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Efficacy of Computer Aided Drafting (CAD) Certifications

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EFFICACY OF COMPUTER AIDED DRAFTING (CAD) CERTIFICATIONS

by

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ABSTRACT

EFFICACY OF COMPUTER AIDED DRAFTING (CAD) CERTIFICATIONS

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This research investigated the perceived effect of industry recognized Computer Aided Drafting (CAD) certifications among community college drafting instructors and employers. The research questions that guided this study were: (1) Do community college drafting instructors believe that certified drafters perform better on the job than non-certified drafters? (2) Do employers believe that certified drafters perform better on the job than non-certified drafters? (3) Do employers seek CAD certified individuals to fill drafting positions? (4) Is there a difference between the perceptions of community college drafting instructors and employers of community college drafting program graduates regarding the importance of drafting certification? (5) What qualifications do employers look for when hiring new drafters?

Drafting instructors from a community college system in one southeastern U.S. state were surveyed to determine their awareness of and perceptions about industry recognized CAD certifications. Employers of drafters within the same state were also surveyed using the same instrument.

This study found that drafting instructors and employers of drafters do not believe that certified drafters perform better than their non-certified counterparts. There is little difference in the perceptions of the two groups. Employers of CAD drafters do not seek certified individuals to fill drafting positions. They look for applicants with experience, education, CAD proficiency, and people skills when hiring drafters.

Currently there is no single industry recognized credential for drafters. Almost every software manufacturer offers their own product specific certification, likely as a "knee jerk reaction to Perkins funding," as one participant stated. The value and validity of such certification is questionable and needs further research. Momentum and awareness of American Design Drafting Association (ADDA) certification appears to be growing, and it may emerge as the industry leader in years to come.

Intuitively, certification appears to be perceived as having some value, though not enough value to warrant the time and expense required to attain it. Does having an industry recognized CAD certification benefit the community college CAD graduate? Based on the research in one southeastern U.S. state the researcher has concluded that there is no significant benefit to attaining such certification.

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INTRODUCTION

Changes in the Carl D. Perkins Career and Technical Education Improvement Act of 2006 (United States Library of Congress, 2006) requiring more accountability for federal dollars may cause some schools to consider adding a certification component to their curricula. The Perkins Act places greater emphasis on academic rigor, relevance of course content, and developing stronger relationships between educational institutions and employers. The local accountability component has been intensified with new requirements for localities to set specific targets for each performance indicator (Brunstein, 2006). One of the performance indicators is attainment of an industry recognized certification upon completion of a program of study. The assumption appears to be that an industry credential is an effective strategy in measuring the effectiveness of an educational program. An industry credential, however, may not be a valid measure of performance across all career and technical education specialties. Consumers of career and technical education (CTE) program graduates (employers) may, in fact, have little interest in certifications. In the field of drafting, for instance, Trent (2007) found that a sample of employers in Virginia did not seek drafting program graduates with certifications of any kind. In fact, many employers did not seek drafting program graduates at all.

Research correlating certifications to on-the-job performance or employer satisfaction is limited. Mosher (1980) found that employers are rarely dissatisfied with entry level drafting skills of employees. Dissatisfaction is more often in the area of attitude or absenteeism. The business community is interested in employees who can

Statement of the Problem

The purpose of this study was to determine the perceived effect of drafting industry certification on job performance among drafting instructors within a southeastern U.S. community college system and drafting industry professionals. A second purpose was to determine which qualifications employers seek when hiring drafters.

Research Objectives

The following research questions guided this study:

1. Do community college drafting instructors believe that certified drafters perform better on the job than non-certified drafters?
2. Do employers believe that certified drafters perform better on the job than non-certified drafters?
3. Do employers seek CAD certified individuals to fill drafting positions?
4. Is there a difference between the perceptions of community college drafting instructors and employers of community college drafting program graduates regarding the importance of drafting certification?
5. What qualifications do employers look for when hiring new drafters?

Background and Significance

Legislators are demanding more accountability for recipients of government funds. One method for measuring accountability in education is the attainment of a certificate by program completers. A certification component was first introduced through the School-to-Work opportunities Act of 1994 (CFDA No. 84.278) with the newly defined term "skill certificate" as:

> ...a portable, industry-recognized credential issued by a School-to-Work Opportunities program under an approved State plan, that certifies that a student has mastered skills at levels that are at least as challenging as skill standards endorsed by the National Skill Standards Board established under the National Skill Standards Act of 1994, except that until such skill standards are developed, the term "skill certificate" means a credential issued under a process described in the approved State plan (United States Code, 1994, § 6103, Definitions, #22).

The School-to-Work Act (STW) was built into the 1990 Perkins Act by creating articulated programs that link academics and vocational/CTE content. The Core Performance Indicator Plan of STW states, "All youth earn a high school diploma or equivalency tied to challenging academic standards, have the opportunity to receive a skills certificate, and are prepared for postsecondary education and careers" (School to Work Opportunities Act, 1994, Chapter 410-8, Objective 2).

