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Delphi Study Identifying Future Technical Competencies for
Architecture and Construction Educators

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Education in Adult and Lifelong Learning

by

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Abstract

The purpose of this modified Delphi study was to identify the dominant technical competencies needed to effectively teach architecture and construction at the secondary and post-secondary level and to determine if there are differences of opinion among educators, recent graduates and business and industry personnel as to what those competencies should be.

At the time of publication, the menu of technical workshops offered by the Kansas Center for Career and Technical Education (KCCTE) was determined by the workshop administrator and the director of the KCCTE. To ensure that these workshops provide instructors with the knowledge and skills that align with industry needs, it was imperative to identify the changing technical competencies needed by members of the workforce and the instructors who prepare them. A three round Delphi study was conducted to identify the dominant technical competencies. Participants from the area of education, recent graduates and industry personnel were asked to provide a list of technical skills they perceived to be lacking as students moved from education to industry. A list of 23 technical competencies was created and participants rated each topic on level of importance. The top 15 topics were then selected and participants re-rated those topics based on their beliefs and the Mean rating of the group from the previous round. Some differences in levels of perceived importance was noted between groups. Seven technical competencies were rated highest in perceived level of importance by the three groups. This study provided a basis on which the KKCTE can act to develop appropriate technical workshops to meet the needs of architecture and construction teachers in the state of Kansas.

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As with any large undertaking, there is more than one person responsible for the outcome of this project. Without encouragement and guidance from a variety of sources, there may have been no completion.

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To my friends and family who have put up with me as this project developed; I appreciate your patience and support more than you know. Thank you.

Dedication

I would like to dedicate the following dissertation to my parents, Marilyn and Richard Jones, who pushed me to do my best and always believed in me no matter what, and to my high school woodshop teacher, Jim Hogan, who is the reason I became a teacher.

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Chapter 1

Introduction

Background

Career and Technical Education (CTE) is defined as:

> Organized educational activities that offer a sequence of courses that provides individuals with coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in current or emerging professions; provides technical skills proficiency, an industry recognized credential, a certificate, or an associate degree; and may include prerequisite courses that meet the requirements of this subparagraph; and include competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of an industry, including entrepreneurship, of an individual. ("Carl D. Perkins," 2006, p.4).

Career and Technical Education (CTE) instructors have the unique job of preparing students for a future in the workplace that requires both academic and technical skills. The process of teaching trade and industry students is often more than challenging as these students tend not to enjoy educational activities, yet their trade and industry occupations require a good deal of proficiency in academic skills including math, writing, reading comprehension, active listening, speaking, and problem solving (Threeton, 2007). Threeton (2007) also suggests that CTE teachers will need to be prepared to assist students who will not actively seek to improve their academic skills on their own. CTE instructors are tasked with providing relevant and rigorous training in order to prepare students for high-skill, high-demand, and high-wage careers. They empower students with the knowledge and training that is necessary to become lifelong learners and succeed in future careers guided by the National Career Clusters Framework (acteonline.org, 2018). The framework consists of 79 career pathways spread among 16 main Career Clusters (Appendix B). The future of CTE will lie in the promotion of rigorous academic and occupational competencies and the pursuit of the development of curriculum to enhance the study of emerging technological fields.

"What sets CTE apart from other academic areas is its focus on the application of knowledge and the creation of in-depth understanding to solve problems" (Drage, 2009 p. 34). According to Threeton & Walter (2013), CTE instructors have a multitude of roles and responsibilities to facilitate in order to effectively manage a technical education laboratory. The following three categories can begin to explain the diverse nature of the responsibilities undertaken by the CTE instructor. They include the areas of instruction, supervision and management. First, CTE instructors provide instruction to students on a variety of tasks including the operation and methods used with tools and equipment in the lab, getting appropriate work standards in place, developing safety policies, enforcing rules, providing for a variety of learners and learning styles, determining which duties and tasks are appropriate for the needs of students and determining prior student knowledge and application of the subject matter as it pertains to the lab setting. Second comes supervision which includes directing and executing the plan of instruction. Within the area of supervision comes the task of assigning students to workstations, making sure materials are distributed in a safe and efficient manner, supervising student activities, dealing with student technical or behavioral issues, and providing student direction. Management is the third category of roles and responsibilities of a CTE instructor. A CTE instructor must handle the program management responsibilities and the physical operations of the lab. Specific examples of management include: "developing a planned program, preparing and maintaining budgets, purchasing equipment, supplies and tools, maintaining equipment and tools and monitoring the effectiveness and economy of instruction" (Threeton & Walter, 2013, p. 2).

Experiential Learning

According to O'Bannon & McFadden (2008), one must be motivated intrinsically to participate and actively engage in an experience in order to effectively learn and then people are able to apply what they learn to new experiences as they come along. Knowles (1980) suggests that adults accumulate a growing reservoir of knowledge because of their experiences which can be a rich resource for learning. This is largely due to the experiential learning that takes place as individuals are exposed to different problems and scenarios that must be overcome throughout their lives. In Career and Technical Education, students are exposed to a wide variety of experiences which they can use to develop a knowledge base and then build upon this to solve more complex problems as they arise.

Conceptual Framework

According to Danielson (2007) the activity of teaching falls into four categories of teaching responsibility. They include: Planning and preparation, the classroom environment, instruction and professional responsibilities. Within domain four, professional responsibilities is Component 4e: Growing and developing professionally. This component suggests that one of the ways teachers gain and maintain competency is through the enhancement of content knowledge and pedagogical skill. In figure 4.21 of Danielson (2007, p. 105), a rubric has been developed to determine the level of performance of growing and developing professionally. A rating of "Unsatisfactory" would mean that a teacher did not engage in any professional development activities. A rating of "Basic" would show the teacher only participated when it was convenient for them. A "Proficient" rating would indicate that the teacher sought out enhancement activities, while a rating of "Distinguished" would mean that the teacher sought out professional development activities and made a conscious effort to conduct research. All of these items indicate that for a teacher to be competent and effective, they must participate in professional development.

Professional Development

Professional development, teacher in-service and workshops readily available to teachers have minimal application for teachers in the Career and Technical Education (CTE) fields. "With little or no help available, often these CTE Instructors become frustrated with the career and leave the profession" (Su, Dainty, Sandford, Townsend, & Belcher, 2011, p. 187). Additionally, Danielson (2007) states:

> Teaching generates stress, and planning activities for students (some of whom would prefer not to be in class) to keep them engaged and effectively fulfilling those plans can be difficult. That, coupled with satisfying the demands from the school district, the community at large and the state can leave teachers, especially inexperienced teachers, confused and discouraged (Danielson, 2007, p. 5).

Professional Development is an important aspect of teacher improvement and retention. Louis (1998) found that the strongest relationship to commitment is the ability to use and develop skills related to one's work. Therefore, "teachers, like most professionals, require sustained stimulation to remain committed to and excited about their work" (Louis, 1998, p. 13). Boser and Daugherty (1994) argued that in order to advance the area of Technology Education, teachers must continually be provided with the latest information on curriculum, teaching methods, and technology advancements which would allow them to make positive program changes that are inherent in technology education. "One method suggested to provide information to technology education teachers is through professional development activities" (Cannon, Kitchel, Duncan, & Arnett, 2011, p. 33). Gusky (1986) determined that in order to be effective, professional development should provide teachers with the educational tools they feel will be helpful in further developing their teaching abilities. "Often, even though teachers are able to find topics that fit their professional growth needs, they still do not participate in those in-service opportunities" (Drage, 2010, p. 27). Some of the obstacles which affect attendance were acknowledged by Yamagata-Lynch and Haudenschild (2009) as: lack of time, lack of money, and opportunities not meeting teachers' needs.

Recently, the Kansas Legislature awarded a Kansas Legislative Enhancement Grant for Pittsburg State University which created the Kansas Center for Career and Technical Education (KCCTE). One of the objectives of the KCCTE is to identify and coordinate technical workshops to help CTE teachers stay current in the technical skills of their field. These workshops are offered at a reduced cost of twenty dollars currently. The Kansas Department of Education (KSDE) has identified 16 Career Clusters and 36 different Pathways [Career Standards and Assessment Services] (Kansas State Department of Education 2015). (Appendix B). While KSDE supports and governs CTE at the secondary level, Kansas Board of Regents (KBOR) Technical Education Authority makes recommendations concerning the planning, enhancement and coordination of CTE programs at the post-secondary level (Kansas Board of Regents, 2017). National Career Clusters Framework (acteonline.org, 2018) has further identified 16 career clusters and 79 career pathways (Appendix C).

This study focused primarily on the technical skill development needs of instructors in the Architecture and Construction field of both secondary and post-secondary institutions in the state of Kansas. Kansas has been identified as a state with a shortage of technical workers. In 2015, the National Association of State Directors of Career and Technical Education Consortium reported a 10% gap in the skillsets of the labor market in Kansas. Only 46% of the workers in Kansas possessed the necessary skills for middle-skill jobs covered by those in CTE areas while the labor market was comprised of 56% middle skill jobs. This skills gap has occurred while the predicted growth of an additional 4% from 2014 to 2024 is in fields related to CTE. The KCCTE was implemented and funded in order to help support CTE teachers in Kansas in order to help them become effective, high quality teachers. Being taught by high-quality teachers who are effective and have subject-matter expertise increases the probability that a student will have higher achievement and educational success (Lee, 2018). Lee (2018) states that “Stakeholders in education should not only aim to hire teachers with higher qualifications and effectiveness but should also consider ways to foster higher qualification and effectiveness among teachers who are presently teaching our students” (p.374).

Problem Statement

The menu of technical workshops offered by the Kansas Center for Career and Technical Education (KCCTE) was determined by the workshop administrator and the director of the KCCTE. To ensure that these workshops provide instructors with the knowledge and skills that align with current and emerging industry needs, it was imperative to identify the changing technical competencies needed by members of the workforce and the instructors who prepare them. Using a panel of industry and education experts, this Delphi study identified the knowledge and skills that were recommended for Architecture and Construction educator workshops.

Architecture and Construction in CTE

According to the Kansas State Department of Education (2018), the Architecture and Construction pathway deals with “designing, planning, managing, building, and maintenance of the built environment for a variety of purposes” (Kansas State Department of Education, p.1). Teachers in this field have a mission to prepare students for a successful career in architecture, construction and skilled mechanical trades occupations by providing them with the knowledge and skills necessary to become skilled in their field or continue with additional educational opportunities at the post-secondary level. Students in the Architecture and Construction Pathway are given high quality classroom, laboratory and field instruction. Students are also given opportunities to obtain professional certifications required for employment. The Kansas State Department of Education (2018) (Appendix A) refers to the Architecture and Construction Career Cluster Design which outlines the courses that fall into the Introductory, Technical, and Application Levels. One may refer to the original document to view the Kansas State Career Cluster Competency Profile for Architecture and Construction which lists approximately 26 different areas of coursework with multiple competencies listed for each course. The Kansas State Department of Education (2016) (Appendix D) shows the Kansas annual median wage for these workers and outlines future employment prospects.

Research Questions

1. What do technical educators, recent graduates, and business and industry personnel perceive to be the dominant technical competencies to effectively teach architecture and construction at the secondary and post-secondary level?

2. On which technical competencies do continuing technical educators, recent graduates, and business and industry personnel have the greatest degree of consensus for secondary and post-secondary architecture and construction education?

3. What is the difference in the perceived importance of the three groups of individuals surveyed; Technical educators, recent graduates and business and industry personnel?

Significance of the Problem

According to Cordeiro (1986), effective teacher training is based on the dissemination of immediately useful teaching materials and methods. Teachers look for ideas that work, and things that can be applied in the classroom right away. According to Knowles (1980), the process of adult learning called andragogy, is based on four assumptions. They include: a person's maturity, level of experience, readiness to learn, and desire to learn in order to deal with an immediate problem or issue. Thus, the need for effective training opportunities for teachers to deal with topics they feel unprepared to teach.

The KCCTE was developed through a legislative grant to support CTE programs in the State of Kansas. One of the main objectives of the KCCTE was to help enhance the teaching skills of CTE professionals and thereby improve the experience of their students. This study was designed to identify the needed skills for Career and Technical Education instructors, specifically in Architecture and Construction. Technological advancements, innovation, and adoption in the construction industry had previously been lacking, due largely to the concept that every project is unique (Laczkowski, Padhi, Rajagopal & Sandrone, 2018). This accounts for approximately 30 percent of the gap in productivity in the construction industry. The survey by Laczkowski, et al. (2018, para. 6) showed that "contractor customers are enthusiastic about the ability to use technology to improve equipment maintenance, project-management tasks and aftermarket purchases". The technology surrounding equipment with operator-guided systems, connectivity to project management software, predictive maintenance and remote monitoring will need to be understood by instructors in the architecture and construction field so that they can adequately prepare their students for a rapidly evolving technological structure within this field. Workshops to meet the changing needs of these instructors can then be designed, scheduled, and sponsored by the KCCTE. This allows the KCCTE to offer technical workshops that meet the real-time needs of architecture and construction instructors.

A limitation of this study may be that the panel members had a personal bias or were unaware of the new technological changes taking place in the Architecture and Construction industry. However, to overcome this bias, the expert panel consisted of 12 members. Four of the members were instructors in the architecture and construction field from either secondary or postsecondary institutions. Four of the members were directly involved in the industry including one from each of the following areas: Architecture, Civil Construction, Commercial Construction and Residential Construction. The remaining four members of the panel were recent graduates of a carpentry or architecture related program from a trade school, community college or university. A limitation of this study was that information will only be gathered in the State of Kansas. This was primarily due to the KCCTE providing services limited to within the state. This study could be easily replicated for use in other states or to gather results for any pathway.

Definition of Terms

Career: an occupation or profession, especially one requiring special training

Career Cluster: broad groups of occupations or industries

KBOR: Founded in 1925, the Kansas Board of Regents, based in Topeka, Kansas, consists of nine members, each of which are appointed by the Governor of Kansas. Kansas Board of Regents is the governing board of the state's six universities and the statewide coordinating board for the state's 32 public higher education institutions. The Board also administers the state's student financial aid, adult education, GED, and career and technical education programs as well as authorizing private proprietary schools and out-of-state institutions to operate in Kansas.

