Perceptions. *Journal of Green Building*, 2(3), 106-122.

Allen, K., Scheve, J., & Nieter, V. (2011). *Understanding Learning Styles*. Huntington
Beach, CA: Shell Education.

American Council for Construction Education (2016, March 29). Retrieved from
http://www.acce-hq.org/accredited_programs/category/baccalaureate-programs

American Institute of Architects (2016a, March 27). Retrieved from
http://www.aia.org/about/history/index.htm

American Institute of Architects (2016b, March 29). Retrieved from
http://www.aia.org/contractdocs/aias076671

American Institute of Architects (2007). AIA Document A201 – 2007 General
Conditions of the Contract for Construction. Copyright 2007 by the American
Institute of Architects, 3.3.1, 13.

American Society of Civil Engineers (2016, March 27). Retrieved from
http://www.asce.org/about_asce

Andert, D. (2011). Alternating Leadership as a Proactive Organizational Intervention:

Addressing the Needs of the Baby Boomers, Generation X-ers and Millennials.

Journal of Leadership, Accountability & Ethics, 8(4), 67-83.

Azhar, S., & Brown, J. (2009). BIM for Sustainability Analysis. *International Journal of

Construction Education and Research*, 5(4), 276-292.

Azhar, S., Hein, M.F., & Sketo, B. (2008). Building Information Modeling (BIM):

Benefits, Risks and Challenges. *ASC Proceedings of the 44th Annual Conference*,

Auburn, AL.

Azhar, S., Lukkad, M.Y., & Ahmad, I. (2012). Modular v. Stick built Construction:

Identification of Critical Decision-Making Factors. *ASC Proceedings of the 48th

Annual Conference*, Birmingham, UK.

Badger, W.W., Wiezel, A., Adams, D.M., & Bopp, P. (2012). Superintendent's

Leadership: A Key Factor in Project Success. *International Journal of Project

Orgainisation and Management,* 4(4).

Bhatti, R. I., & Bart, W. M. (2013). On the Effect of Learning Style on Scholastic

Achievement. *Current Issues in Education*, 16(2), 1-6.

Beard, J.L., Loulakis, M.C., & Wundram, E.C. (2001). *Design Build, Planning Through

Development.* New York, NY: McGraw-Hill.

Bowers, C.J., & Clark, S.N. (2013). A Survey of the Succession Planning Practices for

Superintendents in the Industrial Construction Sector. *ASC Proceedings of the

49th Annual Conference*, San Luis Obispo, CA.

Bryson, L. (1936). *Adult Education*. New York, NY: American Book.

Cardwell, D. S. L. (1972). *Turning Points in Western Technology; a Study of Technology, Science and History*. Madison, WI: Science History Publications

Catalyst. (2015) *Generations: Demographic Trends in Population and Workforce*, retrieved April 22, 2016 http://www.catalyst.org/knowledge/generations-demographic-trends-population-and-workforce#footnote29_slau5cs

Cekada, T.L. (2012). Training a Multigenerational Workforce. *Professional Safety*, 57(3), 40-44.

Cepero, F.R., & Williams, S. (2009). The Multigenerational Workforce: Opportunity for Competitive Success. *SHRM Research Department*. First quarter.

Chae, L.S., & Kang, J. (2015). Understanding of Essential BIM Skills through BIM Guidelines. *ASC Proceedings of the 51st Annual Conference,* College Station, TX.

Cidik, M.S., Boyd, D., Hill, S., & Thurairajah, N. (2014). BIM and Conceptual Design Sustainability Analysis: An Information Categorization Framework. *ASC Proceedings of the 50th Annual Conference,* Washington, D.C.

Coates, J. (2007). *Generational Learning Styles*. River Falls: LERN Books.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). *Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review*. London: Learning & Skills Research Centre.

Construction Management Association of America (2012, August). *CMAA Owner's Guide to Project Delivery Methods*. Retrieved from http://cmaanet.org/files/Owners%20Guide%20to%20Project%20Delivery%20Methods%20Final.pdf

Conway, H., & Roenisch, R. (2005). *Understanding Architecture: an Introduction to Architecture and Architectural History* (2nd Edition). New York, NY: Routledge.

Cooper, T.E. (1989). Construction-Related Applications of Barcode Technology. *ASC Proceedings of the 25th Annual Conference,* Lincoln, NE.

Cunningham, K., Lattanzi, D., Dell'Andrea, R., Riley, M., Huette, T., Goetz, R., & Wilson, R. (2015). UAS-Based Inspection of the Placer River Trail Bridge: a Data-Driven Approach. *Proceedings of the 2015 ASCE Structures Congress*, 607-615.

Curran, C. R. (2001). The mission, the message, and the 'me generation'. *Nursing Economics*, 19(3), 93-93, 99.

Dai, F., & Lu, M. (2010). Assessing the Accuracy of Applying Photogrammetry to Take Geometric Measurements on Building Products. *Journal of Construction Engineering and Management,* 136(2), 242-250.

Dai, F., & Lu, M. (2013). Three-Dimensional Modeling of Site elements by Analytically Processing Image Data Contained in Site Photos. *Journal of Construction Engineering and Management*, 139(7), 881-894.