The skills certificate outlined in 1994 has evolved into specific credentialing and postsecondary certificates or degrees. The Perkins Act of 2006 mandates "the development and implementation of programs of study that lead to an industry recognized credential or certificate at the postsecondary level, or an associate or bachelor's degree" (Brustein, 2006, p. 10). Community colleges offer an associate degree so one might speculate that no industry recognized credential would be required of these program graduates. However, students seeking a one year diploma in drafting, rather than the two year degree, would need some type of certification according to Perkins 2006.

The word certification as it relates to industry recognized credentials is an enigma. The Perkins Act of 2006 often mentions "industry recognized certification" but

> Certification is the practice of qualifying an individual to perform in a job or occupation, based on a minimum set of standards. That means a professional body or organization has come together to set standards concerning what an individual should be able to know, do, and be in a given field. That organization has also created a measurement tool to sample that performance. (Mulkey & Naughton, 2005, p. 21)

The "professional body" referenced by Mulkey and Naughton is elusive in the field of drafting. Thus far, the professional bodies setting standards or developing measurement tools are primarily software manufactures that do so for profit.

The authors quote Jim Olsen, vice president and chief measurement scientist for Alpine Media: "Certification programs are a standard way of distinguishing between qualified and unqualified individuals, companies, and institutions" (Mulkey & Naughton, 2005, p. 21). Certification is typically created for two reasons: it protects the public from incompetent practitioners and promotes the professional competencies of an association's membership (Mulkey & Naughton, 2005, p. 21). Certifications exist for almost every profession. They are not regulated and usually do not require experience in an identified field (Ulmer, 2010). A certification is peer recognition, not registration or licensure (American Society of Quality, 2005, p. 1).

In the field of drafting there are four fairly well known certifying organizations. It is important to note that being well known does not mean there is research evidence of the quality of the certification or of industry acceptance. Many secondary career and technical centers in the state under study utilize instruments provided by Brainbench, an inexpensive online test, of the National Occupational Competency Testing Institute

(NOCTI). According to Jeff Levy, CAD instructor and American Design Drafting Association Deputy Director) these are often viewed as too general, too software specific, and having little to do with actual industry practice (J. Levy, personal communication, March 13, 2009). Community colleges and universities are more likely to employ testing by AutoDesk®, a leader in the production of drafting software, or the American Design Drafting Association (ADDA). Certification examinations currently cost between $49.95 for a single test from Brainbench (Brainbench, n.d.) to $125.00 each for certified professional exams of AutoDesk® products (AutoDesk, 2011a).

AutoDesk® claims that its certification gives completers a reliable validation of their skills and knowledge and can lead to accelerated professional development, improved productivity, and enhanced credibility for the test taker and his/her employer (AutoDesk, 2011b). AutoDesk® certification will accelerate one's professional development, enhance his/her credibility within the field, strengthens one's curriculum vita with an Autodesk certificate and logo, and places the completers detail in Autodesk's Certified Professionals Database (AutoDesk, 2011b). A number of resources are available, for a fee, to prepare for the AutoCAD®, AutoCAD Civil 3D®, AutoDesk 3ds Max Design®, AutoDesk Inventor®, AutoDesk Maya®, and AutoDesk Revit Architecture® proficiency examinations. One may acquire *Certified Associate* credential ($75.00) validating core knowledge of an application or *Certified Professional* credential ($125.00) demonstrating extensive knowledge. Successful test takers may print an electronic certificate "suitable for framing" with a unique identifying number for each software title upon successful completion of the test (AutoDesk, 2009). Certifications are

software version specific and require new testing each time a new version is released (typically annually).

SolidWorks®, a competitor of AutoDesk® in parametric modeling software, offers their own certification program. On their corporate website SolidWorks® assures that as Certified SolidWorks Associates (CSWA), "your students will stand out from the crowd in today's competitive job market. CSWA certification is proof of their SolidWorks® expertise and skills" (SolidWorks, 2011, p. 1). SolidWorks® asserts that their certification is "appropriate for any industry professional or student with a minimum of six to nine months of SolidWorks® experience and basic knowledge of engineering fundamentals and practices" (SolidWorks, 2011, p. 1). SolidWorks® recommends that applicants review the online tutorials on Parts, Assemblies, and Drawings as a prerequisite and have at least 45 hours of classroom time learning or using the software with basic engineering design principles and practices (SolidWorks, 2011). Despite claims that their certifications improve drafter performance none of the drafting software companies provide evidence to support these assertions.

While the efficacy of industry recognized certifications is questionable in many areas, the field of Information Technology has built a certification program that assures an acceptable level of competence for those working in the industry (Dean, 2001). Microsoft® certification is a well known and respected business certification. Microsoft® offers several ranges of this credential: the Associate and Technology Series for technology specialists, the IT Professional/Professional Developer Series for IT professionals and professional developers, the Master Series for master certified professionals, and the Microsoft Certified Architect Series – the highest level of

certification (Microsoft, 2011a). Like other purveyors of industry certifications, Microsoft® makes broad claims regarding the benefits of its credential. Microsoft certification stated benefits:

> By earning a Microsoft Certification, you gain relevant skills that employers respect and you get the opportunity to connect with a global community of other certified professionals. The Microsoft Certification Program also provides you with access to valuable Microsoft resources and benefits, such as access to the member website, career-building tools, and training. Microsoft Certification exams are continually evaluated and updated to ensure their relevance in the marketplace. As a result, earning a Microsoft Certification not only helps you stay up-to-speed on the latest developments in Microsoft technologies and platforms, but also helps enable you to demonstrate to employers your on-the-job skills. (Microsoft, 2011b, p. 1)

This study fills a gap in the literature concerning industry recognized credentials and computer-aided drafters. The research may also be significant for professionals in other CTE areas. Data collected, analyzed. and made available to educators in this study may provide valuable insight into the issues associated with the efficacy of credentialing in other industries.