CTE: Career and Technical Education

KCCTE: Kansas Center for Career and Technical Education was put in place in 2014 in order to provide support for Kansas Career and Technical Education Instructors.

KSDE*:* The Kansas State Department of Education is a service agency that provides leadership, resources, support and accountability to the state's K-12 education system. KSDE administers the state's governance of education, standards and assessments, special education services, child nutrition and wellness, title programs and services, career and technical education, and financial aid. Administration of the agency is the responsibility of the Commissioner of Education, who is appointed by the Kansas State Board of Education.

Professional Development: the advancement of skills or expertise to succeed in a particular profession, especially though continued education.

Chapter 2

Review of Literature

To understand the context of the research, this chapter will review the factors that influence the need for technical workshops for CTE instructors. These factors include:

- Experiential Teaching and Learning
- Career and Technical Education (CTE) Instructors
- Technological changes in CTE
- Technology changes in architecture and construction
- Identification of professional development topics
- Teacher input on training opportunities
- High quality professional development
- School support of CTE
- Kansas Center for Career and Technical Education support of CTE

Introduction

To inform study, the researcher reviewed literature regarding current technical skill development needs of Architecture and Construction teachers in Kansas. While many studies have investigated the needs of teachers for professional development, (Ruhland & Brenner, 2002) (Fullan & Steigelbauer, 1991) (Layfield & Dobbins, 2002) few have focused on the needs of CTE instructors.

The following information in chapter two focuses on Career and Technical Education Instructors, technological changes in CTE, the identification of professional development topics, how teacher input on training opportunities affects teacher reception, the need for high quality professional development, and school support of CTE programs. It is the intent of this literature review to clarify how appropriate professional development and technical workshop activities can make teachers more effective and ultimately increase student achievement.

Experiential Teaching and Learning

Experiential Learning is defined as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p.41). Kolb & Kolb, (2012) state that the fundamentals of experiential learning are based upon exploring the links that develop between experience, learning, and development. Knowles (1980) suggests that adults accumulate a growing reservoir of knowledge due to their experiences which can be a rich resource for learning. This due to the experiential learning that takes place throughout one's life as individuals are exposed to different problems and scenarios that must be overcome. O'Bannon & McFadden (2008) report that in order to effectively learn one must be intrinsically motivated to participate and actively engage in the experience and through this, can then apply what they learn to new experiences as they come along. Service oriented jobs are becoming increasingly more complex and flexibility is the key to success. It is the emphasis on the process of learning that sets experiential learning apart from traditional education and the theories associated with it. Experiential learning assumes that "ideas are not fixed and immutable elements of thought but are formed and re-formed through experience" (Kolb, 2014, p.26). Looking at learning only in terms of outcomes could be considered non-learning. One must modify habits and ideas by incorporating the things they have experienced in their thought processes in order to adapt. "No two thoughts are ever the same, since experience always intervenes (Kolb, 2014, p. 26). Experiential Learning theory provides guidance for helping people become more flexible and understand learning on a more comprehensive level. Experiential learning also provides a method for the study of individual differences as they pertain to different levels of learning in society (Kolb & Kolb, 2012). In Career and Technical Education, students are exposed to a variety of experiences which they then use to build a knowledge base and then expand upon this to solve increasingly complex problems.

Career and Technical Education (CTE) Instructors

"What sets CTE apart from other academic areas is its focus on the application of knowledge and the creation of in-depth understanding to solve problems." (Drage, 2009 p. 34). CTE instructors empower students with the knowledge and training that is necessary to become lifelong learners and succeed in future careers guided by the National Career Clusters Framework (acteonline.org. 2018). This framework consists of 79 career pathways spread among 16 main Career Clusters (Appendix C). Career and Technical Education (CTE) instructors are tasked with providing relevant and rigorous training in order to prepare students for high-skill, high-demand, and high-wage careers. According to Coudriet (2018), two of the top 25 two-year trade schools in the United States are located in Kansas. These schools train students for careers "in high-paying and high-growth areas such as aircraft maintenance, funeral services, dental hygiene and drafting" (Coudriet, 2018, p. 2). Moye, Wescott and Smith (2017) elude to the fact that technology instructors have the unique job of preparing students for a future in the workplace that requires both academic and technical skills. According to Threeton & Walter (2013), CTE instructors must assume a wide array of roles and responsibilities in order to effectively manage a technical education laboratory. Three categories can begin to explain the diverse tasks undertaken by the CTE instructor which include the areas of instruction, supervision and management. First, CTE instructors are tasked with providing instruction to students on a variety of topics including the operation and methods used with tools and equipment in the lab, getting appropriate work standards in place, developing safety policies, enforcing rules, providing for a variety of learners and learning styles, determining which duties and tasks are appropriate for the needs of students and determining prior student knowledge and application of the subject matter as it pertains to the lab setting. The second area of supervision includes the direction and execution of the plan of instruction. This area of supervision includes but is not limited to the task of assigning students to workstations, making sure materials are distributed in a safe and efficient manner, supervising student activities, dealing with student technical or behavioral issues, and providing student direction. The third category of roles and responsibilities of a CTE instructor is management. A CTE instructor must tackle the program management responsibilities and the physical operations of the lab. Specific examples of management include: "developing a planned program, preparing and maintaining budgets, purchasing equipment, supplies and tools, maintaining equipment and tools and monitoring the effectiveness and economy of instruction" (Threeton & Walter, 2013, p. 2).

Often, there is only one CTE teacher in a district which makes collaboration difficult or impossible (DeLay, 2013). CTE instructors also deal with the rigors of managing and sponsoring their Career and Technical Student Organization (CTSO). This includes many activities outside the regular duty day. CTSO sponsors deal with fundraising and preparing for technical competitions which may occur at the district, state or national level. CTSO sponsors travel with students to these competitions for support, guidance and supervision (Moye, Wescott & Smith, 2017). According to Threeton & Pellock (2010), CTE instructors are responsible for ensuring that their students are prepared for and meet the criteria in order to compete in student competitions such as SkillsUSA on a state or national level. The criteria for and activities associated with these competitions are rigorous and are comprised of not only technical skills but are largely based on current academic standards. In order to be competitive at this level, it was found that:

> Students need to be familiar with the basics of business and industry, health and safety, know how to read and comprehend the rules and guidelines of the contest, know how to write using correct spelling, grammar and punctuation, realize that preparation for the contest is a time commitment and that time management is key, and know how to speak in public for the interview process. (Threeton & Pellock, 2010, p. 104)

All of these responsibilities, coupled with the expectation of handling two completely different areas and staying abreast of the technical skills as well as the pedagogical skill required of the classroom is what sets CTE teachers apart from the traditional classroom teacher (Engelbrecht & Ankiewicz, 2015). A CTE teacher's subject matter area consists of a combination of educational institution knowledge, subject knowledge and pedagogical knowledge. Educational Institution knowledge means knowing how the day to day operations of the school are carried out. Subject knowledge refers to the instructor's own knowledge of the subject matter and how it is utilized in an industrial setting, while pedagogical knowledge refers to the presentation of materials, concepts and ideas in a way that makes sense to students (Engelbrecht & Ankiewicz, 2015).

CTE teachers are being held more and more accountable for student scores on standardized tests, thus they must incorporate the academic standards that are on state assessments by integrating these academic skills into their CTE coursework (Daggett, 2003). The future of CTE will lie in the promotion of rigorous academic and occupational competencies and pursuing the development of curriculum to enhance the study of emerging technological fields.

CTE teachers, in general, tend to use workshops and conferences as one of the main sources for their own technology training (Redmann & Kotrlik, 2004).

Technological Changes in CTE

The rapid technological changes occurring in society have had a colossal impact on Career and Technical Education as teachers prepare students for the workforce. Employers are looking for individuals who not only understand technology, but who can also adapt the technology to fit the career and their own development in new and inventive ways (Redmann & Kotrlik, 2004).

In order for CTE programs to keep up with the demands of industry in this day of educational accountability, CTE teachers and administrators will have to “find meaningful ways to equip students with competencies that employment requires and develop and reinforce, with rigor and relevance, the academic standards that are tested on state assessments by embedding and reinforcing these skills in CTE courses” (Daggett, 2003, p. 7).

Many of the changes in CTE are not even necessarily technical in nature but rather driven by the job market. According to Cardon (2014), graduates of four-year institutions are not as marketable as they once were. In order to succeed in the professional world, potential hires need to have some ability and expertise that ensures they stand out in the job market. There should be less focus on grades and degrees and more on critical thinking and technical skills (Cardon, 2104).

Technology Changes in Architecture and Construction

Technological advancements, innovation and adoption of the latest technology in the construction industry had previously been lacking because projects are unique (Laczkowski, Padhi, Rajagopal & Sandrone, 2018). This shortfall in implementation of the latest technology innovations accounts for approximately 30 percent of the gap in productivity in the construction industry. The 2017 survey by Laczkowski, et al. (2018) of almost 1400 businesses related to civil construction in North America asking about their thoughts on equipment with operator-guided systems, connectivity to project-management software, predictive maintenance, fully electric equipment, digital aftermarket sales and full automation of equipment showed that “contractor customers are enthusiastic about the ability to use technology to improve equipment maintenance, project-management tasks and aftermarket purchases” (para. 6). The technology surrounding equipment with operator-guided systems, connectivity to project management software, predictive maintenance and remote monitoring will need to be understood by instructors in the architecture and construction field so that they can adequately prepare their students for a rapidly evolving technological structure within this field. To do this, teachers must be kept up to speed on the latest technology available. Original Equipment Manufacturers may begin offering advanced analytics, automation and artificial intelligence to boost gains in productivity in both agriculture and construction. This will likely affect new equipment sales by adding a mix of changing products as fleets become more automated and convert to full electricity much the way the automotive industry is evolving. Laczkowski, et al. (2018) suggest that contractors will seek ways to be more connected to their fleet utilizing connectivity software, predictive maintenance schedules and remote monitoring which will lead to a decrease in the number of brands within their fleet. These changes point to an increased need for computer and manufacturing technicians which get their start in CTE programs.

Concrete is one of the most used materials for construction because of its relative low cost and excellent mechanical properties. However, once in place, the testing of its properties becomes a difficult undertaking and often requires the destruction of the concrete structure that was just built. In recent years, Non-Destructive Testing (NDT) of concrete has begun to be seen as a viable way to verify the quality of the element without damaging the integrity of the concrete (Bittner, Spalvier & Popovics, 2018). It is the recent advances in technologies such as the ultrasonic transducer that helped produce sensors that are small enough and lightweight so that they may be housed in portable device. While this method is emerging and promises to be a widely acceptable method of testing in the future, the technology associated with the non-destructive testing of concrete and its data analysis still need improvement to ensure that it is an effective application to be utilized in a broad spectrum of the industry (Bittner et. al., 2018).

McDonald (2018), states that smartphones and iPads have taken the place of clipboards on construction sites. The ability to read electronic prints is critical and these prints can be digitized, read and changed right on the screen in real-time. This allows for tradespeople to contribute their expertise early on in the project which helps eliminate many of the design flaws which increases productivity. McDonald (2018) proclaims that technology is evolving at a rapid pace. There is actually concrete that can heal its own cracks and clear ceramics that have the strength of aluminum and 3D printers that are making plastic houses. This leads the push for 3D software to continue to evolve and become more sophisticated. These changes will require a technologically savvy workforce to handle its complexities. “It is, therefore, the continuing work of career and technical educators to provide young workers with the skills they need to be effective, productive and open to change” (McDonald, 2018, p. 57).

Building Information Modelling (BIM) has been the standard for progress in the construction world by providing 3D views of construction prints and virtual walk-throughs of projects in the design phase. BIM is expected to make great strides in the industry (Rowlinson, 2017). Building Integration Modelling and Integrated Project Delivery (IPD) are both processes that have become possible through advances in technology. Their purpose to automatically detect design errors and issue warnings to multiple users and provide safety checking for the construction schedules and modules. Together, BIM and IPD form necessary collaborative tools which improve a projects' sustainability. Collaboration and trust can be emphasized through the use of a reliable technological model of a building. The use of these realistic models produced through the use of BIM and IPD can help make teaching more effective as well. IPD now appears to be at the forefront of the technological revolution driven by the construction industry. It is likely, however, that BIM as an acronym may drop from use as IPD takes over and BIM technology is seen as more of an enabler of IPD (Rowlinson, 2017).

Identification of Professional Development Topics

Properly identifying professional development needs that are in high demand is a crucial part of developing effective teachers (Layfield & Dobbins, 2002), and those who provide professional development opportunities to CTE teachers often have a difficult time identifying the most suitable topics. These providers need to closely observe the needs of these teachers as time progresses and build those professional development programs centered on current needs (Saucier, McKim, Muller & Kingman, 2014).

While the research by Joerger (2002) was primarily focused on the needs of teachers in the Agriculture field, the findings fit well here in that there is a need for applicable professional development opportunities for teachers so that they are well prepared to handle the varying situations in the classroom; yet, it is still very hard to decide what types of professional development activities are best suited for those instructors and are needed the most. Joerger (2002) also found that training activities which were once designed by teacher educators and the state, of late, had begun to come up with methods of identifying the needs of those educators and were offering activities which would be relevant to their needs in their Career and Technical Student Organizations (CTSO's), labs and classrooms.