Dai, F., Rashidi, A., Brilakis, I., & Vela, P. (2013). Comparison of Image-Based and Time-of-Flight-Based Technologies for Three-Dimensional Reconstruction of Infrastructure. *Journal of Construction Engineering and Management*, 139(1), 69-79.

Davis, Kirsten A. (2004). Information Technology Change in the Architecture, Engineering, and Construction Industry: An Investigation of Individuals' Resistance (Doctoral Dissertation). Virginia Polytechnic Institute and State University, Retrieved from ProQuest, Order No. 3123729.

Deal, J. J., Altman, D. G., & Rogelberg, S. G. (2010). Millennials at Work: What We Know and What We Need to Do (if anything). *Journal of Business and Psychology*, 25(2),191-199.

Design-Build Institute of America (2016, March 29). Retrieved from http://www.dbia.org/about/Pages/What-is-Design-Build.aspx

Diekmann, J.E. (2007). Past Perfect: Historical Antecedents of Mmodern Construction Practices. *Journal of Construction Engineering and Management*, 133(9), 652-660.

Dunn, R., & Dunn, K. (1978). *Teaching Students Through Their Individual Learning Styles*. Reston, VA: Reston Publishing.

Eisner, S. P. (2005). Managing generation Y. *S.A.M. Advanced Management Journal*, 70(4), 4-15.

Farnsworth, C.B., Beveridge, S., Miller, K.M., & Christofferson, J.P. (2014). Application, Advantages, and Methods Associated with Using BIM in Commercial Construction. *International Journal of Construction Education and Research*, 11(3), 218-236.

Farrow, C.B., Emig, J., Maloney, T., & Glenboski, M. (2011). Non-Conventional: An Independent Outreach in Integrated Design and Construction Education. *ASC Proceedings of the 47th Annual Conference*, Omaha, NE.

Farrow, C.B., Liu, J., & Tatum, M. (2010). Establishing Curriculum Delivery Preferences of the Net Generation. *ASC Proceedings of the 46th Annual Conference*, Boston, MA.

Felder, R. M., & Brent, R. (2005). Understanding of Student Differences. *Journal of Engineering Education*, 94(1), 57-72.

Felder, R. M., & Silverman, L. K. (1988). Learning and Teaching Styles. *Engineering Education*, 78(7), 674-681.

Felder, R.M., & Soloman, B.A. (1993). Learning Styles and Strategies. Retrieved from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/ILS.pdf, © based on material from R.M. Felder and L.K. Silverman, Learning and Teaching Styles in Engineering Education. *Engineering Education*, 78(7), 674-681 (1988).

Felder, R. M., & Spurlin, J. (2005). Applications, Reliability and Validity of the Index of Learning Styles. *International Journal of Engineering Education*, 21(1), 103-112.

Feng, L., Olbina S., & Issa, R. (2014). Implementation of Building Information Modeling on K-12 Educational Facility Projects in Florida, *ASC Proceedings of the 50th Annual Conference*, Washington, D.C.

Fingland, Jon (2015). Technology Transformation: Going Beyond Automation. *Construction Executive*, July 2015, 34-36.

Florida Institute of Technology. (2016, March 22) Generational Learning Styles (Generation X and Y). Retrieved from http://www.fit.edu/ctle/documents/Course_Design/Generational%20Learning%20Styles%20Handout.pdf

Foliente, G.C. (2000). Development in Performance-Based Building Codes and Standards. *Forest Products Journal*, 50(7), 12-21.

Fonteyn, M.E., Kulpers, B., & Grobe, S.J. (1993). A Description of Think Aloud Method and Protocol Analysis. *Qualitative Health Research*, 3(4), 430-441.

Forbes, L., Ahmed, S.A., Yaris, C.E., & Batie, D.L. (2014). Incorporating Lean in CM Education to Improve the Construction Industry – Proposing a Model. *ASC Proceedings of the 50th Annual Conference*, Washington, D.C.

Foy, D., & Shahbodaghlou, F. (2015). 3D Printing for General Contractors: an Analysis of Potential Benefits. *ASC Proceedings of the 51st Annual Conference*, College Station, TX.

Franks, R.R., Reyes, M.D., & Pittenger, D. (2015). The Role of the Integrated Team Leader in the Architectural, Engineering, and Construction Industry. *51st ASC annual International Conference Proceedings*. College Station, TX, 2015.

Frazoni, A.L., & Assar, S. (2009). Student Learning Styles Adaptation Method Based on Teaching Strategies and Electronic Media. *Journal of Educational Technology & Society*, 12(4), 5-29.

Fry, Richard (2015, 16 January). This year, Millennials will overtake Baby Boomers. Pew Research Center, retrieved from http://www.pewresearch.org/fact-tank/2015/01/16/this-year-millennials-will-overtake-baby-boomers/

Gheisari, M., Irizarry, J., & Walker, B.N. (2014). UAS$SAFETY: The Potential of Unmanned Aerial Systems for Construction Safety Applications. *Proceedings of the 2014 ASCE Construction Research Congress*, 1801-1810.

Ghosh, A., & Root S. (2013). Industry and Academia: A Partnership to VDC Curriculum. *ASC Proceedings of the 49th Annual Conference*, San Luis Obispo, CA.

Ghosh, S., & Robson, K.F. (2014). Analyzing the Empire State Building Project from the
Perspective of Lean Project Delivery System. *ASC Proceedings of the 50th Annual
Conference*, Washington, D.C.