Limitations

Limitations of this study included the following:

1 It was limited to 2010 employers as initially identified by community college drafting instructors.

2. It was limited to drafting and design instructors within a state's community college system located in the southeastern United States.
3. Educators were more inclined to participate in the study than employers.

Assumptions

The following assumptions related to the conditions and participants in this research study:

1. All participants had the necessary expertise to thoughtfully reply to each survey item.
2. Respondents had no stake in the certification of students or employees.
3. Drafting employers desired comparable qualities from new hires.
4. Instruction and drafting program content was consistent throughout all community colleges.
5. The test variable (survey questions) of each independent *t*-test is normally distributed in each of the two populations (instructors and employers).

Procedures

The subjects of this study were employers and instructors of graduates of drafting and design programs from community colleges within a southeastern U.S. community college system. Drafting instructors at each participating community college were asked to identify employer participants by naming two firms within the service area of their respective college. Drafting employers and community college drafting instructors were asked about their awareness of drafting certifications and their perceptions of the effectiveness of certifications for computer aided drafters.

Drafting instructors of active drafting programs at all community college campuses within the system served as the initial point of contact for gathering data for this research. All community colleges were contacted to determine which ones had active CAD programs. Faculty from each active program was invited to participate in this study. Program leaders at each of these schools were interviewed by telephone and asked to complete a survey assessing their views on industry certifications for drafting students, drafting certifications that they are aware of or possess, and the number of certified and non-certified students that have graduated from their school.

Drafting instructors at each college were also asked to identify the top two consumers of their program graduates (employers). These employers were contacted and asked to participate in the study. In the event that employers identified by drafting instructors declined to participate, advertisements in the yellow pages of local (service area of the college) telephone directories were consulted. Both physical telephone directories and online listings were consulted. Drafting supervisors at each participating company were interviewed by telephone. A line of questioning similar to that used with drafting instructors was used to determine employer's awareness of drafting certifications, their perceptions of the effectiveness of drafting certifications, their requirements for new hires, and their degree of satisfaction with drafters' performance on the job.

Additionally, the researcher conducted a document review of online employment advertising for drafting jobs within the state. Online want ads provided more depth in identifying employer requisites for drafters due to the greater volume of statewide want ads versus local newspaper advertising and participant (employers) responses. The

researcher scrutinized the drafting skills, non-drafting skills, training requirements (such as industry certification), education, personal characteristics, and other hiring requisites to identify precise employment qualifications that employers search for when hiring drafters. Data regarding CAD certification was compared to survey results from instructors and employers and from an earlier study (Trent, 2007) to improve validity. In the earlier study the researcher examined over 250 online want ads to determine the skills, experience, and education employers seek when advertising for new drafters. Education and experience were the most often mentioned requisite for beginning drafters. None of the ads mentioned drafting certifications as an essential element for drafters (Trent, 2007).

Definition of Terms

The following terms were defined to insure their specific and consistent interpretation in the context of this research and in the conduct of this study.

ADDA -- acronym for the American Design Drafting Association; a provider of industry recognized certification credential.

AutoCAD® -- product name for drafting software produced and sold by the AutoDesk® Company; commonly used in American industry to produce technical drawings.

AutoCAD® certification -- designation awarded to one who has completed a standardized test administered by AutoDesk®. The instrument is supposed to indicate proficiency and depth in most AutoCAD® functions.

AutoDesk® -- parent company of and major producer and distributor of AutoCAD® software in the United States. AutoDesk® provides training, support, and certifications for their products.

Brainbench -- provider of inexpensive, industry recognized drafting certification that is often utilized at the secondary level of instruction.

CAD -- acronym for Computer Aided Drafting.

CADD -- acronym for Computer Aided Drafting and Design.

Certificate -- a document serving as evidence or as written testimony, as of status, qualifications, privileges, and the truth of something or a document attesting to the fact that a person has completed an educational course, issued either by an institution not authorized to grant diplomas, or to a student not qualifying for a diploma (Certificate, n.d).

Certification -- the act of certifying, the state of being certified (Certification, n.d.).

Certified -- having or proved by a certificate (Certified, n.d).

Drafter -- any person employed in the drafting industry that designs things and/or creates drawings. These professionals were formerly known as "Draftsmen," a term that may reflect gender bias.

Maya® -- an AutoDesk® application that offers powerful, integrated 3D modeling, animation, visual effects, and rendering.