Teacher Input on Training Opportunities

According to Ruhland (2002), the best source for learning what training opportunities are needed by teachers is from the teachers themselves. Many professional development activities are broken up, not focused, and not very energizing and in turn, tend to not make much impact on teaching practices. Teachers, in general, tend to prefer single day training opportunities in an area they want to learn more about rather than any professional development designed or identified by a university or even their own school district (Supovitz & Turner, 2000). In-service opportunities which allow the chance to experiment, discuss, investigate, reflect, and collaborate with their peers can promote more positive change in teacher practice (Darling-Hammond & McLauglin, 1995). However, the short time trainings designed to force feed information about ways to fix something that is broken "requires little in the way of intellectual struggle or emotional engagement, and takes only superficial account of teachers' histories or circumstances" (Little, 1993, p. 22). These types of trainings often turn teachers into unreceptive participants who develop an adverse approach to professional development which creates a barrier to learning which takes place in an in-service type setting (Knowles, Holton III, & Swanson, 2005). Knowles et al. (2005) came up with several generalizations concerning the needs of adult learners. The first was that adults, as learners, only desire to learn what they need to know. The adult has to be aware of the need in order for learning to take place. This means that teachers should be actively involved in planning and designing their own professional development based on what they perceive that they need to know in order to be better teachers. Teachers begrudge training opportunities which make them feel as if they are being told what to learn. In many instances, adults have little input about either the method of delivery or the content presented and are treated like students in a traditional primary school classroom. This type of activity tends to make teachers develop a poor attitude and become unreceptive to the process. Trainings that are designed around teacher input are seen as much more attractive and give teachers a sense of efficacy (Knowles et al., 2005). Adults need to be active in identifying their own professional development activities. In order to be meaningful for the participant, teachers need to control both the content and delivery methods of the trainings. This gives the teacher a chance to have some control over what they see as fitting for them to learn (Gregson & Sturko, 2011).

Enhanced teacher training activities that happened within the school setting designed to develop new skills were most effectively put on by teacher-organized programs. Trainings that drew on teacher talents and skills within the school such as “train the trainer” models so that knowledge could be shared were deemed very positive by participants. The traditional training opportunities like taking coursework, in-service district wide and going to conferences were not as effective because the knowledge was less likely to be utilized beyond the individual. Chances for adults to make decisions regarding their own development is seen as important, but just because teachers are empowered does not automatically make them more engaged. The better explanation is that when teachers are given a chance to voice their opinions and those opinions are followed, they tend to feel more respected (Louis, 1998).

High Quality Professional Development

In order for the education profession to move forward, practicing teachers require continually updated information on curriculum, technology and methodology to allow them to make program and equipment changes to improve technology education (Boser & Daugherty, 1994). The study by Lee (2018) found that those who were taught by a group of high quality teachers, based on years of experience, subject-matter expertise and effectiveness, were significantly more likely to have a higher level of achievement. Thus, having quality teachers can have a lasting impact on the educational success of students. This leads to not only hiring teachers who are more qualified, but also finding ways to build upon existing teacher's qualifications and effectiveness through positive, relevant, and quality professional development activities. Effective professional development programs require careful planning and delivery, as well as an ability to check on the teachers' success in implementing what they learned in the classroom (Boser & Daugherty, 1994). Professional development should do more than simply disseminate information or demonstrate new technology. There should be chances for teachers to practice and implement new skills while getting coaching and feedback and utilizing these skills in the classroom in order for the training to be effective. Meaningful professional development should afford teachers the skills and knowledge that they see as useful in making them better teachers (Guskey, 1996). Cordiero (1986) agreed that effective professional development requires information about methods and innovations that is ready for use in the classroom the next day. Teachers search out ideas that work and those things that can be put into practice right away.

The term "high quality professional development" refers to training opportunities for teachers that utilize most or all of the following six elements: 1. It must immerse participants in inquiry, questioning and experimentation. 2. It must be both intensive and sustained. 3. It must engage teachers in concrete tasks and be based on teachers' experiences with students. 4. It must focus on subject-matter knowledge and deepen teachers' content skills. 5. It must be grounded in a common set of professional development standards and show teachers how to connect their work to specific standards for student performance. 6. It must be connected to other aspects of school change. (Supovitz & Turner, 2000).

On the other hand, Boser & Daugherty (1994) suggested that moving technology education forward would require arming teachers with “updated information on curriculum, methodology, and technology to allow them to make philosophical and programmatic changes that augment technology education” (p. 4.). One way to get technology education teachers the information they need is through in-service training. Custer & Daugherty (2009) described three components to training opportunities that seemed to be effective. They include hands-on activities, teacher collaboration, and instructor credibility. It is essential to further develop qualified teachers within their content area. Upgrading the professional qualifications of instructors adds to the equalization of instruction. Professional development should, however, not only aim to increase the technical knowledge of instructor, but also focus on developing the whole teacher (Engelbrecht & Ankiewicz, 2015). Yet, the study by Lee (2018), indicated that “cumulative teachers’ subject-matter expertise was the only qualification measure shown to have a positive and significant relationship with students’ short and long-term educational success” (Lee, 2018, p. 375).

School Support of CTE

Drage (2010) determined that there were certain things which kept teachers from participating in professional development activities. These roadblocks included lack of money, lack of time, and the development opportunity not meeting the needs of the teacher. Ruhland (2002) decided that school culture can also be a hindrance to well-designed teacher training due to the lack of support available for those teachers who spend time outside of the duty day for learning activities. The fact that the learning activities are usually designed and mandated by the state, district, and administration rather than by teachers also put a negative stigma on the professional development activities. In order to be effective, CTE programs need support from the school administration. Administrators have the responsibility of allowing for individualized professional development in order to keep the faculty up to date on what the trends are in their field (Stone, Kowske & Alfeld, 2004). Yet, at a time when school support of CTE appears to be waning, Coudriet (2108) published an article in the August 2018 edition of Forbes magazine naming the top 25 Trade Schools in the nation. The State of Kansas had both North Central Kansas Technical College and Salina Area Technical College on the list ranking number two and eight respectively. These schools cover a wide array of careers that have high growth and offer high pay such as drafting, dental hygiene, and aircraft maintenance. It is the purpose of these schools to get students started in a career.

Kansas Center for Career and Technical Education Support of CTE

Recently, the Kansas Legislature awarded a Kansas Legislative Enhancement Grant to Pittsburg State University which created the Kansas Center for Career and Technical Education (KCCTE), the only Center of its kind in the State. One of the objectives of the KCCTE is to identify and coordinate technical workshops to help CTE teachers stay current in the technical skills of their field. These workshops are offered at a cost of $20.00 per person per workshop unless there are materials or equipment included in the workshop fee. An example of an additional fee would be a small engines workshop where teachers leave with a Briggs and Stratton engine to use in their own classroom. Another objective of the Center is to provide free resources to Kansas CTE instructors through the Resources Library at, www.KCCTE.pittstate.edu, which can include anything from a sample worksheet or activity to complete course curriculum. The Center also provides mentoring free of charge to Kansas CTE instructors when they sign up and make the request for mentoring. Coursework is the fourth objective of the Center. This coursework enables people who have been hired as teachers in a CTE area to get their alternative teaching certificate, bachelor's or master's degree from Pittsburg State University. The KCCTE is designed to provide help to CTE teachers in the state of Kansas in whatever areas they may need it.

Summary

The literature review shares with the reader the results of other studies that are closely related to the one by (Creswell, 2009). This review provided information regarding how important professional development is for teachers and the fact that these training opportunities need to be seen as relevant in order to ultimately increase student achievement. Yet, there was little information on how to go about deciding what technical workshops would be beneficial. None of the articles pointed to anything specific as far as what to offer when it comes to technical skills of CTE teachers. Chapter two of this study focused on Experiential Teaching and Learning, Career and Technical Education Instructors, Technological Changes in CTE, the Identification of Professional Development Topics, how Teacher Input on Training Opportunities affects teacher reception, the need for High Quality Professional Development, School Support of CTE programs and the Kansas Center for Career and Technical Education Support of CTE. Each of these topics fully support the need for professional development. The shortage of specific technical workshop topics for CTE teachers, specifically in the Architecture and Construction Pathway will allow the researcher to delve deeper into the subject of identifying technical teacher workshop activities at a later time.

Chapter 3

Methodology

The purpose of this study was to gather information related to the needs of technical workshop topics for Architecture and Construction teachers in the State of Kansas. The study helped the KCCTE to identify appropriate technical workshop topics for this group of teachers.

Research Design

Data for this study was collected using a modified Delphi technique which was introduced in the 1950's by Norman Dalkey of the RAND Corporation for a United States military project. "The Delphi technique is a widely used and accepted method for gathering data from respondents within their domain of expertise" (Hsu & Sandford, 2007, p. 1). The Delphi technique can also be described as "an exploratory methodology that allows for consensus development among geographically diverse individuals who have some expertise and experience with a subject or phenomenon" (Miller & Murry, 2015, p.4). According to Thaangaratinam and Redman (2005), the original purpose of a Delphi study was to build reliable consensus from the opinions of a group of experts using a series of questionnaires and controlled feedback. This information is developed, as opposed to gathered, by providing feedback from each round of questionnaires (Williamson, 2002). According to Brady (2015), Delphi studies usually have three rounds of data collection. The first round is developed by the researcher and is based on what is already known about the subject. The second round allows participants to give opinions about the responses from round one. The third round is developed from the previous two rounds and is designed to reach a consensus on the topic. The Delphi technique is a way to generate a reasonably accurate forecast about a future outcome. Ideally, each successive round will decrease the range of answers to converge on a central topic (Guest, Namey & Mitchell, 2103). "The technique is designed as a group communication process which aims to achieve a convergence of opinion on a specific real-world issue" (Hsu & Sandford, 2007, p. 1). While Rowe and Wright (1999) claimed that a classical Dephi study would contain four features: 1) Anonymity of the Delphi participants – to allow participants to express their opinions without outside pressures. This allows for the idea presented to be evaluated on merit rather than who submitted the idea. 2) Iteration – to allow participants to modify their opinions as the consensus of the group progresses from one round to the next. 3) Controlled Feedback – gives participants the opportunity to see other's perspectives and allows them to modify or clarify their own views. 4) Statistical aggregation of group response – allows for interpretation of data through quantitative analysis.

Advantages and Disadvantages

According to Williamson (2002), some advantages to utilizing the Delphi method may include: Gathering responses from those who bring knowledge, authority and expertise to the study provides a stronger basis for a decision than individual opinions, panel members are not limited to one geographical area, it allows participants to change their minds without the pressure often associated with face to face meetings, and the process is usually inexpensive to administer. The Delphi method allows for more influence from those in lower positions of power. Allowing panelists to participate without knowing who else is involved helps reduce the typical power dynamic and promote participation (Brady, 2015). Since the panelists are separated by space and time, they can engage in the process at their own pace without their opinions being influenced by other expert panelists as issues are voted on or ranked (Nworie, 2011).

The disadvantages of the Delphi method may include: Researchers or panel members may not understand the written input of other panelists, a lack of opportunity for a "brainstorming" session which can provide for rich discussion, panel members could think too much alike and produce skewed data, the researcher could bias the feedback so that it reflects his or her views, and remaining anonymous might lead to a lack of perceived accountability for individual responses (Williamson, 2002). Another limitation to the Delphi method is that "it relies on expert perception or opinion of a situation" (Miller & Murry, 2105, p. 4).

Curriculum Development

The Delphi technique is regarded as a reasonable strategy for achieving consensus on additions to and deletions from current curriculum (Thaangaratinam and Redman, 2005). Deciding what constitutes good practice is essential to establishing competences for curriculum development. This would require careful consideration of differing views and opinions based upon industry input rather than solely on educational input. The Delphi technique is used to obtain and identify both differences of opinion and build consensus. The Delphi study is best used where there is a problem that can be addressed with subjective judgement that can be given by expert panel members. This is based on the notion that "the collective viewpoints of expert panelists can yield better results than the limited view of an individual" (Nworie, 2011, p.29). Nworie (2011) also contends that the Delphi method is best used in studies where the goal is to identify new directions in a field, new or emerging competencies, best practices, changes, technology applications, and policy issues in order to improve what is happening in the field.

Typical surveys attempt to identify "what is," whereas the Delphi technique is used to address "what could or should be" (Miller, 2006). This allows us to arrive at a conclusion of what the curriculum needs to be built around. The Delphi Method is very useful for predicting the future and for making policy and planning decisions (Williamson, 2002).

Typical Delphi Process

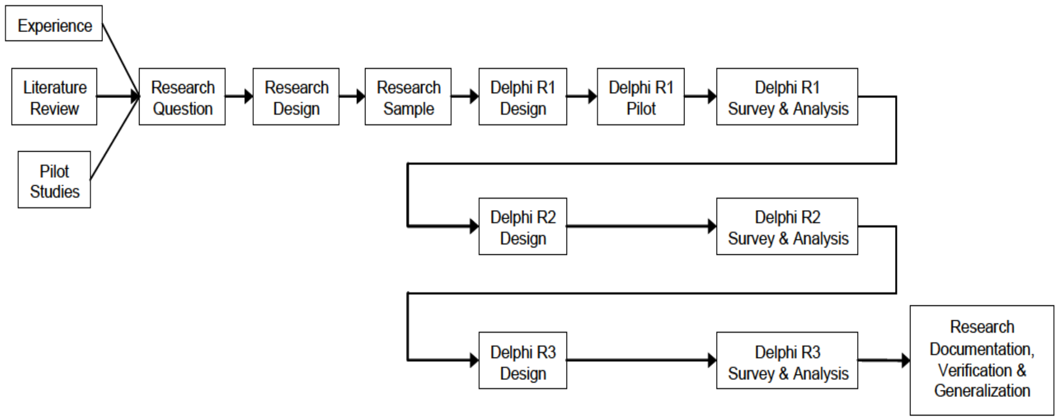

Figure 1: Three Round Delphi Process

Skulmoski, Harman and Krahn (2007)

Round 1: The first round of the Delphi process typically begins with an open-ended survey or questionnaire. This will serve as a way to gather specific information about a given topic from the Delphi panel (Custer, Scarcella, & Stewart, 1999). After panel members have responded, researchers convert their information into a well-structured document. This document is used as the survey instrument for Round Two of data collection. It is acceptable and common for the Delphi process to use a structured document as the questionnaire in Round One that is based upon the literature or what is already known about the subject (Brady, 2015).

Round 2: For the second round, each panel member will receive a second questionnaire and will review the items compiled by the researcher from the information gathered in round one. Panel members may be asked to rate or "rank-order items to establish preliminary priorities among items. As a result of round two, areas of disagreement and agreement are identified" (Ludwig, 1994, pp. 54-55). Sometimes, panel members are required to state their reasoning for rating priorities as they have (Jacobs, 1996). During this round, consensus begins to form and the ranking order can begin to be recognized among the panelists' responses (Jacobs, 1996).