Gier, D.M., Loftin, E., & Coogan, K. (2006). Are Building Information Models Effective
for Teaching Productivity Analysis? *ASC Proceedings of the 42nd Annual
Conference*, Ft. Collins, CO.

Gillins, M.N., Gillins, D.R., & Parrish, C. (2016). Cost-Effective Bridge Safety
Inspections Using Unmanned Aircraft Systems. *Proceedings of the 2016 ASCE
Geotechnical and Structural Engineering Congress*, 1931-1940.

Gordon, C. (1994). Choosing Appropriate Construction Contracting Method. *Journal of
Construction Engineering and Management*, 120(1), 196-210.

Gordon, C., & Slattery, K.T. (2008). Spatial Inspection of Steel Pile Driving Operations
Using Laser Scan Data. *ASC Proceedings of the 44th Annual Conference*, Auburn,
AL.

Gravitt, D. (2005). A Bar Code Based Quality Inspection Procedure for Residential
Construction. *ASC Proceedings of the 41st Annual Conference,* Cincinnati, OH.

Gray, K. C., & Herr, E. L. (1988). *Workforce Education*. Needham Heights, MA: Allyn
and Bacon.

Grayson, L. P. (1977). A Brief History of Engineering Education in the United States.
Engineering Education, 68(3), 246-64.

Gregorc, A. F. (1982). *An Adult's Guide to Style*. Columbia, CA: Gregorc Associates.

Gregorc, A. F. (1984). *Gregorc Style Delineator: Development, technical and
administration manual*. Columbia, CT: Gregorc Associates.

Gunderson, D.E. (2011). Superintendent Competencies and Attributes: First Look at a

   National Study. *Proceedings of the Associated Schools of Construction Annual*

   International Conference, Omaha, NE

Gunderson, D.E., & Gloeckner, G.W. (2011). Superintendent Competencies and

   Attributes Required for Success: A National Study Comparing Construction

   Professionals' Opinions. *International Journal of Construction Education and*

   Research, 7(4), 294-311.

Gutek, G. L. (1991). *Education in the United States*. Needham Heights, MA: Allyn and

   Bacon.

Hall, E., & Moseley, D. (2005). Is There a Role for Learning Styles in Personalised

   Education and Training? *International Journal of Lifelong Education*, 24(3), 243-

   255.

Harfield, T., Panko, M., Davies, K., & Kenley, R. (2007). Toward a Learning-Styles

   Profile of Construction Students: Results from New Zealand. *International*

   Journal of Construction Education and Research, 3, 143-158.

Hedrick, T.E., Bickman, L., Rog, D.J. (1993). *Applied Research Design: A Practical*

   Guide. Sage Publications, Newbury Park, CA.

Hermann, M.M., Hermann, H.C., & McGlohn, E.M. (2015). Educating Integrated

   Project Delivery Educators: A Study on the Source of IPD Knowledge Among

   Educators. *Proceedings of the Associated Schools of Construction Annual*

   International Conference, College Station, TX.

Holt, E. (2015). Analysis of the Learning Styles of Undergraduate Students in

Construction Management Bachelor Degree Programs in the U.S. (Doctoral

Dissertation). Purdue University, Retrieved from ProQuest, Order No. 3735182.

Honey, P., & Mumford, A. (1986). *Using Your Learning Styles*. Maidenhead, UK: Peter

Honey.

Houle, C. O. (1961). *The Inquiring Mind*. Madison, WI: University of Wisconsin.

Hubley, A. M., & Zumbo, B. D. (2011). Validity and the consequences of test

interpretation and use. *Social Indicators Research*, 103 (2), 219-230.

Hughes, G. (1984) *Electricity and Buildings*. London, UK: P. Peregrinus on behalf of the

Institution of Electrical Engineers.

Jaselskis, E. J., Gao, Z., & Walters, R. C. (2005). Improving Transportation Projects

Using Laser Scanning." *Journal of Construction Engineering and Management*,

131(3), 377-384.

Johnson, S.A., & Romanello, M.L. (2005). Generational Diversity: Teaching and

Learning Approaches. *Nurse Educator,* 30(5), 212-216.

Joshi, A., Dencker, J. C., Franz, G., M., & Martocchio, J. J. (2010). Unpacking

Generational Identities in Organizations. *Academy of Management Review*, 35,

392 - 414.

Jung, C. G. (1923). *Psychological Types*. New York, NY: Harcourt Brace.

Jung, Y., & Jeong, M.G. (2015). RFID Readability Test for Construction Materials: A

Senior Project. *ASC Proceedings of the 51st Annual Conference*, College Station,

TX.

Kaifi, B. A., Nafei, W. A., Khanfar, N. M., & Kaifi, M. M. (2012). A multi-generational workforce: Managing and understanding Millennials. *International Journal of Business and Management*, 7(24), 88-93.

Karan, E.P., Sivakumar, R., Irizzary, J., Guhathakurta, S. (2014). Digital Modeling of Construction Site Terrain Using Remotely Sensed Data and Geographic Information Systems Analyses. *Journal of Construction Engineering and Management*, 140(3): 04013067.