Inventor® -- computer aided drafting software by AutoDesk® that specializes in parametric modeling.

NOCTI -- acronym for the National Occupational Competency Testing Institute; an industry recognized provider of drafting certification often used at the secondary level of instruction.

Revit® -- an AutoDesk® architecture building design software package designed for building information modeling (BIM).

SolidWorks® -- computer aided drafting software utilizing parametric modeling. SolidWorks® is a competitor of AutoDesk®'s Inventor program.

Summary and Overview

In the diverse specialty of drafting and design there was little scholarly research to indicate that industry certification had any effect upon drafter employability or job performance. Students should receive the maximum benefit from the time and effort that they invest in their education (Carkhuff, 2006). Providers of drafting education must carefully and thoughtfully examine what students need to achieve upon program completion and judiciously select the content that is introduced for optimal return on investment. Data-based decision making is very important to effective curriculum design. Educators must thoroughly weigh the costs in both time and money of adding requirements to a finite block of instructional time and ask if each requirement affords significant value.

The reauthorized Perkins Act of 2006 encouraged: (1) connections between schools and business and industry, (2) connections between academics and careers, and (3) valid and reliable assessments (Brustein, 2006). Partnerships between educational institutions and consumers of their graduates (business and industry) were intuitively a constructive step. A connection between academics and career was also intuitive.

Material being taught in the classroom should be directly linked to the career under study. Cooperation among all parties to address needs, emerging technologies, and weaknesses in training could benefit everyone concerned. If a lack of industry support for certification as a valid assessment means emerged, schools may want to evaluate whether or not to take time and resources away from the study of other material in order to make time for federally mandated professional certifications that industry does not require or desire. The expectation was that students who graduate from any program of study possess a skill set that reflected competence and proficiency in that area. Attaining an industry recognized credential may be "quick and easy," but perhaps not the best measure of the depth of knowledge gained in an educational program. Credentials vary widely between the different specialties in the drafting profession (mechanical, civil, architectural, etc.) and may not address current industry needs. These needs could differ from region to region, and a certification may not necessarily reflect a relationship between a school and an employer.

Software developers like AutoDesk® and SolidWorks® make claims that their certifications are of great benefit to drafting students and drafters by providing "a reliable validation of your skills and knowledge" (AutoDesk®, 2011a, p. 1) and "can be used as a benchmark to measure your knowledge and competency" (SolidWorks®, n.d., p. 1). Data to support these claims were nonexistent. Research regarding the effect of certification among other industries was mixed, sometimes within the industry. Dean (2001) found that industry certification provided significant benefits for employers and employees in the Information Technology industry. Vakhitova (2006) found that IT certification generally had a significant impact only on the earnings of an employee. Only select

certifications in the IT field provided a significant return on investment. Similarly, International Organization for Standards (ISO) 9000 certification yielded mixed results (McLean, 2006; Skyrabec, 1999). Positive effects were seen in the automotive industry. Automotive Service Excellence (ASE) certification appeared to improve the performance of automotive service technicians in the areas of job performance and the reduction of customer complaints (Kolo, 2006). No scholarly research concerning the efficacy of drafting certifications on employment or performance among drafting program graduates existed. This study aimed to fill that gap.

The following chapter will present background information and other research and literature related to the drafting profession. Research associated with certifications in other occupations is also presented in Chapter II. Chapter III explains the methods and procedures used to gather and analyze data. The findings from this research are discussed in Chapter IV. The final chapter summarizes what was learned from the study, discusses the conclusions drawn from the research, and recommends further research concerning the use of industry recognized credentials and drafting certifications as measures of teaching effectiveness.

CHAPTER II

REVIEW OF LITERATURE

The effect of industry certification in the drafting profession is essentially unknown. The drafting industry was complex and dynamic and drafters in different fields required distinct skill sets in order to perform their duties. Employers tended to look for experience and attitude over training and certification when hiring new drafters (Mosher, 1980; Trent, 2007).

Little has been written concerning the efficacy of credentialing in the drafting profession. Perhaps this gap in the literature is due to the diversity of industries that drafters serve or the dynamic nature of the engineering profession. The American Design Drafting Association (ADDA) lists four separate careers in the drafting industry: drafters (or CADD operators), designers/engineering technicians, digital technicians (or graphic designers or graphic artists), and technical illustrators along with 25 related careers. Designers and engineering technicians may work in diverse engineering specialties such as aerospace, architectural, civil, electrical, electromechanical, environmental, industrial, and mechanical engineering (American Design Drafting Association, 2006a). The U.S. Department of Labor divides drafters into seven common categories: aeronautical, architectural, civil, electrical, electronics, mechanical, and pipeline drafters (United States Department of Labor, 2010). With such a diverse array of careers and specialties it is a small wonder that no single credential has emerged as dominant in the field. Drafting software developers, companies specializing in industrial certifications, and at least one professional drafting organization offer some form of drafting credentialing. All tout the

benefits of their particular certification but none provide empirical evidence of the benefit of obtaining such certification.