Round 3: In round three, the survey is developed by the by the researcher from the previous two rounds in order to reach a level of consensus on the topic being studied (Brady, 2015). This round lets participants have an opportunity to be sure of their judgments of the relative importance of the items. Compared to round two, the increase in the degree of consensus will be very slight (Dalkey & Rourke, 1972; Anglin, 1991; Jacobs, 1996).

Round 4: In round four, which may be unnecessary, the list of remaining items and their ratings, along with minority opinions and items achieving consensus are distributed to the panelists. This round allows a chance for panelists to revise their judgments. One should note that the number of Delphi rounds administered will mainly depend on the degree of consensus required by the study and may range from two to five (Ludwig, 1994).

Panel Rounds

The number of rounds used in a Delphi study is variable and depends upon the purpose of the research. Bammer, McDonald & Deane (2013) suggest that a two or three round Delphi is sufficient for most research. If the purpose of the study is to reach group consensus and the sample is relatively dissimilar, then three or more rounds may be required. However, if the purpose of the study is to understand implication and the sample is fairly similar, it is possible that fewer than three rounds could be acceptable to reach consensus, theoretical saturation, or uncover the information being sought. The limitation here, resides in response rate and quality. As the number of rounds increases, so does the effort required by Delphi participants. This often leads to a fall in the response rate (Alexander, 2004; Rosenbaum, 1985; Thomson, 1985). Custer, Scarcella, & Stewart (1999) agree that three rounds are usually sufficient to collect the required information and reach consensus.

Table A.

Delphi Steps

1) Develop the research question	This will be completed with the help of a supervisor. The researcher's own industry experience also contributes to the interest in this research area.
2) Design the Research	Judgement of a panel of experts using the Delphi method for group decision-making will be utilized to reach consensus.
3) Research Sample	According to Adler & Ziglio (1996), there are four requirements for "expertise": i) knowledge and experience with the topic to be studied; ii) ability to participate; iii) time to participate in the study; and, iv) adequate communication skills. A purposive sample is utilized where people are not selected to represent the general public, but rather their expert ability to answer the research question (Fink & Kosecoff 1985).
4) Delphi Pilot Study	This is sometimes used in order to test the survey and make adjustments that would improve comprehension. This is especially helpful for the novice researcher who might not understand how much time and commitment responses may take on the part of the panelist.
5) Release and Analyze Round One Questionnaire	Panelists complete the survey and return them to the researcher, whose job it is to compile the results into a list of all possible issues: in this case, technical topics.
6) Develop Round 2 Questionnaire	The responses from round one are compiled into a list of topics. It is common to use this round to shorten the list.
7) Release and Analyze Round Two Questionnaire	The survey for round two is released to panel members. Members have a chance to see if the results reflect the opinions that were given in round one. Participants will rank all items form the list as to perceived value.

Table A. (cont'd)

Delphi Steps

8) Develop Round Three Questionnaire	Developed from round two responses, researcher will pare down responses to a manageable number of choices in order to become more focused on the specifics of the research.
9) Release and Analyze Round Three Questionnaire	Similar to round two, the third round will allow panelists to further modify their answers and comment on emerging themes. The survey process ends at this round of enough information has been gathered or consensus has been reached.
10) Verify, Generalize and Document Research Results	Results are verified and analyzed as to their generalizability. These results are often extended with subsequent research and published in top tiered publications (Skulmoski, Harman and Krahn, 2007).

Panel Selection

Choosing appropriate subjects for the expert panel is the most important step in the entire process of conducting a Delphi study because it directly reflects the quality of the results (Judd, 1972; Taylor & Judd, 1989; Jacobs, 1996). The Delphi technique is designed to elicit expert opinions in a relatively short period of time. This requires that the selection of Delphi subjects be well versed in the areas of expertise required by the specific topic. Ways to identify expert panel members include using professional organization memberships, word of mouth recommendations from professional colleagues and other sources that would promote or determine participation of those who are best qualified and have a good knowledge base of the issues at hand. Often, diversity in the background of panel members can be advantageous as it adds a broader and deeper understanding of the issue by having multiple individual perspectives on the same issue (Nworie, 2011). Delphi panel experts should be competent within the area of knowledge surrounding the target topic and should demonstrate knowledge that members of society at large and recognized professions would see as being of expert quality (Hallowell & Gambatese, 2009).

Size of Panel

Rowe and Wright (1999) determined that a Delphi panel may consist of as few as three members and as many as 80 on the high side. Most, they found, used a panel of between eight and 16 members so they suggest a minimum of eight although no direct correlation between the number of panel members and their effectiveness was cited. The researcher should take into consideration how much time and expense is available for completion of the study. Quality representation is assessed by the qualities of the expert panel rather than its numbers. For the purpose of this study, the researcher chose a panel of 12 members. Four of these members were from areas in business directly related to the architecture and construction industries from companies, unions, or entities deemed progressive and upstanding via personal reputation and represented their own industrial entity during the study. Four of the members were from education. These four were chosen from both secondary and post-secondary institutions to participate based upon having been recognized as outstanding educators and stated so by their peers. The remaining four panel members were recent graduates from a secondary or post-secondary architecture and construction program who were currently employed in the architecture and construction field. These four members will be recommended to participate by their previous instructors. All panel members resided and were employed in the state of Kansas.

Expertise Criteria

Delphi panelists should meet four requirements in order to be considered an "expert": "i) knowledge and experience with the issues under investigation; ii) capacity and willingness to participate; iii) sufficient time to participate in the Delphi; and iv) effective communication skills" (Adler & Ziglio, 1996, p. 14). Each panel member's commitment to participate in a multi-round Delphi can be determined by the response rate in each successive round (Keil, Tiwana & Bush, 2002). Often, true experts in a field have great insight, yet are usually very busy and may not be able to fully engage. Pertinent, concise, and well-written questions can sometimes enhance participation. Researchers who possess marketing skills may have a better chance to excel at survey development and achieve a higher response rate than those who lack marketing skills. Previous instructors and company supervisors may prove to be a valuable resource to those who qualify as experts. According to Hallowell & Gambatese (2009), the criteria for deciding if an individual qualifies as an expert can be ambiguous. One of the main concerns of any study is to utilize an unbiased sample. This eludes to the method of panel selection being unbiased also. It was suggested by Hallowell & Gambatese (2009) that expert panelists meet certain criteria or requirements. One of which could be the "demonstration of knowledge which members of recognized professions and society at large judge as being of expert quality" (p.102). Another requirement for qualification might be at least 5 years of professional experience in the topic being studied. Yet another criteria could be that the person be employed as a faculty member at an accredited institution. For the purpose of this study, the researcher identified 12 subject matter experts (SME). An SME can be defined as a person who has a greater than average insight and expertise about a given topic due to their training, education, experience or position (Lavin, Dreyfus, Slepski & Kasper, 2007). Lavin et al. (2007) further reports that a requirement of an SME is to possess recognized competence which can be validated by experience in a relevant profession, academic degrees, and significant accomplishments.

For this study, a 12 member panel was assembled and broken down by the following categories: SME's were determined for the four recent graduate positions by previous instructors. They each had gone through an architecture or construction program and were identified by their previous instructors as having a great deal of expertise and being standout students and were currently employed in the field. The four industry personnel SME's were identified as those who either owned or operated a successful architectural firm or construction company or were recommended by the owner or operator of said company or firm. Four educators were identified as SME's due to the successful nature of the programs they taught in either architecture or construction. These individuals were vetted through the KCCTE mentoring program and were considered to be not only technical experts but educational experts as well.

Instrumentation

The researcher developed the survey instruments. The first survey asked the panel members to identify five or more specific technical topics where the panel member had noticed a skill gap. This might have been in the technical areas recognized under the categories of products, processes, tools, equipment, materials safety, software, technology, or green building as well as others which were not yet identified. The second survey listed all the technical areas that were identified in the first survey, less any duplications and edited for clarity. It asked panel members to use a Likert 5 point scale to rate the importance of the items identified in the first round. According to Allen & Seaman (2007), the use of a five point scale tends to make the scale more reliable. A rating of "5" on the scale would mean the topic is perceived to be extremely important, while a rating of "1" would mean the topic is perceived to be completely unimportant. There has been some discussion about the use of the midpoint on the Likert Scale. A scale with no midpoint seems to eliminate some bias without changing the direction of the opinion, but it does change the intensity of that opinion. The way people tend to respond to a balanced Likert scale appears to be more related to content (Garland 1991). For the purpose of this study, the midpoint on the Likert scale was left intact. Since this scale was a rating of perceived importance, there would be no true neutral stance or category.

The content validity of these survey instruments was tested by presenting the instruments to a panel of three professors from the Career and Technical Education field with experience in survey development. These individuals were asked to check the following:

a) Make sure the meaning of each statement is clear and easily understood.

b) Suggest any changes that might improve how the statements are written.

c) Suggest items to add or delete from the survey to get better information.

d) Suggest ways to improve the appearance and format of the survey.

Modifications were made to the instruments based upon input from this panel. These instruments were used to glean the desired information needed by the KCCTE in order to facilitate meaningful and useful technical workshops for Kansas CTE teachers from the Delphi panel.

Data Collection

In a Delphi study, data analysis may utilize both qualitative and quantitative data. The researcher will need to examine qualitative data if the classic Delphi technique of using open-ended questions to harvest subjects' opinions is used in the first round. Additional rounds are used to achieve the necessary level of consensus and identify any panelist's change in judgment. The main statistics used in the Delphi method are measures of central tendency (means, median, and mode) and level of dispersion (standard deviation and inter-quartile range) in order to determine consensus among the collective responses of participants (Hasson, Keeney, & McKenna, 2000).

As suggested by Dillman, Smyth & Christian (2009), the following open-ended question guidelines were followed: “Specify the number and type of responses desired in the question stem” and “design the answer spaces to support the type and number of responses desired” (p. 149). The first round survey asked that respondents fill in up to five technical areas where the panel member had noticed a skill gap. This might have been in the technical areas recognized under many different categories such as: products, processes, tools, equipment, materials safety, software, technology or green building as well as others which were not identified.

Once the initial questionnaire was sent via email to the panel members, each member had approximately five days to respond and be included in the second round ranking survey. The researcher combined the topics into a list containing a 5 point Likert scale as presented by Allen & Seaman (2007). The second round rating survey was then distributed and respondents had approximately five days to return the completed survey. The instructions for filling out the surveys were stated clearly and plainly on the survey instruments. The second and third round surveys were used for the purpose of attaining consensus of the panel of experts (Thaangaratinam and Redman, 2005). The goal was to identify the most important technical topics in the architecture and construction field where a skill gap was recognized and could be addressed with a technical workshop provided by the KCCTE.

The third round rating survey had a compilation of the top 15 items ranked higher in importance during the second round survey. Round three asked panel members to rank the topics as to their perceived importance. A rating of “5” on the scale would mean the topic is perceived to be extremely important, while a rating of “1” would mean the topic is perceived to be completely unimportant.

The third round survey, was designed so that panel members could rate the importance of the top 15 skills and competencies that were identified during the first round and were found to have a perceived higher value of importance during the second round. Members were also shown the descriptive statistics surrounding the topics. The group Mean was shown, along with the Range and the panel member's own rating from the second round. Based on studying these numbers, panelists were expected to re-rate the items on a 5 point Likert scale. From this rating, the top five most perceived skills or competencies were identified and were the ones that the KCCTE will focus efforts on to provide Technical Workshop opportunities for Architecture and Construction educators. There can easily be more areas that each respondent would be interested in, but for the purpose of developing workshops, the KCCTE prefers to meet the needs of the most teachers first while still taking into consideration all of the topics which were deemed important by the panel. These ranking scores were compiled and provide information regarding the top seven choices for technical workshops for architecture and construction teachers in the state of Kansas, to be organized through the KCCTE and developed and delivered by technical experts.

Chapter 4

Data Analysis and Findings

Introduction

The purpose of this study was to gather information about the perceived importance of technical competencies from individuals who teach in, are recent graduates of a program in, or are considered business and industry personnel in the architecture and construction field. This study was designed to identify the needed skills for Career and Technical Education instructors, specifically in Architecture and Construction. Technological advancements and innovation in the construction industry have been slow to be adopted, due largely to the concept that every project is unique (Laczkowski, Padhi, Rajagopal & Sandrone, 2018). The technology surrounding equipment with operator-guided systems, connectivity to project management software, predictive maintenance and remote monitoring will need to be understood by instructors in the architecture and construction field so that they can adequately prepare their students for a rapidly evolving technological structure within this field (Laczkowski, Padhi, Rajagopal & Sandrone, 2018). Workshops to meet the changing needs of these instructors can then be designed, scheduled, and sponsored by the KCCTE. This will allow the KCCTE to offer technical workshops that meet the real-time needs of Architecture and Construction Instructors.

This study utilized a modified Delphi design with three rounds of surveys. This design allowed for input from individuals of varied backgrounds toward achieving consensus. For the 12 member panel of experts, four recent graduates of an architecture and construction program were chosen based on recommendations from respected instructors within the state of Kansas. Four distinguished educators who are currently teaching in the architecture and construction area in either secondary or postsecondary institutions were also chosen to be participants. Finally, four key people from business and industry were chosen to be panelists as well. These individuals either own or are in management roles in successful architecture or construction companies within the state. The mix of demographics within and among panel members establishes a Delphi panel that would more than likely produce a diverse view of the subject.

Chapter four of this dissertation presents the data collected through three rounds of surveys completed by those who were able to participate in all three rounds of the surveys. There was some attrition within the 12 member panel which will be discussed further in the next section. This chapter will be divided into three sections. The first section will provide a detailed description of the sample. Next will be a discussion on the methodology utilized in the study and the data analysis. The conclusion will provide an overview and summary of the research findings.