Keefe, J. W. (1987). *Learning Style Theory and Practice*. Paper presented at the National Association of Secondary School Principals, Reston, VA.

Keeler, K., Clevenger, C.M., & Atadero, R. (2013). Framework for Sustainability Challenges within the Building Industry. *ASC Proceedings of the 49th Annual Conference*, San Luis Obispo, CA.

Khosrowpour, A., Niebles, J.C., & Golparvar-Fard, M. (2014). Vision-based Workface Assessment Using Depth Images for Activity Analysis of Interior Construction Operations. *Automation in Construction*, 48(2014), 74-87.

Knowles, M. (1977). *The Modern Practice of Adult Education: Andragogy versus Pedagogy.* New York, NY: Association Press.

Koch, D., & Benhart, B. (2010). Redefining Competencies for Field Supervision. *ASC Proceedings of the 46th Annual Conference,* Boston, MA.

Koch, D., Benhart, B., & Jenkins, J.L. (2015). Assessment of an Online Field Supervisor Training Program. *ASC Proceedings of the 51st Annual Conference*, College Station, TX.

Kolb. (1981). Learning styles and disciplinary differences. *The Modern American College*, 232-255.

Kolb. (1984). *Experiential learning: Experience as the source of learning and development*: Prentice Hall.

Kolb, & Kolb. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of management learning & education*, 4(2), 193-212.

Kunreuther, F. (2003). The changing of the guard: What generational differences tell us about social-change organizations. *Nonprofit and Voluntary Sector Quarterly*, 32(3), 450-457.

Kyriacou, MD, D. N. (2016) The Enduring Evolution of the *P* Value. *Journal of the American Medical Association*, 315(11), 11-13.

Lambert, M. (2015). Generational Difference in the Workplace: The Perspectives of Three Generations on Career Mobility. (Doctoral Dissertation). George Washington University, Retrieved from ProQuest, Order No. 3688763.

Lancaster, L. C., & Stillman, D. (2010). Rocking the workplace: How the Millennial generation is shaking things up and how companies are adapting to maximize performance. *International Professional Performance Magazine*, 18(2), 24-25.

Langar, S., & Pearce, A. (2014). State of Adoption for Building Information Modeling (BIM) in the Southeastern United States. *ASC Proceedings of the 50th Annual Conference,* Washington, D.C.

Leathem, T.M. (2014). Lean Strategies as a Teaching Tool in a Collaborative

    Undergraduate Construction/Architecture Course. *ASC Proceedings of the 50th*

    Annual Conference, Washington, D.C.

Lee, N., & Hollar, D. (2013). Probing BIM Education in Construction Engineering and

    Management Programs Using Industry Perceptions. *ASC Proceedings of the 49th*

    Annual Conference, San Luis Obispo, CA.

Lesser, S. B., & Bacon, B. A. (2008). Construction Lawyer's Guide to the 2007 AIA

    A201 "General Conditions of the Contract for Construction". *Tort Trial &*

    Insurance Practice Law Journal, 43(44), 113–149.

Lindeman, E. C. (1989). *The Meaning of Adult Education* (4th ed.). Canada: Harvest

    House.

Litzinger, T. A., Lee, S. H., Wise, J. C., Felder, R. M. (2007). A Psychometric Study of

    the Index of Learning Styles, *Journal of Engineering Education*, 96(4), 3009-319.

Liu, J., Holley, P., & Jennesse, Jr., M. (2016). Utilizing Light Unmanned Aerial Vehicles

    for inspection of Curtain Walls: A Case Study. *Proceedings of the 2016*

    Construction Research Congress, University of Puerto Rico, Mayagüez, San

    Juan, PR.

Liu, K., & Golparvar-Fard, M. (2015). Crowdsourcing Construction Activity Analysis

    from Jobsite Video Streams. *Journal of Construction Engineering and*

    Management, 10.1061/(ASCE)CO.1943-7862.0001010, 04015035.

Lu, N., & Korman, T.M. (2010). Opportunities for Advancement of Mmodular

    Construction Projects using Building Implementation Modeling (BIM). *ASC*

    Proceedings of the 46th Annual Conference, Boston, MA.

Lu, N., & Liska, R. (2008). Designers' and General Contractors' Perceptions of Offsite
Construction Techniques in the United States Construction Industry. *International
Journal of Construction Education and Research*, 4(3), 177-188.

Luo, X., Li, H., Huang, T., & Skitmore, M. (2016). Quantifying Hazard Exposure Using
Real-Time Location Data of Construction Workforce Equipment. *Journal of
Construction Engineering and Management,* 10.1061/(ASCE)CO.1943-
7862.0001139.

Lyons, S. (2004). An Exploration of Generational Values in Life and at Work (Doctoral
Dissertation). Carleton University (Canada). Retrieved from ProQuest, Order No.
NQ94206.

Maloney, T. J. (1990). Flirting with disaster: the AIA owner-architect agreement shifts
the risk of loss to owners. *Loy. L. Rev.*, 36, 409.

Maslow, A. H. (1954/1970). *Motivation and Personality* (2nd ed.) New York, NY:
Harper & Row.

Mazria, E. (2003). It's the Architecture, Stupid! *Solar Today*, May/June 2003, 48-51.