Contemporary research in the area of drafting certification is not extensive. Therefore drafting competencies identified and developed by schools and school systems, community colleges, and state and federal agencies were examined. Parallel studies dealing with certifications in the information technology (IT) field were investigated, as were certifications in the manufacturing sector. A great deal of the literature concerning the drafting industry was written in the 1980s as computer aided drafting (CAD) began to overtake traditional "drawing board" drafting. Much of that literature dealt with developing effective strategies to make the transition from drawing board to computer.

Historical Foundations

Drafting has been called a universal graphic language and dates to Egyptian hieroglyphics (Giesecke et al., 2002). For many years engineers and designers produced and used drawings and sketches as a means of communicating ideas simply and efficiently. As the complexity of engineering design increased drafters were trained "on the job" by engineers who taught apprentices the skills they deemed appropriate (Delaney, 2007). Agricultural and mechanical colleges and trade schools taught engineering concepts and drawing skills related to industry, but students being trained in the drafting arts were removed from industry. Experts who had worked in the field and were familiar with the skills needed to be successful became teachers of these courses (Majchrzak, 1990). Engineers no longer needed to be tied down to the cumbersome, often tedious work of drawing. They could explain their ideas to drafters who would bring these ideas to life on a sheet of paper or parchment for craftsmen to create. Drawings needed to be

simple and easily interpreted by these craftsmen. This was accomplished by creating detail drawings, simple geometric constructions, multi-view projections, section views, and assembly views (Giesecke et al., 2002). Drafters emerged as a liaison between engineers and trades people finding a niche somewhere between engineering/design and the manufacturing and construction industries. Professional drafters merged the art and science of engineering and manufacturing or construction.

Standards and Competencies for Drafters

There are no industry, state, or federally mandated licensure or certification requirements associated with the drafting profession. Mechanical ability and visual aptitude are two important qualities for drafters to possess. Prospective drafters should be able to draw well and perform detailed work accurately and neatly. Artistic ability is helpful in some specialized fields, as is knowledge of manufacturing and construction methods. In addition, prospective drafters should have good interpersonal skills because they work closely with engineers, surveyors, architects, and other professionals, and sometimes, with customers (Bureau of Labor Statistics, 2010).

While no standards currently exist as a requisite to enter the drafting profession, drafters do need to be capable of creating drawings that adhere to established standards. Several organizations determine the information that must be included on drawings and how that information is to be displayed. The American National Standards Institute (ANSI) is the most often cited set of standards used in the drafting profession. ANSI serves as the voice of the U.S. standards and conformity assessment system and empowers its members and constituents to strengthen the U.S. marketplace position in the

global economy while helping to assure the safety and health of consumers and the protection of the environment (American National Standards Institute, n.d.).

ANSI oversees the creation, promulgation, and use of thousands of norms and guidelines that directly impact businesses in nearly every sector from construction equipment to energy distribution, and many more. ANSI is also actively engaged in accrediting programs that assess conformance to standards – including globally-recognized cross-sector programs such as the International Organization for Standardization's ISO 9000 (quality) management systems (American National Standards Institute, n.d.).

The International Organization for Standardization (ISO) is the world's largest standards developing and publishing organization. Between 1947 and the present day, ISO has published more than 17,000 International Standards, including standards for activities such as agriculture and construction, mechanical engineering, medical devices, the newest information technology developments, and even time and date standards. The ISO is a network of the national standards institutes of 162 countries, one member per country, with a Central Secretariat in Geneva, Switzerland, who coordinates the system. It is a non-governmental organization that forms a bridge between the public and private sectors (International Organization for Standardization, 2011a). ISO publishes a number of drawing (drafting) standards that apply to both manually generated and CAD produced drawings. For example: ISO 128-20:1996 details basic conventions for lines (often referred to by drafting instructors as the "alphabet of lines"), ISO 128-30:2001 discusses basic conventions for views, ISO 129-1:2004 outlines the indication of dimensions and tolerances, and ISO 10209-1:1992 discusses terms relating to technical drawings or

vocabulary used in the drafting industry (International Organization for Standardization, 2011b). Interestingly, there is no mention of ANSI, ISO, or any other standards in the AutoDesk® Certification Exam Guide (AutoDesk, 2011c) or on the SolidWorks® certification web page (SolidWorks, 2009). CAD software vendor certification focuses on an individual's familiarity and proficiency using the product rather than drafting industry standards. This may be due, in part, to the fact that most drafting packages allow one to set preferences for the way dimensions appear on the screen (and print) when formatting a new drawing. According to ADDA Deputy Director Jeff Levy, the ADDA may address ANSI and ISO issues in future versions of their certification examination as they attempt to gain consensus among all interested parties (Levy, J., personal communication, March 13, 2009).

Other organizations have standards specific to their particular industry. There is the Society of Automotive Engineers (SAE), who focus on aerospace, construction, and motor vehicle standards (Society of Automotive Engineers, 2008), the IEEE (formerly the Institute of Electrical and Electronic Engineers, Inc.) that has a Standards Association (ISEE-SA) who develops industry standards in a broad-range of industries such as power and energy, information technology, telecommunications, transportation, medical and healthcare, nanotechnology, and green technology (IEEE, 2011), and the American Society of Mechanical Engineers (ASME) to name just a few. Each has its own agenda and may have slightly different drawing standards. For instance the ASME has their own set of drawing standards that apply to mechanical drawings in the United States. The latest standard is the Y14.5 Standard that governs geometric dimensioning and

tolerancing (American Society of Mechanical Engineers, 2010). It should be noted that these standards were voluntary because they acted as guidelines without the force of law.