Description of the Sample

The sample consisted of a diverse group of individuals. Those targeted for participation were from the following categories: education, recent graduates and business and industry. The educators who were asked to participate had to be currently teaching in an architecture and construction program at either a secondary or postsecondary educational institution. The recent graduates that were considered could only have graduated from and architecture or construction program within 1-4 years from the date of the study and were required to be currently employed in an architecture or construction-related field in the state of Kansas, as well as being recommended to participate by their previous instructor. Since architecture and construction covers a wide array of business and industry backgrounds, those people targeted to be panelists from business and industry were specifically chosen based on their particular area of expertise. For this study, one participant from each of the following was chosen: civil construction, commercial construction, residential construction, and an architect, all of whom were either owners or in upper management from established, viable companies. These individuals made up a 12 member panel which consisted of 4 members from each of the areas of education, recent graduates and business and industry. All 12 members of the original panel were solicited via email and agreed to participate in the study. The study concluded with only 7 participants which was just over one-half or 58.3% of the originally intended 12 member panel. The original 12 members reflected a diverse range of experience desired for the study and all 12 members received the first round survey.

Gender did not factor into the screening process. Several individuals and entities were sought out to participate in the study some of whom were females. All of the females and several other individuals chose not to respond to the solicitation email, thus, all 12 identified members of the original panel were male. Among the 12 panelists chosen for the study, age did not factor into the screening process, but reflected a diverse group of participants with one-third (33.3%) reporting an age range of 20-30, less than one-fifth (16.7%) reporting an age range of 31-40, one-quarter (25%) reporting an age range of 41-50, and one-quarter (25%) of panel members reporting an age range of 51 or older. The amount of education was not a consideration in screening panel members but did reflect a diverse group. One participant (8.3%) reported no higher education degree. Two panelists reported receiving trade or technical training resulting in 16.7% of the total. Five panel members (41.7%) reported having attained a Bachelor's degree and four panel members (33.3%) reported having attained a Master's degree. It has already been reported that there were four members from each categories of education, business and industry and recent graduates, resulting in an even split of 33.3% of the total for each group (See Table 1). The number of years of experience that each of the 12 original panel members had in business and industry was not factored in to the screening process, other than the fact that they had to be currently employed in the architecture or construction field or currently be teaching in an architecture and construction program at the secondary or postsecondary level. The panelist's reported work experience ranged from two to 41 years, with an average of 16.67 (SD = 13.553) years of experience (See Table 2). Likewise, the number of years that each individual panelist had been employed at their current position was not factored into the screening process. The number of years spent working at their current position reported by panel members ranged from two to 33, with a Mean of 10.5 (SD = 10.51) (See Table 3).

Table 1.

Demographics

Age Range	Frequency	Percent
20-30	4	33.3
31-40	2	16.7
41-50	3	25.0
51 or older	3	25.0
Total	12	100.0
Education Completed		
High school graduate	1	8.3
Trade/technical training	2	16.7
Bachelor's degree	5	41.7
Master's degree	4	33.3
Total	12	100.0
Education / Business and Industry / Recent Graduate		
Education	4	33.3
Industry	4	33.3
Recent Graduate	4	33.3
Total	12	100.0

Table 2.

Number of years of Industry Experience

Years of Industry Experience	Frequency	Percent
2	1	8.3
3	1	8.3
4	1	8.3
5	1	8.3
8	1	8.3
11	1	8.3
15	1	8.3
22	1	8.3
23	1	8.3
30	1	8.3
36	1	8.3
41	1	8.3
Total	12	100.0
Mean = 16.67 SD = 13.553		

Table 3.

Number of years employed at current position

Years at Current Position	Frequency	Percent
2	3	25.0
3	2	16.7
4	1	8.3
5	1	8.3
13	1	8.3
14	1	8.3
22	1	8.3
23	1	8.3
33	1	8.3
Total	12	100.0
Mean = 10.5 SD = 10.51		

The seven participants who completed the study, reflected a diverse group of participants. Two participants (28.6%) reported an age range of 20-30 years. One participant (14.3%) reported an age range of 31-40. Two participants reported an age range of 41-50 and two more reported an age range of over 51 resulting in 28.6% for each age category respectively. The amount of education was also not a consideration in screening these participants but reflected a diverse panel. One participant reported no higher education degree, representing 14.3% of the total. Four participants reported earning a bachelor's degree, resulting in 57.1% of the total, and two participants reported having earned a Master's degree resulting in 28.6% of the total. Of the seven participants to complete all rounds of the study, one panel member (14.3%) was from the education. All four of the business and industry personnel completed all three rounds of surveys accounting for 57.1% of the respondents and two recent graduates fully participated in all three rounds of surveys occupying 28.6% of respondents (See Table 4). Fields of study was a factor in the screening process and all of the participants who participated in postsecondary studies did so in an architecture or construction related program, thus reflecting the heterogeneous nature of the Delphi panel.

The number of years of experience that each of the seven participants had in business and industry was not factored in to the screening process, other than the fact that they had to be currently employed in the architecture or construction field or currently be teaching in an architecture and construction program at the secondary or postsecondary level. The participant's reported years of experience ranged from two to 41, with a Mean of 19.57 (SD = 13.551) years of experience (See Table 5). Likewise, the number of years that each individual participant had been employed at their current position was not factored into the screening process. The number of years spent working at their current position reported by participants ranged from two to 33, with a Mean of 13.00 (SD = 12.689) (See Table 6).

Table 4.

Demographics

Age Range	Frequency	Percent
20-30	2	28.6
31-40	1	14.3
41-50	2	28.6
51 or older	2	28.6
Total	7	100.0
Education Completed		
High school graduate	1	14.3
Bachelor's degree	4	57.1
Master's degree	2	28.6
Total	7	100.0
Education / Business and Industry / Recent Graduate		
Education	1	14.3
Industry	4	57.1
Recent Graduate	2	28.6
Total	7	100.0

Table 5.

Number of years of Industry Experience

Years of Industry Experience	Frequency	Percent
2	1	14.3
8	1	14.3
11	1	14.3
22	1	14.3
23	1	14.3
30	1	14.3
41	1	14.3
Total	7	100.0

Mean = 19.57 Standard Deviation = 13.551

Table 6.

Number of years employed at current position

Years at Current Position	Frequency	Percent
2	1	14.3
3	2	28.6
5	1	14.3
22	1	14.3
23	1	14.3
33	1	14.3
Total	7	100.0
Mean = 13.00 Standard Deviation = 12.689		

Summary of the Findings

Round One Data

Twelve panel members were sent the round one survey. Of the 12, only eight panel members responded before the data was compiled and round two was sent out. The responses of the eight participants yielded a response rate of 66.6%. The goal of the first round was to identify what educators teaching in an architecture and construction program in either a secondary or postsecondary institution, industry personnel specifically in architecture and construction and recent graduates of an architecture and construction program perceived to be the areas where there were skill gaps or what the future competencies would be in the field of architecture and construction. Each individual was asked to identify up to five topics to be considered by the members of the Delphi panel. The only restraint placed on these individuals was that the topics contrived had to be technical in nature. Individual responses are provided (See Table 7).

Table 7.

Round one individual responses

Participant #1 provided the following responses to the round one questionnaire:

1. Construction: Safety procedures and practices. OSHA
2. Architecture: Technical drafting skills, Manual and CAD
3. Architecture: Design development processes
4. Construction: Layout techniques and basic construction processes
5. Construction: Toll and equipment usage

Participant #2 provided the following responses to the round one questionnaire:

1. One on one verbal communication! While this is not seen as a technical skill it is the most important skill that we teach the next generation. This generation is very well trained in computer skills and social media but we have not done a good job in teaching them to talk. The construction field is very fast paced and very fluid, we need answers quickly in order to be financially successful, it is much quicker to pick up a phone and to get an answer rather than sending an email.
2. Again not a technical skill but being responsible for self is an attribute that most young people have no knowledge of.
3. Civil plan reading, seems like most of the focus is put on commercial building print reading. I can’t tell you how many college grads are not familiar enough with civil work to know about stationing, base lines, center lines, elevations let alone looking up station or down station and left and right of base line.
4. Scheduling! As project completion dates continue to be evermore ridiculous, labor shortages and qualified subcontractor shortages it is vitally important that construction managers are well versed in this upon graduation. It seems like the burden of scheduling often falls on the new guy, the least qualified to do this.
5. Get rid of survey! A class needs to be added that teaches some fundamental construction skills; how to read a tape measure (inches and tenths), know how to read a grade stake, know how to set up and use a builders level and a transit, know how to layout a square, know how to use the most basic of hand tools, know the difference between a cut and a fill.

Participant #3 provided the following responses to the round one questionnaire:

1. Cost loading, 4D Schedules, real life examples of why it is important
2. Plans – Print Reading
3. Computer skills/ hyperlink specs. Electronic Links
4. How to control a set of drawings. Track changes and keep up to date
5. Design/ Build

Table 7. (Cont'd)

Round one individual responses

Participant #4 provided the following responses to the round one questionnaire:

1. Graphic Skills- A graduate must first and foremost, be able to communicate their thoughts and ideas by hand. They must have an understanding of drawing techniques, shade & shadows, perspective, etc. The creative connection between mind and paper must first be developed by hand before being developed with a CAD program. Example: A construction professional should always be the best player at "Pictionary"; communicating an idea quickly and simply.
2. Computer Skills- A graduate must be proficient in a BIM program; for architects this is Revit. A graduate must know when to model an object and when to simply 2-D draft a detail in the program. They should be able to put together a set of construction documents that is clear, easy to read and has the necessary information to explain the design or construction details.
3. Communication Skills- A graduate must be able to communicate in written form to others. To be able to communicate both on a technical level and in a more simplified way, to a lay person. A graduate must understand simple principles of grammar. In addition, a graduate must be able to communicate verbally. It's extremely important that a graduate has developed public speaking and presentation skills. They must be able to communicate clearly to a group of lay people that may have no knowledge of the construction industry.
4. Construction Knowledge- A graduate must know how a building is constructed from the ground up. Not necessarily how to size a footing or a beam, but how all of the pieces go together to create a building. Onsite construction experience is essential. A general understanding of MEP systems is required along with green materials and construction techniques. Learning how to put together a construction cost estimate is important, along with understanding the organization and writing of technical specifications through actual use of industry standard programs such as Spec link or Materspec.
5. Professional Practice Skills- A graduate should have an understanding of how a project is completed from start to finish. They should be familiar with the various project delivery techniques and the pros and cons of each; understanding each of the team members 'roles. They should also have an understanding of the various AIA documents, how they are used and the legal situations that can arise during the course of a project. Just as construction knowledge is best learned in the field on actual projects, professional practice knowledge is best learned through actual "real life" stories told by a construction professional with working knowledge.

Table 7. (Cont'd)

Round one individual responses

Participant #5 provided the following responses to the round one questionnaire:

1. Detailed plan reading (plot plan, architectural, structure etc.)
2. Professional writing and communication
3. Contract and scope reading and or writing
4. Time management and planning
5. Computer software skills excel, adobe/ blubeam pdf, work, outlook

Participant #6 provided the following responses to the round one questionnaire:

1. Drafting and blueprint/plans reading
2. Surveying and construction layout
3. Welding and metal fabrication
4. Mechanical trades – plumbing, electrical, mechanical
5. Building Codes and State Statutes regarding licensed design professionals

Participant #7 provided the following responses to the round one questionnaire:

1. How to efficiently and effectively use software programs potential employers in the industry use. Examples: Procore, Prolog, Bluebeam, Sage. Already knowing these programs and how they work will make a student look very valuable to a potential employer since they will not have to expend as many resources training them as opposed to someone who has never used the programs.
2. Document control / management / organization. This could be difficult to teach in a classroom setting. Keeping work/project documents organized is absolutely crucial to efficiency and success but is something not a lot of people are effective at. Project managers and projects themselves fail in the construction industry if documents are not organized electronically and physically in a way someone can come in and take over the job or your position if need be or are forced to. I have been at it for almost two years and am just now getting good at how all the processes work and where documents need to be and when.
3. The step by step sequence of a construction project from beginning to end. This will be different for different types of companies, but a general knowledge of each step would be very beneficial. Procuring work > securing work > preconstruction work/estimating > the bidding process > writing contracts > the building process step by step > closeouts > the turnover process, etc. Could be a fun and effective class to start at the very beginning of the entire process and end the semester with turning the "project" over to the owner. I am just now grasping the whole process from beginning to end.

Table 7. (Cont'd)

Round one individual responses

4. How to read construction plans. Being able to open a set of commercial building plans and effectively read them will put someone way ahead of someone who can't. Effectively learning how to read prints in school will take 6 months to a year learning curve off of any given persons training/on boarding and will make them look like a seasoned vet even though they are fresh out of school.
5. Effective, organized and clear communication. Whether it be properly writing emails, talking on the phone or talking face to face, a person's ability to effectively and clearly communicate is crucial. Constant communication with subs, the design team, the owner and anyone else involved is how a project is successful. Construction schedules do not have time for communication channels to suffer. There must be clear and organized communication from top to bottom in order for a project to make it.

Participant #12 provided the following responses to the round one questionnaire:

1. Coping Style Trim work
2. Textures and Drywall Finishes
3. Stick Framing
4. Proper window and door installations
5. Concrete finishing

Round One Data Analysis

The responses from the eight participants who completed and returned the round one survey were compiled and analyzed by the researcher and a colleague separately and examined for duplication, clarity and the technical nature of the topic. The researcher and colleague compared the generated lists of topics and selected those which were deemed technical in nature. Responses that were duplications or considered to be non-technical were eliminated for the development of the round two survey. It was determined that five topics identified by the participants were non-technical in nature. The topics deemed non-technical in nature included: Verbal communication, responsibility for self, time management, professional practice and document control. Computer skills, fundamental construction skills, and layout techniques were each identified twice by different participants. Industry specific software and design/build were identified three times by different participants. Plan and print reading and verbal communication were identified four times by different participants.

From the edited list of responses, 23 technical competencies that are needed by those entering the architecture and construction field in the future were identified and condensed for inclusion in round two. The identified technical competencies were: Industry specific software, 4D schedules, plan/print reading, computer skills, control of a set of drawings, design/build, professional/technical writing, civil plan reading, scheduling, fundamental construction skills, graphic skills, coping style trim work, textures and drywall finishes, stick framing, window and door installation, concrete finishing, OSHA safety, technical drafting skills, design development process, layout techniques, welding and metal fabrication, mechanical trades, and building codes and state statutes.