Meadati, P., Irizarry, J., & Liou, F. (2013). Teaching Using 3D Laser Scans. *ASC
Proceedings of the 49th Annual Conference,* San Luis Obispo, CA.

Mehany, M.S.H.M. (2015). Lean Construction Principles Past and Present – A Business
Model Consistency. *ASC Proceedings of the 51st Annual Conference*, College
Station, TX.

Meredith, G. E., Schewe, C. D., & Karlovich, J. (2002). *Defining markets defining
moments*. New York, NY: Hungry Minds Inc.

Migilinskas, D., Popov, V., Juocevicius, V., & Ustinovichius, L. (2013). The Benefits, Obstacles and Problems of Practical BIM Implementation. *11th International Congress on Modern Building Materials, Structures, and Techniques*, Vilnius, Lithuania.

Mitropoulos, P., & Tatum, C.B. (2000). Forces Driving Adoption of New Information Technologies. *Journal of Construction Engineering and Management*, 126(5), 340-348.

Mohammadpour, A., Karan, E., Asadi, S., and Rothrock, L. (2015). Measuring End-User Satisfaction in the Design of Building Projects Using Eye-Tracking Technology. *Computing in Civil Engineering 2015*, 564-571.

Mrazek III, J.C. (2015). Investigating and Comparing the Differences in Feedback Orientation between Three Generations. (Doctoral Dissertation). University of the Rockies, Retrieved from ProQuest, Order No. 3717969.

Nasr, E., Shehab, T., & Vlad, A. (2013). Tracking Systems in Construction: Applications and Comparisons. *ASC Proceedings of the 49th Annual Conference*, San Luis Obispo, CA.

Ng, E. S., W., Schweitzer, L., & Lyons, S. T. (2010). New generation, great expectations: A field study of the millennial generation. *Journal of Business and Psychology*, 25(2), 281-292.

Nobe, M.C., & Greenwell, C. (2016). Moving Operations and Maintenance Practices of Existing Buildings beyond Sustainability: A Case Study of the LENSES Framework during Post Occupancy. *International Journal of Construction Education and Research*, 12(2), 122-141.

O'Bannon, G. (2001). Managing our future: The Generation X factor. *Public Personnel Management,* 30(1), 95.

Olsen, M., Kuester, F., Chang, B., & Hutchison, T. (2010). Terrestrial laser scanning based structural damage assessment. *Journal of Computation in Civil Engineering*, 24(3), 264-272.

Ozcan-Deniz, G., & Zhu, Y. (2014). Application of Formal Concept Analysis in Estimating the Cost of Green Buildings. *ASC Proceedings of the 50th Annual Conference*, Washington, D.C.

Pandey, A.R., & Shahbodaghlou, F. (2015). Measuring Contribution of Building Information Modeling (BIM) to the Construction Sustainability Goals. *ASC Proceedings of the 51st Annual Proceedings*, College Station, TX.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning Styles: Concepts and Evidence. *Psychological Science in the Public Interest (Wiley-Blackwell)*, 9(3), 105-119.

Pendergast, D. (2007). The MilGen and society. In N. Bahr & D. Pendergast (Eds.), *The millennia adolescent* (pp. 23-40). Canberra, Australia: Australian Council for Educational Research.

Perrenoud, A.J., & Sullivan, K.T. (2013). Frequency and Timeline of Leadership Transitions within Construction Companies. ASC *Proceedings of the 49th Annual Conference*, San Luis Obispo, CA.

Pishdad-Bozorgi, P., & Beliveau, Y. (2016). Symbiotic Relationships between Integrated Project Delivery (IPD) and Trust. *International Journal of Construction Education and Research*, 12(2), 142-160.

Riding, R. J., & Cheema, I. (1991). Cognitive Styles: an Overview and Integration. *Educational Psychology*, 11, 193-215.

Riessman, F. (1962). *Action approaches to low-income culture. Part I.* New York, NY: Mobilization for Youth.

Rodgers, M., Runyon, D., Starrett, D., & Von Holzen, R. (2006). Teaching the 21st Century Learner. *22nd Annual Conference on Distance Technology and Learning*. Madison, WS

Rodriguez, R.O., Green, M.T., & Ree, M.J. (2003). Leading Generation X: Do the old rules apply? *Journal of Leadership & Organizational Studies,* 9: 67

Santally, M. I., & Senteni, A. (2013). Effectiveness of Personalised Learning Paths on Students Learning Experiences in an E-Learning Environment. *European Journal of Open, Distance, and E-Learning*, 16(1), 36-52.

Sapers, C., & Merliss, P. (1988). The Liability of Architects and Engineers in Nineteenth Century America. *Journal of Architectural Education*, 41(2), 39-45.

Schexnayder, C. & Anderson, S. (2011). Construction Engineering Education: History and Challenge. *Journal of Construction Engineering & Management*, 137(10), 730-739.

Scott, C. (2010). The Enduring Appeal of 'Learning Styles'. *Australian Journal of Education (ACER Press)*, 54(1), 5-17.

Sheak, J.C., & Korzun, T.J. (1988). Old Game, New Rules: A Brief Guide to 1987 Changes in the AIA A201, General Conditions of the Contract for Construction. *The Construction Lawyer*, 8(3).

Shih, N. & Wang, P. (2004). Point cloud based comparison between construction

schedule and as-built progress: Long range three dimensional laser scanner's

approach. *Journal of Architectural Engineering*, 10(3), 98-102.