ASME defines a standard as: A set of technical definitions and guidelines, "how to" instructions for designers, manufacturers, and users (American Society of Mechanical Engineers, 2011). Standards promote safety, reliability, productivity, and efficiency in almost every industry that relies on engineering components or equipment. Standards can run from a few paragraphs to hundreds of pages and are written by experts with knowledge and expertise in a particular field who sit on many committees. When a standard is adopted by one or more governmental bodies and has the force of law, it becomes a code (American Society of Mechanical Engineers, 2011). The drafting industry adheres to multiple standards, but there is no single or universal drafting code.

The American Design Drafting Association (ADDA) is the only professional drafting organization that has established a certification program for drafters. Although employers rarely require drafters to be certified, certified drafters should demonstrate a deep knowledge and understanding of nationally recognized drafting practices (Bureau of Labor Statistics, 2007). Individuals who wish to become ADDA certified must pass the Drafter Certification Test, administered periodically at ADDA-authorized sites. Applicants are tested on basic drafting concepts, such as geometric construction, working drawings, and architectural terms and standards (American Design Drafting Association, 2006b).

Instructional Methods Used in Drafting Education

Training differs somewhat within the drafting specialties, although the basics, such as mathematics, projection, and dimensioning are similar. In an electronics drafting

program, for example, students learn how to depict electronic components and circuits in drawings. In architectural drafting, they learn the technical specifications of buildings (Bureau of Labor Statistics, 2007).

Many employers prefer applicants who have completed postsecondary school training in drafting, which is offered by technical institutes, community colleges, and some 4-year colleges and universities (Trent, 2007). Virginia community colleges provide the majority of post secondary CAD education in the state. No four year institutions of higher education have CAD degree programs. According to Ron Williams, President of Ronald A. Williams, Ltd., a leading provider of drafting software, equipment and training in the state under study, "They simply give students a copy of the software and tell them to learn it" (Williams, R.A., personal communication, November 20, 2008). CAD is taught at over 220 high schools in the state under study. AutoDesk® has 70-72% of the drawing software market in the state, 40% of the U.S. market, and 37% of the European market with 8 million users worldwide (Williams, R.A., personal communication, November 20, 2008).

Employers are most interested in applicants with well-developed drafting and mechanical drawing skills; knowledge of drafting standards, mathematics, science, and engineering technology; and a solid background in CAD techniques. According to the Bureau of Labor Statistics (2007), employers in the United States prefer applicants who have completed postsecondary school training in drafting, which is offered by technical institutes, community colleges, and some 4-year colleges and universities. Secondary courses in mathematics, science, computer technology, design, computer graphics, and, where available, drafting are useful for people considering a drafting career. Technical

institutes offer intensive technical training in the field of drafting, but they provide a less general education than do community colleges. Either certificates or diplomas may be awarded. Community colleges offer courses similar to those in technical institutes but include more classes in theory and liberal arts. Often, there is little difference between technical institute and community college programs. Courses taken at community colleges are more likely to be accepted for credit at 4-year colleges. After completing a 2-year associate degree program, graduates may obtain jobs as drafters or continue their education in a related field at a 4-year college (Bureau of Labor Statistics, 2007).

Drafting curricula are often developed by the institution or the state where the training takes place. The best programs involve educators and industry professionals working in concert to use the assets available to achieve the greatest return on investment. Development of such a program requires an intense investment in time, money, and effort. It is often easier to simply adopt a textbook and teach the table of contents (as in other disciplines) (Thilmany, 2002). The ADDA notes that drafting curricula/certification is moving from being professionally driven to educationally driven (American Design Drafting Association, 2006b). Perkins legislation mandating industry certification has generated much interest and discussion at Community College Drafting Peer Group conferences. In the past drafting certification was software based with few engineering or design standards or abilities (skills) included. Now industry based performance objectives are being considered. AutoDesk® and the ADDA are working together to build a more practical set of standards and are beginning to recognize one another's certifications and are coming together to create a better certificate without losing either organization's integrity (Levy, J., personal communication, March 13, 2009). The goal is to go beyond

competencies such as, "Place a door in a wall" that are focused solely on a single, simple drawing and isolated from any true application. The new certification would have more practical, real world, applications that are relevant to industry. Students might be asked to properly place a door in a wall based on ASME standards while considering architectural and engineering design factors (Levy, J., personal communication, March 13, 2009)

Computer Aided Drafting

Little research existed in the area of identifying drafter competencies or task lists prior to 1980. Employers and educators appeared to have found existing drafting training simply "good enough" to meet their needs (Peters, 1997) without seriously examining what was being taught. Unfortunately, textbook publishers often determine course content with very little input from manufacturing professionals basing content, instead, on what an author feels is needed (Budiansky, 2001). In the 1980s a surge of scholarly interest in the field of drafting developed as educators and researchers began to address computer aided drafting (CAD) issues. CAD began to overtake the traditional "drawing board" forcing educators to reexamine traditional teaching strategies and content. Many of these studies merely compared the efficiency of performing the same basic drafting operations or functions using new technology versus traditional methods (Collins & King, 1988). Drawings, tasks, and drafting requirements remained the same while drawing tools changed. Finding essential skills or characteristics of drafters or drafting students continued to be unaddressed.