Round Two Data

Those who did not complete the round one survey were not included in round two data collection, therefore, eight participants were sent the survey for the second round. Of those eight participants who were sent the round two survey, seven completed the survey and sent it back. The responses of the remaining seven participants yielded a response rate of 87.5% which is much higher than the 66.6% response rate from round one.

As described in the previous section, responses from the eight participants who completed and returned the round one survey were identified, edited for clarity and duplication, verified that the topic was technical in nature and condensed for inclusion in round two. Given the list of identified and edited topics from round one, participants were asked to rate the topics on a five point Likert scale as to their perceived level of importance (Allen & Seaman, 2007). A rating of “5” on the scale would mean the topic was perceived to be extremely important, a rating of “4” would mean the topic was perceived to be very important, a rating of “3” would indicate the topics was perceived to be important, a rating of “2” would indicate that the topic was perceived to be not very important, while a rating of “1” would mean the topic was perceived to be completely unimportant.

Table 8 presents a numeric representation of the responses of the seven participants who completed and returned the round two survey. The individual response of each participant is included along with the Range, Mean and Standard Deviation of the responses from this group of participants.

Table 8.

Round 2 survey results and individual ratings

	Range	Mean	SD	#1	#2	#3	#4	#5	#6	#7
Software	2	4.14	.900	4	5	3	5	5	3	4
4D Schedules	3	2.43	.976	2	2	4	1	3	3	2
Plan and print reading	2	4.29	.756	4	5	3	5	5	4	4
Computer skills	2	4.14	.900	5	5	3	4	5	3	4
Control of drawings	2	4.00	1.000	3	5	3	5	4	3	5
Design/build	2	4.14	.900	3	3	4	5	5	4	5
Prof/tech writing	2	4.14	.690	4	3	4	5	5	4	4
Civil plan reading	2	3.57	.787	3	5	3	3	4	4	3
Scheduling	2	4.00	.816	3	5	4	3	5	4	4
Construction skills	3	3.71	1.113	5	5	2	3	4	4	3
Graphic skills	3	3.00	1.155	4	2	2	5	3	3	2
Trim work	2	2.00	.816	3	1	2	1	2	3	2
Drywall finishes	2	2.00	.816	3	1	2	1	2	3	2
Stick framing	2	3.00	.577	3	2	3	3	4	3	3
Window/door installation	2	3.00	.577	3	2	3	3	4	3	3
Concrete finishing	3	3.00	1.000	3	5	3	3	2	3	2
OSHA	2	4.43	.787	5	5	3	4	5	4	5
Drafting	3	3.57	1.272	4	2	3	5	5	4	2
Design processes	2	3.43	.787	3	2	4	4	4	3	4
Layout techniques	3	3.43	.976	2	3	4	3	4	5	3
Welding and fab	3	2.71	1.113	2	2	3	3	2	5	2
Mechanical trades	3	3.57	.976	3	2	4	4	3	5	4
Building codes and statutes	3	3.57	1.272	2	2	4	5	4	5	3

Round Two Data Analysis

The responses from the seven participants who completed the round two survey were analyzed and the mean and standard deviation for each topic was calculated. Only the top 15 topics with the highest perceived rated Mean were included in the round three survey. The top 15 topics with the highest perceived level of importance included: Industry specific software, plan/print reading, computer skills, control a set of drawings, design/build, professional/technical writing, civil plan reading, scheduling, fundamental construction skills, OSHA safety, technical drafting skills, design development process, layout techniques, mechanical trades,, and building codes and statutes (See Table 8).

Round Three Data

Of the seven participants who responded to the round two survey and were included in round three, seven responded yielding a response rate of 100% from round two to round three, but only a 58.3% response rate from the original 12 selected panel members. The 15 top ranked technical competencies were included in the round three survey and the participants had the opportunity to compare their rating with that of the group Mean and either confirm or change their initial rating (Skulmoski et al., 2007). The ratings were the same for round three as for round two. Participants were asked to rank the topics on a five point Likert scale as to their perceived level of importance (Allen & Seaman, 2007). A rating of “5” on the scale would mean the topic was perceived to be extremely important, a rating of “4” would mean the topic was perceived to be very important, a rating of “3” would indicate the topics was perceived to be important, a rating of “2” would indicate that the topic was perceived to be not very important, while a rating of “1” would mean the topic was perceived to be completely unimportant. Table 9 presents a numeric representation of the responses of the seven participants who completed and returned the round three survey. The individual response of each participant is included along with the Mean and Standard Deviation of the responses from this group of participants.

Table 9.

Round 3 survey results and individual ratings

	Mean	SD	#1	#2	#3	#4	#5	#6	#7
Plan and print reading	4.43	.787	4	5	3	5	4	3	5
OSHA	4.29	.756	4	5	3	5	5	4	5
Design/build	4.29	.756	5	5	4	4	4	3	4
Scheduling	4.14	.690	4	5	3	4	3	3	5
Prof/tech writing	4.14	.690	4	3	4	5	5	4	5
Computer skills	4.14	.690	4	3	4	4	5	4	5
Software	4.14	.900	3	5	3	4	4	4	4
Control of drawings	3.86	.900	3	5	4	4	5	4	4
Construction skills	3.86	1.069	5	5	2	3	4	4	4
Civil plan reading	3.86	.690	5	5	3	4	4	4	5
Layout techniques	3.71	.756	4	2	3	4	4	4	3
Mechanical trades	3.57	.976	3	2	4	4	4	3	4
Design processes	3.43	.787	3	3	4	4	4	5	3
Drafting	3.43	.787	3	2	4	4	3	5	4
Building codes and statutes	3.29	.951	3	2	3	4	3	5	3

Research question one

What do technical educators, recent graduates, and business and industry personnel perceive to be the dominant technical competencies to effectively teach architecture and construction at the secondary and post-secondary level?

Round Three Data Analysis

The responses from the seven participants who completed Round Three were analyzed and placed in order of perceived importance per the group mean from the third round survey. All of the 15 technical competencies were deemed “important”, “very important”, or “extremely important” by the group having received an importance rating of above 3.0 as a group Mean.

Plan/print reading was deemed by the group to be the most important technical competency of the 15 that were included in the third round survey with a group Mean rating of importance at 4.43. OSHA and design/build were a close second with a group Mean rating of importance of 4.29. Scheduling, professional/technical writing, computer skills and industry specific software were all tied for the third level of importance with a group mean rating of 4.14 (See Table 9). These seven topics were deemed by the Delphi panel to be the dominant technical competencies to effectively teach architecture and construction at the secondary and post-secondary level.

Control of drawings, construction skills and civil plan reading were in a three-way tie for the next rated level of importance with a group Mean rating of 3.86. Layout techniques received a group Mean rating of 3.71. Mechanical trades were rated at 3.57. Design processes and drafting both received a group Mean rating of 3.43, and building codes and statutes received a perceived importance group Mean rating of 3.29 (See Table 9). Each of the 15 technical competencies were deemed “important”, “very important”, or “extremely important” by the group having received an importance rating of above “3.0” as a group mean.

Research questions two and three

On which technical competencies do continuing technical educators, recent graduates, and business and industry personnel have the greatest degree of consensus for secondary and post-secondary architecture and construction education, and what is the difference in the perceived importance of the three groups of individuals surveyed; technical educators, recent graduates and business and industry personnel?

For the purpose of this research, similarities and differences in perceived levels of importance between groups was analyzed. Of the seven participants who responded to all three rounds of the survey, only one was an instructor at an educational institution. This accounts for the Standard Deviation in the Education column being zero (See Table 10). The areas of most agreement between groups were the following: The use of industry specific software was rated at 4.25, 4.0 and 4 by members of business, recent graduates and the instructor, respectively. This accounts for only a .25 difference in perceived level of importance across groups. Likewise, the control of a set of drawings also had only a .25 difference in perceived level of importance across groups. Plan and print reading, design/build, professional/technical writing, and design processes all showed only a .5 difference in level of perceived importance across groups (See Table 10).

Computer skills were rated “extremely important” by the educator at 5. The business participants rated computer skills just above “very important” at 4.25, while recent graduates rated computer skills just above “important” at 3.50, thus, there was a difference of 1.5 points of level of perceived importance between the groups. Scheduling was rated at 4.5 by members of business, 4.00 by recent graduates and 3 by the educator. This also accounts for a 1.5 point difference of level of perceived importance between groups. Basic construction skills were rated at 3.5 by members of business, 4.00 by recent graduates and 5 by the educator resulting in a difference of 1.5 points on the level of perceived importance between groups. Mechanical trades were rated 3.25 by members of business, 4.5 by recent graduates and 3 by the educator, resulting in a 1.5 point difference in level of perceived importance between groups. The participant from education rated computer skills very high as opposed to the rating by recent graduates. The educator also rated basic construction skill very high as opposed to the perceived level of importance by members of business. However, recent graduates rated mechanical trades much more important than either members of business or the educator, and members of business rated scheduling much more important than the educator (See Table10).

Table 10.

Mean between groups and Standard Deviation within groups

	Business		Recent Graduates		Education	
	Mean	SD	Mean	SD	Mean	SD
Software	4.25	.957	4.00	1.414	4	0
Plan and print reading	4.50	1.000	4.50	.707	4	0
Computer skills	4.25	.500	3.50	.707	5	0
Control of drawings	3.75	.957	4.00	1.414	4	0
Design/build	4.25	.957	4.50	.707	4	0
Prof/tech writing	4.00	.816	4.50	.707	4	0
Civil plan reading	4.00	.816	4.00	.000	3	0
Scheduling	4.50	.577	4.00	.000	3	0
Construction skills	3.50	1.291	4.00	.000	5	0
OSHA	4.00	.816	4.50	.707	5	0
Drafting	3.25	.957	3.50	.707	4	0
Design processes	3.50	1.000	3.50	.707	3	0
Layout techniques	3.75	.500	4.00	1.414	3	0
Mechanical trades	3.25	.957	4.50	.707	3	0
Building codes and statutes	3.00	.816	4.00	1.414	3	0

Chapter 4 Summary

A panel of participants who are considered subject matter experts in the architecture and construction field was selected for this modified Delphi study in order to identify future technical competencies for architecture and construction educators. This study utilized three rounds of surveys. In the first round, panel members were asked to provide up to five technical competencies where there is a skill gap or changes are being made at a rapid pace. The responses from participants were compiled and analyzed by the researcher and a colleague and examined for duplication, clarity and the technical nature of the topic. The researcher and colleague compared the lists of topics and selected those deemed technical in nature to develop the round two survey. Duplications or non-technical responses were eliminated. The purpose of the second round was to rate the technical competencies as to their level of importance. The results of the round two survey were analyzed and the Mean and Range calculated for inclusion in the round three survey. While full consensus of all participants on the most important technical competency was not achieved, the top seven technical competencies as topics for future workshops provided by the KCCTE were identified. Differences and similarities between the groups of participants were also examined.

Chapter 5

Conclusions and Recommendations

Introduction

Career and Technical Education (CTE) instructors have the unique job of preparing students for a future in the workplace that requires both academic and technical skills (Threeton, 2007). CTE instructors are tasked with providing relevant and rigorous training in order to prepare students for high-skill, high-demand, and high-wage careers. They empower students with the knowledge and training that is necessary to become lifelong learners and succeed in future careers (acteonline.org, 2018). The future of CTE will lie in the promotion of rigorous academic and occupational competencies and the pursuit of the development of curriculum to enhance the study of emerging technological fields.

The purpose of this modified Delphi study was to identify the needed technical competencies for Career and Technical Education instructors, specifically in Architecture and Construction. It is the goal of the KCCTE to then offer Technical Workshops to meet the changing needs of these instructors. Once the most important and needed topics have been identified, the KCCTE can then design, schedule, and sponsor technical workshops that meet the real-time needs of Architecture and Construction instructors. This chapter of the dissertation begins with a summary of the study's findings, followed by a discussion of the results. Limitations of the study will be presented and the chapter will conclude with recommendations for future research.

Summary of the Findings

This study used a modified Delphi design in order to identify and build consensus toward the most important technical competencies to effectively teach architecture and construction at the secondary or postsecondary level by using the perceptions of a group of participants via three rounds of surveys. It was also the intent of this study to determine how the different groups of participants agreed and disagreed on the importance of the technical competencies identified. The main idea behind the Delphi technique is that "collective viewpoints of expert panelists can yield better results than the limited view of an individual" (Nworie, 2011, p.25). The Delphi technique was a good fit for this study because it has been shown to be a reasonable strategy for achieving consensus on additions to and deletions from current curriculum (Thaangaratinam and Redman, 2005). The Delphi technique is used to address what could or should be and can be very useful for predicting the future and making policy and planning decisions (Miller, 2006; Williamson, 2002).

Discussion of the Findings

This study sought to answer the following research questions:

1. What do technical educators, recent graduates, and business and industry personnel perceive to be the dominant technical competencies to effectively teach architecture and construction at the secondary and post-secondary level?

2. On which technical competencies do continuing technical educators, recent graduates, and business and industry personnel have the greatest degree of consensus for secondary and post-secondary architecture and construction education?

3. What is the difference in the perceived importance of the three groups of individuals surveyed; Technical educators, recent graduates and business and industry personnel?

After compiling responses from three rounds of surveys, it can be noted that the following seven technical competencies: Plan/print reading, OSHA safety, design/build, scheduling, professional/technical writing, computer skills and industry specific software were perceived to be the dominant technical competencies to effectively teach architecture and construction at the secondary and post-secondary level. The greatest consensus among the technical educator, recent graduates and business and industry personnel were in the use of industry specific software and control of a set of drawings. Plan/print reading, design/build, professional/technical writing, and design processes all showed only a minimal difference in level of perceived importance across groups. Each of these competencies would be considered to have high levels of consensus as to their perceived level of importance as rated by the three groups, thus answering research question two. Computer skills, scheduling, basic construction skills, and mechanical trades were among the areas of differing perceived importance among the groups studied, which answers research question three. One of the interesting things to note was that when given the option to change their opinion after seeing the Mean of the group, five of the seven participants chose to change at least some of their responses between round two and three. Participants may have been interested in trying to move toward achieving consensus from the pressures associated with the group ratings.