Simpson, J. (1999). *Chatauqua: An American Utopia*. New York, NY: Harry N. Abrams.

Spence, W.P. (2006). *Construction Materials, Methods, and Techniques* (2nd Edition).

Clifton Park, NY: Thomson Delmar Learning.

Sternberg, R., Grigorenko, E., (2001). Unified Psychology. *American Psychologist*,

56(12), 1069-1079.

Stets, J. E., & Burke, P. J. (2000). Identity Theory and Social Identity Theory. *Social

Psychology Quarterly*, 63(3), 224-237.

Strunk, K. (2016). Analysis of Variance – The One Way ANOVA [Powerpoint slides].

Retrieved from

https://auburn.instructure.com/courses/960035/files/folder/Lecture%20Notes?prev

iew=61177031

Suh, M.J., Pearce, A.R., & Jeon, M. (2014). Green Construction: An Inventory of

Training and Education Approaches in the United States. *ASC Proceedings of the

50th Annual Conference*, Washington, DC.

Swiggard, S. B. (2011). Generations and Employee Commitment: An Exploration of the

Impact of Changes in Technology, Home and Family Structure, and Employer-

Employee Relationships (Doctoral Dissertation). Capella University. Retrieved

from ProQuest, Order No. 3439654.

Switala-Elmhurst, K., & Udo-Inyang, P. (2014). Life Cycle assessment of Residential

    Windows: Saving Energy with Window Restoration. *ASC Proceedings of the 50th*

    Annual Conference, Washington, D.C.

Tavernor, R.)1998). *On Alberti and the Art of Building*. New Haven, CO: Yale

    University Press.

Taylor, J.M., & Olsen, D.A. (2012). Sustainable Building Contracts and the 2012 AIA

    Documents. *ASC Proceedings of the 48th Annual Conference*, Birmingham, UK.

Teicholz, P. (2013). Labor-Productivity Declines in the Construction Industry: Causes

    and Remedies (Another Look), *AECbytes*, Viewpoint #67.

Thomsen, C. & Sanders, S. (2011). *Program Management 2.0*, McLean, VA:

    Construction Management Association of America Foundation.

Thorpe, T., & Mead, S. (2001). Project-Specific Websites: Friend or Foe? *Journal of*

    Construction Engineering and Management, 127(5), 406-413.

Trujillo, D., & Spencer-Workman, S. (2015). Campus Collaboration for Experiential

    Learning in Sustainability Education: LEED Lab. *ASC Proceedings of the 51st*

    Annual Conference, College Station, TX.

Tuckman, B.W. (1999). *Conducting Educational Research* (5th ed.). Fort Worth, TX:

    Harcourt Brace Publishers.

University of Florida (2016, March 29). Program History. Retrieved from

    http://www.bcn.ufl.edu/about/history

U.S. Department of Commerce (2016). January 2016 Value of Construction Put in Place

    – Seasonally Adjusted Annual Rate, *U.S. Census Bureau News*, retrieved March

    23, 2016 from http://www.census.gov/construction/c30/pdf/totsa.pdf

U.S. Energy Information Administration (2016, April 2). How much energy is consumed

      in residential and commercial buildings in the United States? Retrieved from

      www.eia.gov/consumption/commercial.

U.S. General Services Administration (GSA). (2011, March 27). Public building service.

      Green building performance: a post occupancy evaluation of 22 GSA buildings.

      Retrieved from http://www.gsa.gov/graphics

Vitruvius (1914). *The Ten Books on Architecture*. Translated by Morgan, M. H.

      Cambridge, MA: Harvard University Press.

Wallick, R. D., & Stafford, J. A. (1964). The Miller Act: Enforcement of the Payment

      Bond. *Law and Contemporary Problems*, 29(2), 514-530.

Ware, J., Craft, R., & Kerschenbaum, S. (2007). Training Tomorrow's Workforce. *T+D,*

      61(4), 58.

Wesner, M. S., & Miller, T. (2008). Boomers and Millennials Have Much in Common.

      Organization Development Journal, 26(3), 89-96.

Willenbrock, J. H., & Thomas, Jr., H.R. (2007). History of Construction, Engineering,

      and Management in the Department of Civil and Environmental Engineering at

      Penn State. *Journal of Construction Engineering & Management*, 133(9), 644-

      651.

Windapo, A., Odediran, S., & Akintona, R. (2015). Establishing the Relationship

      between Construction Project Managers' Skills and Project Performance. *ASC*

      Proceedings of the 51st Annual Conference, College Station, TX.

Woo, J.H. (2007). BIM (Building Information Modeling) and Pedagogical Challenges.

      ASC Proceedings of the 43rd Annual Conference, Flagstaff, AZ.

Yip, B. (2010). A Critical Review on Sustainable Information Technology in the
Construction Industry. *ASC Proceedings of the 46th Annual Conference*, Boston,
MA.

Zhang, L. F., & Sternberg, R. J. (2005). A threefold model of intellectual styles.
Educational Psychology Review, 17(1), 1-53.

Zhang, L. F., Sternberg, R., Rayner, W., (2012). *Handbook of Intellectual Styles*. New
York, NY: Springer Publishing Company, LLC.