Once CAD became the dominant form of drawing technology in the 1990s, issues regarding the topic of drafting curriculum were largely ignored. Some school systems and state agencies disseminated information related to the drafting industry including

workplace issues like salaries, working conditions, employment outlook, and career advancement opportunities (Moore, 2002; Ohio State University, 1992; Seattle Community College District, 1994). While job skills were often listed, they tended to reflect program competencies rather than actual industry requirements. These documents were typically reports of statistical information with little or no data analysis.

Post CAD Requirements

In 1990 and 1991 Ohio State University used a modified DACUM (Developing a Curriculum) process involving business, industry, labor, and community agencies in Ohio to develop a comprehensive and verifiable competency profile for drafting occupations (Ohio State University, 1992). This remains one of the most ambitious studies of drafting competencies to date. This study produced a great deal of information and established an inventory of traditional drafting skills for the auto industry. The study is seriously outdated and does not take into account modern CAD competencies. It also does not address the certification issue.

In the post CAD era there has been much discussion about what employers want or expect from their drafting employees. The widespread use of computers in the drafting and design process has caused some companies to hire engineers "more for software proficiency than for engineering abilities" (Thilmany, 2002, p. 11). CAD operators can do incredible things with drafting software and only a cursory knowledge of engineering practice. Indeed, the researcher has taught individuals who could produce high quality drawings without understanding the most rudimentary engineering concepts. These CAD operators may draw circles on paper without comprehending that the circle they have drawn is actually a visual representation of a physical hole in a mechanical part.

Traditionally mechanical drafters and engineers had core engineering knowledge and were taught how to use CAD software. Increasingly CAD instructors are teaching people how to use drawing software without teaching them about engineering principles. Engineering companies face a dilemma: "Should they hire CAD operators who know how to design parts, or should they hire mechanical engineers who know how to use CAD systems?" (Thilmany, 2002, p. 12).

Information Technology Certifications

Positive effects for certification have been observed in some CTE areas, most notably in the field of information technology (IT). In a matter of about 10 years the IT industry went from having no certification requirements in assuring a competent employee base to having multiple levels of certification indicating advancing degrees of proficiency (Seattle, 1994). These certifications have come about with the support of the information technology community and have been driven by perceived industry need.

This certification evolution began in the early 1990's when the Novell Corporation owned approximately 80% of the world's local area network market (Dean, 2001). As the company expanded, Novell saw a need for establishing an acceptable level of competency for people that worked with its products, many of whom were third party vendors not trained by the parent company. They trained and certified experts who oversaw and operated systems around the world (Dean, 2001). Others soon began to see the wisdom of the certification process for IT professionals. Microsoft® developed its Microsoft Certified Systems Engineer (MCSE) certification for its products and Cisco® followed suit with its own set of standards for its product line. Other companies soon entered the fray with vendor specific certifications until there were eventually over 500

different IT certifications (Dean, 2001). According to Dean (2001), only about 10 are highly sought after, with Microsoft's MCSE certification and Cisco's Cisco Certified Network Associate (CCNA) being the top two, respectively.

A few years after the initial race to enter the certification market vendor neutral certification examinations began to show up in the marketplace. The Computing Technology Industry Association (CompTIA) developed a set of homogeneous requirements and skills for service technicians. One of the first certifications was the A+ certification in the area of desktop computer hardware and software management and repair (CompTIA, 2010). Most leading IT vendors have embraced CompTIA certifications realizing the value of generic introductory competency certifications. In fact, some of the largest IT companies demand the A+ certification as a prerequisite to their vendor specific certifications (Dean, 2001). The evolution of IT certification sounds like a roadmap to certification success, albeit a slow trip that took 15 years.

Manufacturing Certifications

The National Association of Manufacturing (NAM) is advancing a solid model for a nationally portable certification system for those in the manufacturing workforce (ManufacturingSkills.org, n.d.a). Manufacturing is a very diverse industry and adheres to a variety of third party standards, similar to the drafting industry discussed previously. The NAM plan does not launch any new certifications or credentials; rather it compiles a set of those already generally accepted by many manufacturers. This gives employers a clear set of formal documentation they should expect from potential workers to prove their skills and give job seekers a comprehensive pathway to guaranteed employment. NAM hopes that more of their member companies will begin requiring their skills

credentials and the country's community colleges will begin helping more of their students attain skills credentials alongside traditional academic degrees (Moltz, 2009). The association has created a multi-tiered competency model beginning with personal effectiveness competencies, academic competencies, workplace competencies, industry wide competencies, and advancing to various categories of industry specific categories.