Limitations

The following limitations were a part of this study:

1. The Delphi panel was limited to a small number of participants.
2. Only one educator fully participated in all three rounds of surveys, thus possibly not giving an accurate representation of the opinion of the population.
3. Only two recent graduates fully participated in all three rounds of surveys, thus possibly not giving an accurate representation of the opinion of the population.
4. Although multiple attempts were made to include females in the study, the entire Delphi panel was made up of only males.

5. The results of the study reflect the opinions of one group of experts at one point in time, so there is a possibility that different results may be obtained should the study be replicated.
6. The analysis of the first round results is limited to the researcher and colleague's ability to correctly code and include the responses for round two.
7. The study is limited to the state of Kansas.
8. Being technical in nature, the study would need to be replicated often in order to maintain the validity of the results as technology is constantly evolving.

Conclusions

The purpose of this study was to identify the future technical competencies for architecture and construction educators so that technical workshops could be designed to fit those needs. This study provided a framework for further identification of technical competencies within the architecture and construction areas of CTE as well as any other CTE areas where a need exists to identify future technical competencies. Based on the information in Table 10, the educator rated three items at a much higher level of importance than the other groups. These items included: Computer skills, basic construction skills and OSHA Safety. From the standpoint of an educator, these items are perceived to be extremely important whereas industry personnel and recent graduates may not see them as being quite so important. On the contrary, business and industry personnel tended to rate plan/print reading and scheduling higher in level of importance than the educator while recent graduates closely agreed on the importance of these items. Recent graduates rated mechanical trades much higher in level of importance than either members of business and industry or the educator, indicating their perception of a skill that is greatly lacking from their point of view, while other technical competencies were rated similar to the other groups. The findings presented in Table 9 point to a lack of technological expertise. Six of the seven highest rated technical competencies could be considered to be directly related to technology. This finding falls directly in line with the views of Laczkowski, et al. (2018), as they determined technological advancements, innovation and adoption of the latest technology in the construction industry had been lacking accounting for an approximate 30 percent gap in production across the construction industry. OSHA safety was tied for second place in Mean ratings which indicates the participants all deemed safety was a priority. A majority of the responsibility for safety instruction lies with the CTE instructor. “Students must receive an endless amount of general and specific safety education” (Threeton & Walter, 2013, p. 66-67). A number of highly rated competencies were connected by a common thread beyond technology. Control of drawings, civil plan reading, layout techniques, design processes and drafting, along with plan/print reading, computer skills and industry specific software skills all require the user to have some level of graphic and visualization skills. Professional/technical writing was listed among the third highest rated competencies. This was a surprise since each of the other identified competencies could be viewed as more technical or laborious in nature and professional/technical writing is viewed as more academic in nature. Building on this study in this and other CTE areas merits continued effort as technical competencies are ever-changing.

Implications of the Findings for Practice

Research has suggested that properly identifying professional development needs that are in high demand is a crucial part of developing effective teachers (Layfield & Dobbins, 2002). Technological advancements, innovation and adoption of the latest technology in the Construction Industry have been lacking (Laczkowski, Padhi, Rajagopal & Sandrone, 2018). Part of this slow moving adoption of new technology may have been due to the roadblocks put in place which hindered professional development of teachers (Drage, 2010).

The implications for practice of this study are that it represents a basis on which the KCCTE can design, coordinate and support relevant and needed technical workshops to help architecture and construction educators stay current in the technical skills of their field. While the findings of a Delphi study only reflect the opinions of a small number of people at one particular point in time, this study determined that there is a need for technical training for educators on several future competencies. The KCCTE will begin to work through the list of most important perceived technical competencies that were identified in this study and offer workshops to address those competencies.

Plan and print reading had the highest rated Mean score which makes this competency the most likely choice to begin designing a technical workshop around. Referring to the list of highest Mean rated competencies from Table 9, six of the seven competencies that had a Mean rating of above 4.0 could be deemed technological in nature. This may actually allow for some combination of topics into single workshops rather than having separate workshops designed around each competency. Computer skills and industry specific software are two technical competencies which would fall into this category. Design/Build and Scheduling are two identified technical competencies which could possibly be combined into one technical workshop with the possibility of offering more advanced levels of this topic in the future. OSHA Safety was a top rated competency which would be considered technical but not technology based. Safety should always be a major priority for CTE classrooms and labs. Instructors must "focus on their own professional development by attending technical update workshops that provide occupational specific information on new safety practices" (Threeton & Walter, 2013, p.

67). OSHA Safety is a topic that a technical workshop should be designed for to meet the needs of CTE teachers. Professional/technical writing was a competency rated high in importance by participants and could be incorporated into each technical workshop to help meet the gap in this area. Based upon the findings that suggest a theme of graphics and visualization among the identified technical competencies, workshop presenters should be sure to incorporate activities in each of their workshops to increase competence related to these skillsets. Looking back at the findings from the round two survey, it is recommend that the lower Mean rated technical competencies not be considered priorities for technical workshops. These competencies include: 4D scheduling, trim work, drywall finishes, and welding and fabrication. While these competencies may still be important skillsets to possess, they were not seen by participants to be areas where a large amount of concentration was needed.

Recommendations for Further Research

Given the limitations of this study and the findings, further research is recommended. Future studies could investigate any or all of the CTE areas in the state to identify different technical competencies where training is needed to meet the demands of their respective industries. This study could be easily replicated in other states and be similarly implemented on a national or international level to identify different technical competencies where training is needed to meet the demands of industry in other states or countries. A recommendation would be to include ample time to gather a sufficient number of panel members so that the number of actual participants involved in the study yields the appropriate amount of data to maintain a solid foundation and premise of need. Another recommendation would be to start with a larger panel of 20–24 people evenly spread between the groups of educators, recent graduates and business and industry personnel. This could alleviate the challenges associated with the low numbers in some groups due to attrition. If the study were replicated, the researcher recommends the participants making up the panel of experts have equal representation in each of the current occupational areas. It would be interesting to send the round three survey, listing the 15 top rated competencies to a larger number of individuals from each of the occupational groups represented and compare the results of their ratings with those found in this study to determine to what extent the results agree with and differ from what was found in this Delphi study.

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Appendices

Appendix A

Architecture & Construction
CAREER CLUSTER DESIGN

Construction & Design– CIP Code 46.0000

Approved Pathway:

1) Includes minimum of three secondary-level credits.
2) Includes a work-based element.
3) Consists of a sequence: Introductory-level, Technical-level, and Application-level courses.
4) Supporting documentation includes Articulation Agreement(s), Certification, Program Improvement Plan, and a Program of Study.
5) Technical-level and Application-level courses receive .5 state-weighted funding in an approved CTE pathway.

INTRODUCTORY LEVEL

**Introduction to Industrial Technology	38001	.5 credit
Drafting	21102	.5 credit

TECHNICAL LEVEL

Design Strand		
Drafting / CAD	21107	1 credit
Architecture Design	21103	1 credit

Construction Strand		
Carpentry	17002	1 credit
Woodworking Principles	17007	1 credit
Skilled Mechanical Crafts	17062	.5 credit

APPLICATION LEVEL

Design Strand		
Research & Design for Pre-Construction	21109	1 credit
Advanced Studies	38050	.5 credit
Residential Interior Design	22212	.5 credit
Commercial & Industrial Interior Design	38212	.5 credit

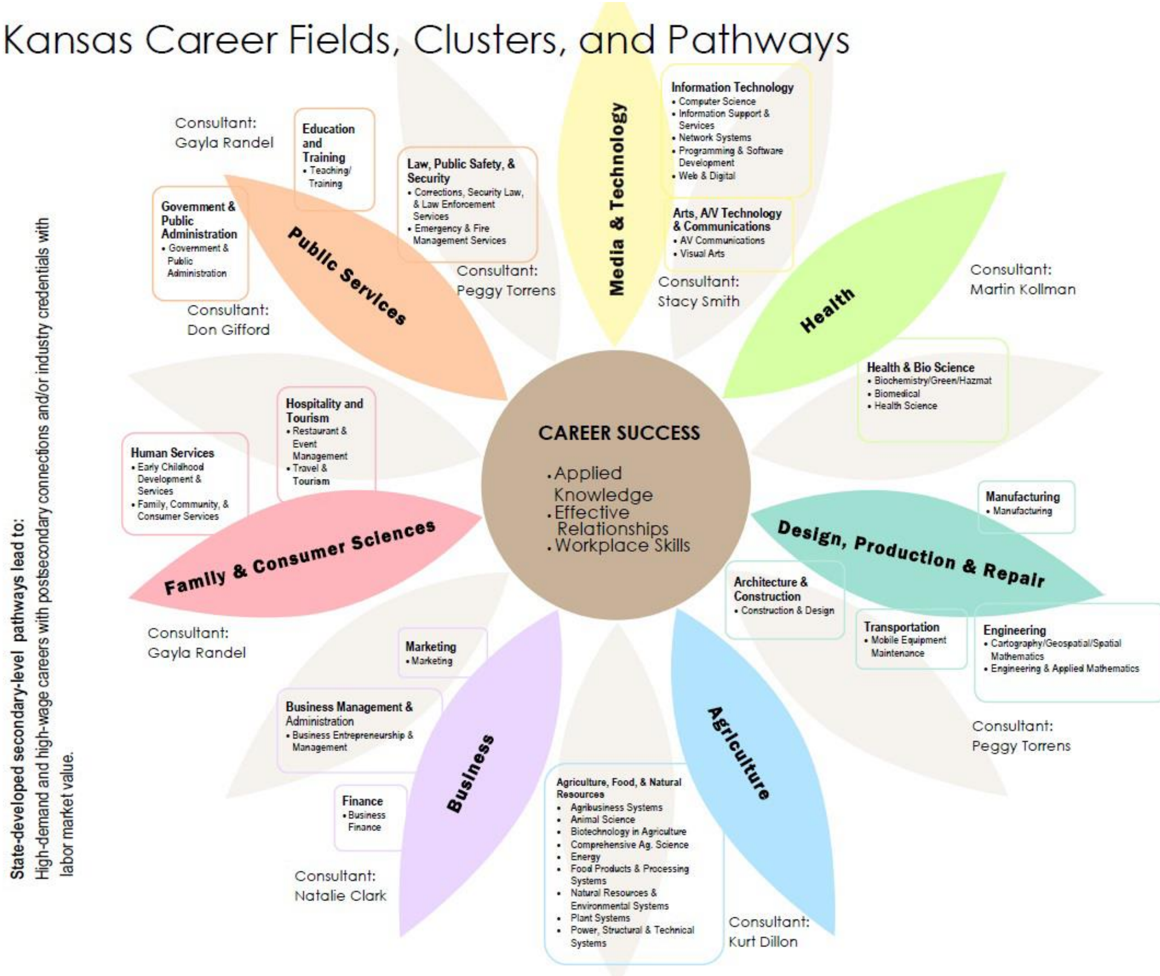
Construction Strand		
*Carpentry II	38002	1 credit
Furniture & Cabinetry Fabrication	38007	1 credit
*Sheet Metal & HVACR	38012	1 credit
*Research & Design in Building Trades	17005	1 credit
*Remodel & Building Maintenance	17009	.5 credit
*Sheet Metal	13205	.5 credit
*HVAC Technology	17056	.5 credit
*Plumbing Technology	17058	.5 credit
*Electrical & Security Systems	17113	.5 credit
*Pipefitting Technology	17061	1 credit
***Advanced Materials Technology	38010	1 credit

* Carpentry I (17002) is a Pre-requisite ** Required for Construction Strand *** 17007 & 38007 are Pre-requisites

Approved Pathway must contain 3 credits within one strand before adding courses from other strand.

12

Appendix B


Kansas Career Fields, Clusters, and Pathways
State-developed secondary-level pathways lead to:
High-demand and high-wage careers with postsecondary connections and/or industry credentials with labor market value.
CAREER SUCCESS
• Applied Knowledge
• Effective Relationships
• Workplace Skills
Public Services
Government & Public Administration
• Government & Public Administration
Consultant: Don Gifford
Education and Training
• Teaching/ Training
Consultant: Gayla Randel
Law, Public Safety, & Security
• Corrections, Security Law, & Law Enforcement Services
• Emergency & Fire Management Services
Consultant: Peggy Torrens
Media & Technology
Information Technology
• Computer Science
• Information Support & Services
• Network Systems
• Programming & Software Development
• Web & Digital
Arts, A/V Technology & Communications
• AV Communications
• Visual Arts
Consultant: Stacy Smith
Health
Health & Bio Science
• Biochemistry/Green/Hazmat
• Biomedical
• Health Science
Consultant: Martin Kollman
Design, Production & Repair
Manufacturing
• Manufacturing
Architecture & Construction
• Construction & Design
Transportation
• Mobile Equipment Maintenance
Engineering
• Cartography/Geospatial/Spatial Mathematics
• Engineering & Applied Mathematics
Consultant: Peggy Torrens
Agriculture
Agriculture, Food, & Natural Resources
• Agribusiness Systems
• Animal Science
• Biotechnology in Agriculture
• Comprehensive Ag. Science
• Energy
• Food Products & Processing Systems
• Natural Resources & Environmental Systems
• Plant Systems
• Power, Structural & Technical Systems
Consultant: Kurt Dillon
Business
Marketing
• Marketing
Business Management & Administration
• Business Entrepreneurship & Management
Finance
• Business Finance
Consultant: Natalie Clark
Family & Consumer Sciences
Hospitality and Tourism
• Restaurant & Event Management
• Travel & Tourism
Human Services
• Early Childhood Development & Services
• Family, Community, & Consumer Services
Consultant: Gayla Randel

Appendix C

The 16 Career Clusters® & 79 Career Pathways

Agriculture, Food & Natural Resources Agribusiness Systems Animal Systems Environmental Service Systems Food Products & Processing Systems Natural Resources Systems Plant Systems Power, Structural & Technical Systems	**Hospitality & Tourism** Lodging Recreation, Amusements & Attractions Restaurants & Food/ Beverage Services Travel & Tourism
Architecture & Construction Construction Design/ Pre-Construction Maintenance/ Operations	**Human Services** Consumer Services Counseling & Mental Health Services Early Childhood Development & Services Family & Community Services Personal Care Services
Arts, A/V Technology, & Communications A/V Technology & Film Journalism & Broadcasting Performing Arts Printing Technology Telecommunications Visual Arts	**Information Technology** Information Support & Services Network Systems Programming & Software Development Web & Digital Communications
Business Management & Administration Administrative Support Business Information Management General Management Human Resources Management Operations Management	**Law, Public Safety, Corrections & Security** Correction Services Emergency & Fire Management Services Law Enforcement Services Legal Services Security & Protective Services

Appendix C (Cont'd.)