Zhao, D., McCoy, A., Bulbul, T., Fiori, C., & Nikkhoo, P. (2015). Building Collaborative
Construction Skills through BIM-integrated Learning Environment. *The
International Journal of Construction Education and Research*, 11:2, 97-120

Zwyno, M. S. (2003). A Contribution of Validation of Score Meaning for Felder-
Soloman's Index of Learning Styles. *Proceedings, 2003 Annual ASEE
Conference and Exposition*, Nashville, TN.

ILS Questions and Demographic Questions

I understand something better after I
- ◯ try it out.
- ◯ think it through

I would rather be considered
- ◯ realistic.
- ◯ innovative.

When I think about what I did yesterday, I am most likely to get
- ◯ a picture.
- ◯ words.

I tend to
- ◯ understand details of a subject but may be fuzzy about its overall structure.
- ◯ understand the overall structure but may be fuzzy about details.

When I am learning something new, it helps me to
- ◯ talk about it.
- ◯ think about it.

If I were a teacher, I would rather teach a course
- ◯ that deals with facts and real life situations.
- ◯ that deals with ideas and theories.

I prefer to get new information in
- ◯ pictures, diagrams, graphs, or maps.
- ◯ written directions or verbal information.

Once I understand
- ◯ all the parts, I understand the whole thing.
- ◯ the whole thing, I see how the parts fit.

In a study group working on difficult material, I am more likely to

- ◯ jump in and contribute ideas.
- ◯ sit back and listen.

I find it easier

- ◯ to learn facts.
- ◯ to learn concepts.

In a book with lots of pictures and charts, I am likely to

- ◯ look over the pictures and charts carefully.
- ◯ focus on the written text.

When I solve math problems

- ◯ I usually work my way to the solutions one step at a time.
- ◯ I often just see the solutions, but then have to struggle to figure out the steps to get to them.

In classes I have taken

- ◯ I have usually gotten to know many of the students.
- ◯ I have rarely gotten to know many of the students.

In reading non-fiction, I prefer

- ◯ something teaches me new facts or tells me how to do something.
- ◯ something that gives me new ideas to think about.

I like teachers

- ◯ who put a lot of diagrams on the board.
- ◯ who spend a lot of time explaining.

When I'm analyzing a story or a novel

- ◯ I think of the incidents and try to put them together to figure out the themes.
- ◯ I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.

When I start a homework (or other) problem, I am more likely to

- ◯ start working on the solution immediately.
- ◯ try to fully understand the problem first.

I prefer the idea of
- ○ certainty.
- ○ theory.

I remember best
- ○ what I see.
- ○ what I hear.

It is more important to me that an instructor
- ○ lay out material in clear sequential steps.
- ○ give me the overall picture and relate the material to other subjects.

I prefer to study
- ○ in a group.
- ○ alone.

I am more likely to be considered
- ○ careful about the details of my work.
- ○ creative about how I do my work.

When I get directions to a new place, I prefer
- ○ a map.
- ○ written directions.

I learn
- ○ at a fairly regular pace. If I study hard, I'll 'get it.'
- ○ in fits and starts. I'll be totally confused and then suddenly it all 'clicks.'

I would rather first
- ○ try things out.
- ○ think about how I'm going to do it.

When I am reading for enjoyment, I like writers to
- ○ clearly say what they mean.
- ○ say things in creative, interesting ways.

When I see a diagram or picture in class, I am most likely to remember
- ○ the picture.
- ○ what the instructor said about it.

When considering a body of information, I am more likely to

- ○ focus on details and miss the big picture.
- ○ try to understand the big picture before getting into the details.

I more easily remember

- ○ something I have done.
- ○ something I have thought a lot about.

When I have to perform a task, I prefer to

- ○ master one way of doing it.
- ○ come up with new ways to do it.

When someone is showing me data, I prefer

- ○ charts or graphs.
- ○ text summarizing the results.

When writing a paper, I am more likely to

- ○ work on (think about or write) the beginning of the paper and then progress forward.
- ○ work on (think about or write) different parts of the paper and then order them.

When I have to work on a group project, I first want to

- ○ have group 'brainstorming' where everyone contributes ideas.
- ○ brainstorm individually and then come together as a group to compare ideas.

I consider it high praise to call someone

- ○ sensible.
- ○ imaginative.

When I meet people at a party, I am more likely to remember

- ○ what they looked like.
- ○ what they said about themselves.

When I am learning a new subject, I prefer to

- ○ stay focused on that subject, learning as much about it as I can.
- ○ try to make connections between that subject and related subjects.

I am more likely to be considered

- ○ outgoing.
- ○ reserved.

I prefer courses that emphasize

- ○ concrete material (facts, data).
- ○ abstract material (concepts, theories.)

For entertainment, I would rather

- ○ watch television.
- ○ read a book.

Some teachers start their lectures with an outline of what they will cover. Such outlines are

- ○ somewhat helpful to me.
- ○ very helpful to me.

The idea of doing homework in groups, with one grade for the entire group

- ○ appeals to me.
- ○ does not appeal to me.

When I am doing long calculations,

- ○ I tend to repeat all my steps and check my work carefully.
- ○ I find checking my work tiresome and have to force myself to do it.

I tend to picture places I have been

- ○ easily and fairly accurately.
- ○ with difficulty and without much detail.