The 16 Career Clusters® & 79 Career Pathways

Education & Training Administration & Administrative Support Professional Support Services Teaching/ Training	**Manufacturing** Healthy, Safety & Environmental Assurance Logistics & Inventory Control Maintenance, Installation & Repair Manufacturing Production Process Development Production Quality Assurance
Finance Accounting Banking Services Business Finance Insurance Securities & Investments	**Marketing** Marketing Communications Marketing Management Marketing Research Merchandising Professional Sales
Government & Public Administration Foreign Service Governance National Security Planning Public Management & Administration Regulation Revenue & Taxation	**Science, Technology, Engineering & Mathematics** Engineering & Technology Science & Mathematics
Health Science Biotechnology Research & Development Diagnostic Services Healthy Information Support Services Therapeutic Services	**Transportation, Distribution & Logistics** Facility & Mobile Equipment Maintenance Health, Safety & Environmental Management Logistics Planning & Management Services Sales & Service Transportation Operations Transportation Systems/ Infrastructure Planning, Management & Regulation Warehousing & Distribution Center Operations

Appendix D

Architecture and construction occupational outlook

DEGREE/TRAINING REQUIRED Standard Occupational System (SOC) Code	OCCUPATION	KANSAS MEDIAN ANNUAL WAGE[i]	% CHANGE / EMPLOYMENT PROSPECTS	
			KANSAS 2012-2022[ii]	USA 2014-2024[iii]
47-4011	Construction & Building Inspectors	$54,360/yr.	+1.5%	+8%
49-9044	Millwright/Industrial Machinery Mechanic	$57,540/yr.	+1.7%	+15%
47-2031	Carpenters	$36,720/yr.	+1.3%	+6%
51-7011	Woodworkers/Cabinetmakers	$30,950/yr.	+1.2%	-1%
47-2141	Painters, Paperhangers, Construction & Maintenance	$29,520/yr.	+1.1%	+7%
47-2051	Cement Masons & Concrete Finishers	$36,140/yr.	+1.7%	+13%
47-2181	Roofers	$29,850/yr.	+0.3%	+13%
47-2121	Glaziers	$35,100/yr.	+1.5%	+4%
17-3022	Civil Engineering Technicians	$42,350/yr.	+0%	+5%
17-3025	Environmental Engineering Technicians: Wastewater Maintenance Technician	N/A	N/A	+10%
37-3011	Landscaping & Grounds keeping Workers	$23,300/yr.	+1.4%	+6%
47-2081	Drywall/Ceiling Tile Installers	$35,240/yr.	+0.4%	+5%
47-2041	Carpet Installers/Floor Layers	$44,720/yr.	+0.3%	-1%
47-4041	Hazardous Material Removal Workers	$31,910/yr.	+1.3%	+7%
47-2044	Tile & Marble Setters	$44,750/yr.	+0.6%	+6%
49-2098	Security & Fire Alarm System Installers	$42,100/yr.	+1.4%	+13%
Bachelor's Degrees Colleges / Universities				
11-9041	Engineering Managers: Safety Directors	$114,100/yr.	+1.4%	+2%
17-2051	Civil Engineers: Construction Engineer / Project Engineer	$72,440/yr.	+2.1%	+8%
11-2022	Sales Managers	$94,150/yr.	+0.9%	+5%
13-1051	Cost Estimators	$54,680/yr.	+1.7%	+9%
11-2021	Marketing Managers	$112,500/yr.	+1.7%	+9%
11-9021	Construction Managers: General Contractor/ Specialty Contractor/ Project Manager/ Equipment &	$72,560/yr.	+0.6%	+5%

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ARCHITECTURE AND CONSTRUCTION CLUSTER
PATHWAY: CONSTRUCTION & MAINTENANCE OPERATIONS

DEGREE/TRAINING REQUIRED Standard Occupational System (SOC) Code	OCCUPATION	KANSAS MEDIAN ANNUAL WAGE[i]	% CHANGE / EMPLOYMENT PROSPECTS	
			KANSAS 2012-2022[ii]	USA 2014-2024[iii]
-Associate Degree -Certifications -On the Job Training -2 Yr. Community/Technical Colleges -Registered Apprenticeship				
11-9021	Construction Managers: General Contractor, Specialty Contractor, Project Manager, Equipment & Material Manager	$72,560/yr.	+0.6%	+5%
47-1011	First-Line Supervisors/Managers of Construction Trades & Extraction Workers	$54,600/yr.	+1.3%	+10%
49-9021	HVAC Mechanics / Refrigeration	$42,720/yr.	+1.3%	+14%
47-2021	Brickmasons/Block masons	$53,370/yr.	+2.1%	+19%
47-2111	Electricians	$47,300/yr.	+1.1%	+14%
47-2152	Plumbers, Pipefitters, Steamfitters	$47,720/yr.	+1.2%	+12%
47-2073	Operating Engineers & Other Construction Equipment Operators	$34,730/yr.	+0.8%	+10%
41-4012	Sales Representatives, Wholesale & Manufacturing, Except Technical & Scientific Products	$54,830/yr.	+0.5%	+16%
47-2221	Structural Iron and Steel Workers	$36,670/yr.	+1.1%	+4%

[i] 2012-2022 Kansas Occupational Outlook Study, http://www.dol.ks.gov
[ii] 2012-2022 Kansas Occupational Outlook Study, http://www.dol.ks.gov
[iii] 2015-2016 National Employment Occupational Outlook Handbook, http://www.bls.gov/ooh

1

Appendix D (Cont'd)

Architecture and construction cluster pathway

DEGREE/TRAINING REQUIRED Standard Occupational System (SOC) Code	OCCUPATION	KANSAS MEDIAN ANNUAL WAGE[i]	% CHANGE / EMPLOYMENT PROSPECTS	
			KANSAS 2012-2022[ii]	USA 2014-2024[iii]
	Material Manager/ Scheduler			
11-3061	Purchasing Managers	$88,370/yr.	+0.5%	1%
11-3131	Training & Development Managers	$82,360/yr.	+1.6%	+7%
17-2081	Environmental Engineers	$82,890/yr.	+1.1%	+12%

N/A = Data Not Available

Employment is projected to:	Growth compared to average:
increase 21 percent or more	Grow much faster than average
increase 14 to 20 percent	Grow faster than average
increase 7 to 13 percent	Grow about as fast as average
increase 3 to 6 percent	Grow more slowly than average
decrease 2 percent to increase 2 percent	Little or no change
decrease 3 to 9 percent	Decline slowly or moderately
decrease 10 percent or more	Decline rapidly

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Appendix E

Sept. xx, 2018

Dear Panel Member,

You have been chosen to participate in this study about Technical Competencies in the Architecture and Construction fields.

It is critical to help educators maintain their technical skills so that they can pass those skills on to their students and thus, have a better-prepared workforce.

I am attempting to identify the most critical technical competencies needed by those teaching in the Architecture and Construction areas. While I realize that the “Soft Skills” such as showing up to work on time, **this study will focus only on the technical skills and competencies**.

The study will utilize a three-round modified Delphi procedure to identify the most critical technical competencies needed in the workforce and possibly to identify gaps in what is currently being taught in these areas. This will allow for further future training to be offered which will enhance the technical skills of educators where they need it most.

The Delphi process is a survey technique which uses the expert opinions and judgements of respondents to reach consensus on a topic. Respondents are given a series of surveys and group opinions are formed through the controlled feedback provided with each round.

The procedure for this study will be:

Round 1: The current email contains the first round of the Delphi study. You are asked to respond to the open-ended questionnaire regarding what you deem to be the most important topics for technical competencies or skills. Once all round one responses are returned, the information will be compiled and used to construct the survey for the next rounds.

Round 2: The second round questionnaire will be sent via email during the last week of September. For this round, you will be asked to rate your level of agreement with all of the statements on a 5-point scale. Upon return of the second round surveys, group statistics will be calculated.

Round 3: This final round will ask you to rate the same items as Round 2, while comparing your rating to the consensus of the group responses. Consider both your own rating and the rating of the group consensus and re-rate the items based upon your thoughts while comparing the given information.

Since only 12 individuals have been selected to participate, your involvement is vital to the success of this project. Also, your participation through the entire three round procedure is crucial to the validity of the results. Findings from this project should have important benefits for anyone concerned about the technical skills of an evolving Architecture and Construction workforce.

Appendix E (Cont'd)

Only group responses will be reported. Your participation is completely voluntary and you retain the right to withdraw from the study at any time. A number has been assigned to you for follow-up purposes only. I hope that you will decide to participate in this project and welcome your involvement. **Please return your completed Round 1 Questionnaire by September xx, 2018.**

Thank you in advance for your help with this study!

If you have any questions or concerns, please do not hesitate to contact me. For questions or concerns about your rights as a research participant, please contact Brian Peery at the office of Graduate and Continuing Studies. 620-235-4175, or via email at bpeery@pittstate.edu.

Sincerely,

Jon R. Jones
Assistant Professor
Kansas Center for Career and technical Education
Pittsburg State University
620-235-4998

Date: ____________________

Participant Signature: __________________________________

Appendix F

Delphi Study Identifying Future Technical Competencies for Architecture and Construction Educators

Demographic Information

Male: ____ Female ____

Age: ____ 20-30
____ 31-40
____41-50
____51 or above

Highest educational degree earned:
____High school graduate
____Trade/Technical Training
____Associate Degree
____Bachelor Degree
____ Master Degree
____Other

What specific training or field of study did you complete to prepare you for employment?

____

____

____

How many years of industry experience do you have?

____

How long have you been employed in your current position?

____

Appendix G

Delphi Study Identifying Future Technical Competencies for Architecture and Construction Educators

Round 1 Survey

Please identify up to five technical skill areas for an individual entering the workforce in either architecture or construction that need to be taught in formal education programs at the secondary or postsecondary level.

1. ____

2. ____

3. ____

4. ____

5. ____

Thank you for your participation!

Please return this survey no later than September xx, 2018 to Jon Jones, Pittsburg State University. (jon.jones@pittstate.edu)

Follow Up Number: ____

Appendix H

Delphi Study Identifying Future Technical Competencies for Architecture and Construction Educators
Round 2 Survey

The purpose of this study is to determine the future technical competencies needed by individuals who are teaching in an Architecture and Construction Program or Pathway so that they may better prepare their students for the needs of the workforce. In the first round survey, professionals, such as yourself, identified several technical skills that need to be taught at the secondary or postsecondary level. These identified technical skills have been edited for duplication and clarification.

In this round, you are asked to rank each skill on a 1-5 scale where 5 = extremely important, 4 = very important, 3 = important, 2 = not very important, and 1 = not important at all.

Please consider the following technical skill areas identified for an individual entering the workforce in either architecture or construction and indicate your level of agreement by rating the items 1-5 according to their need to be taught in education programs at the secondary or postsecondary level.

	Skill/Competency	Level of Importance				
1.		5	4	3	2	1
2.		5	4	3	2	1
3.		5	4	3	2	1
4.		5	4	3	2	1
5.		5	4	3	2	1
6.		5	4	3	2	1
7.		5	4	3	2	1
8.		5	4	3	2	1
9.		5	4	3	2	1
10.		5	4	3	2	1
11.		5	4	3	2	1
12.		5	4	3	2	1
13.		5	4	3	2	1
14.		5	4	3	2	1
15.		5	4	3	2	1
16.		5	4	3	2	1
17.		5	4	3	2	1
18.		5	4	3	2	1
19.		5	4	3	2	1
20.		5	4	3	2	1
21.		5	4	3	2	1
22.		5	4	3	2	1
23.		5	4	3	2	1

Thank you for your participation in this survey!

Please return the completed survey no later than September xx, 2018.

Follow Up Number ____

Appendix I

Delphi Study Identifying Future Technical Competencies for Architecture and Construction Educators

Round 3 Survey

The purpose of this study is to determine the future technical competencies needed by individuals who are teaching in an Architecture and Construction Program or Pathway so that they may better prepare their students for the needs of the workforce. In the first round survey, professionals, such as yourself, identified several technical skills that need to be taught at the secondary or postsecondary level. In the second round, professionals, like you, considered the technical skill areas identified for an individual entering the workforce in either architecture or construction and indicated their level of agreement by rating the items 1-5 according to their need to be taught in education programs at the secondary or postsecondary level.

In this third and final round, you should consider how the group rated each item and re-rate the item taking into account the group input. In this round, only the top 15 skills are included.

In this round, you are asked to rank each skill on a 1-5 scale where 5 = extremely important, 4 = very important, 3 = important, 2 = not very important, and 1 = not important at all.

Please consider the following technical skill areas identified for an individual entering the workforce in either architecture or construction and indicate your level of agreement by rating the items 1-5 according to their need to be taught in education programs at the secondary or postsecondary level.

Skill/Competency		Group Mean	Range	Your Round 2 Rating	Your Final Rating
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

Thank you for your participation in this survey!

Please return the completed survey no later than October xx, 2018.

Follow Up Number____

Appendix J

UNIVERSITY OF ARKANSAS

To:	Jon Richard Jones
From:	Douglas James Adams, Chair IRB Committee
Date:	09/13/2018
Action:	**Exemption Granted**
Action Date:	09/13/2018
Protocol #:	1808140204
Study Title:	Delphi study identifying future technical competencies for architecture and construction educators

The above-referenced protocol has been determined to be exempt.

If you wish to make any modifications in the approved protocol that may affect the level of risk to your participants, you must seek approval prior to implementing those changes. All modifications must provide sufficient detail to assess the impact of the change.

If you have any questions or need any assistance from the IRB, please contact the IRB Coordinator at 109 MLKG Building, 5-2208, or irb@uark.edu.

cc: Kit Kacirek, Key Personnel