When solving problems in a group, I would be more likely to

- ○ think of the steps in the solution process.
- ○ think of the possible consequences or applications of the solution in a wide range of areas.

Please answer the following demographic questions.

What is your age? _____

In a classroom or similar training space, about how many total hours of formal construction-related training have you undertaken in the past year?

- ○ None
- ○ 1 to 5 hours
- ○ 6 to 20 hours
- ○ More than 20 hours

What is the highest level of school or degree that you have completed?

- ○ High School graduate, diploma or equivalent (GED)
- ○ Some college credit, no degree
- ○ Trade/Vocational training
- ○ Associate Degree
- ○ Bachelor's degree
- ○ Other

Thank you for participating in this study.

Appendix B

Permission to Utilize the ILS Instrument

Subject: Re: ILS use in research

Date: Saturday, September 19, 2015 at 11:11:48 AM Central Daylight Time

From: Richard Felder

To: Paul Holley

Dear Professor Holley,

I'm attaching the forms you'll need. Good luck with your work.

Sincerely,

Richard M. Felder
Hoechst Celanese Professor Emeritus of Chemical Engineering
North Carolina State University
www.ncsu.edu/effective_teaching

On Sep 13, 2015, at 12:13 PM, Paul Holley <hollepw@auburn.edu> wrote:

> Dr. Felder -
>
> I hope this finds you well. I am very interested in utilizing the ILS in my research related to learning styles in the construction management industry. I was hopeful that I might have your permission to use the instrument, and have attached the signed certification as requested on your website. Please let me know if you need any other information to be able to forward the scoring key, etc.
>
> Thank you in advance -
>
> Paul Holley
>
>
> **Paul W. Holley**
> Professor
> McWhorter School of Building Science
> Auburn University
>
> hollepw@auburn.edu
> 334-844-5377
>
> <AU logo - cropped, AU only   resized small for email signature[18].png>
> <ILS-certification.doc>

Appendix C

IRB Approval

Revised 2.1.2014   Submit completed form to **IRBsubmit@auburn.edu** or 115 Ramsay Hall, Auburn University 36849.

Form must be populated using Adobe Acrobat / Pro 9 or greater standalone program (do not fill out in browser). Hand written forms will not be accepted.

1. **PROPOSED START DATE of STUDY:** May 15, 2016

PROPOSED REVIEW CATEGORY (Check one): ☐ FULL BOARD ☑ EXPEDITED

SUBMISSION STATUS (Check one): ☑ NEW ☐ REVISIONS (to address IRB Review Comments)

2. **PROJECT TITLE:** Learning Styles and Preferences of Field Managers in U.S. Non-residential Construction

3. Paul Holley _____ Professor _____ Building Science _____ hollepw@auburn.edu
   PRINCIPAL INVESTIGATOR   **TITLE**   **DEPT**   **AU E-MAIL**

   118 M. Miller Gorrie Center _____ 334-844-5377 _____ pwholley@mindspring.com
   MAILING ADDRESS   **PHONE**   **ALTERNATE E-MAIL**

4. **FUNDING SUPPORT:** ☑ N/A ☐ Internal ☐ External Agency: _____   ☐ Pending ☐ Received

For federal funding, list agency and grant number (if available). _____

5a. List any contractors, sub-contractors, other entities associated with this project:

   N/A

b. List any other IRBs associated with this project (including Reviewed, Deferred, Determination, etc.):

   N/A

PROTOCOL PACKET CHECKLIST

All protocols must include the following items:

☑ **Research Protocol Review Form** (All signatures included and all sections completed)
  (Examples of appended documents are found on the OHSR website: http://www.auburn.edu/research/vpr/ohs/sample.htm)

☑ **CITI Training Certificates** for all Key Personnel.

☑ **Consent Form or Information Letter** and any Releases (audio, video or photo) that the participant will sign.

☑ **Appendix A**, "Reference List"

☑ **Appendix B** if e-mails, flyers, advertisements, generalized announcements or scripts, etc., are used to recruit participants.

☑ **Appendix C** if data collection sheets, surveys, tests, other recording instruments, interview scripts, etc. will be used for data collection. Be sure to attach them in the order in which they are listed in # 13c.

☐ **Appendix D** if you will be using a debriefing form or include emergency plans/procedures and medical referral lists (A referral list may be attached to the consent document).

☑ **Appendix E** if research is being conducted at sites other than Auburn University or in cooperation with other entities. A **permission letter** from the site / program director must be included indicating their cooperation or involvement in the project. NOTE: If the proposed research is a multi-site project, involving investigators or participants at other academic institutions, hospitals or private research organizations, a letter of **IRB approval** from each entity is required prior to initiating the project.

☐ **Appendix F** - Written evidence of acceptance by the host country if research is conducted outside the United States.

FOR ORC OFFICE USE ONLY

DATE RECEIVED IN ORC:_____ by_____ PROTOCOL #

DATE OF IRB REVIEW:_____ by_____ APPROVAL CATEG

DATE OF IRB APPROVAL:_____ by_____ INTER

COMMENTS:

> **The Auburn University Institutional Review Board has approved this Document for use from**
> **05/31/2016** to **05/30/2019**
> **Protocol #**   16-167 EX 1605