The foundation of the NAM system is the National Career Readiness Certificate. This baseline certification was developed by ACT, an independent, not-for-profit organization that provides more than a hundred assessment, research, information, and program management services in the broad areas of education and workforce. This certification is typically earned in high school to complement the high school diploma and prove to employers that students holding this certification have the core academic and workplace competencies to be hired (ACT, 2009). Virginia has a comprehensive Career Readiness Certificate that helps employers by certifying that a recipient possesses core skills in applied mathematics, reading for information, and locating information – skills required by at least 85% of all jobs profiled by ACT Workkeys in the country. The Certificate is based on established WorkKeys assessment tests. WorkKeys is a comprehensive skills assessment tool recognized by thousands of companies in the U.S. and by state and federal agencies. To earn a Career Readiness Certificate, individuals undergo testing related to reading, applied mathematics, and locating information through the WorkKeys skills assessment system. The Career Readiness Certificate program falls under the Education for a Lifetime initiative. Oversight of the CRC is the responsibility of the Senior Advisor to the Governor for Workforce Development; administration of the CRC is handled by the Virginia Community College System (Virginia.gov, 2009).

The second tier of the manufacturing industry model is academic competencies consisting of basic or core competencies necessary for almost all entry level jobs across all sectors of manufacturing, as well as other industries. Students should be competent readers and writers, have basic computer skills, communicate effectively, be proficient at locating and utilizing information, perform mathematical operations including measurement, and understand basic science concepts (ManufacturingSkills.org, n.d.b). Manufacturing industry executives and the U.S. Department of Labor identified these core competencies in 2005 and 2006. Workplace competencies, the third tier of the model, include "soft skills" such as problem solving, planning and organizing, and working as a team member. Fourth tier competencies narrow to more industry wide competencies such as production, maintenance and repair, and quality assurance (ManufacturingSkills.org, n.d.b).

NAM feels that workers typically attain industry specific skill training after graduating from high school. They wish to address a need in the "middle skill" job market, which is the area where most manufacturing jobs fall. Holzer and Lerman (2009) classify jobs based on education and training levels and define middle skill jobs as those that generally require some education and training beyond high school but less than a bachelor's degree. These postsecondary education or training requirements can include associate's degrees, vocational certificates, significant on-the-job training, previous work experience, or some college, but less than a bachelor's degree.

Holzer and Lerman (2009) further divide the broad occupational groups into high-skill, middle-skill, and low-skill categories based on Bureau of Labor Statistics estimates

of the educational attainment and training of people in those jobs. Using this information, they define:

- High-skill occupations as those in the professional/technical and managerial categories.
- Low-skill occupations as those in the service and agricultural categories.
- Middle-skill occupations as all the others, including clerical, sales, construction, installation/repair, production, and transportation/material moving. (Holzer & Lerman, 2009, p. 2)

The National Association of Manufacturing has built a certification model based upon the framework of competencies for the advanced manufacturing industry from the Department of Labor, Education and Training Administration. In addition to advanced manufacturing, the Department of Labor has competency models for aerospace, automation, construction-heavy, construction-residential, energy, entrepreneurship, financial services, hospitality/hotel and lodging, information technology, and retail. These models are presented as a pyramid with foundational competencies at the base, industry related competencies in the center, and occupation related competencies at the top. The advanced manufacturing industry framework has eight levels of competencies moving from broad skills and knowledge to a more focused skill set. The first three levels (personal effectiveness, academic, and workplace competencies) are so broad that they could be included in most career areas. Levels four and five (industry-wide technical and industry-sector technical competencies) focus on broad manufacturing industry competencies. Levels six, seven, and eight (occupation-specific knowledge areas, occupation-specific technical competencies, and occupation-specific requirements)

narrow the focus to specific job requirements within the industry while the top level (management competencies) addresses administrative skills (CareerOneStop.org, 2009).

NAM endorses the view that the United States is on the verge of a crisis in the workforce pipeline and that their certification programs are the most effective means to address the shortage of qualified manufacturing entry level employees (National Association of Manufacturing, 2005). The manufacturing industry employs 13 million workers and supports 5 million related industries (ManufacturingSkills.org, n.d.c). The association believes that educators should help workers to transition to new careers and help students graduate from school ready for work. Their belief is that this can best be accomplished by addressing the confusion in education and training. Efforts should be made in aligning industry needs with curriculum and industry based certifications (ManufacturingSkills.org, n.d.c). NAM asserts that community colleges are on the front lines of educating displaced or directionless workers. Community colleges are seen as the training provider of choice for employers (National Association of Manufacturing, 2005). Those in the process of attaining an associate's degree, for example, should have the ability to concurrently earn an industry specific skills credential, e.g., one from the National Institute for Metalworking or the American Welding Society (Moltz, 2009). The association also endorses the Manufacturing Skills Certification System which provides skills assessment, standardized curriculum, and portability of credentials.

Employer Requirements

Employers, in general, look for employees with specific workplace skills, e.g., reading, writing, mathematics and problem solving abilities, a strong work ethic, positive attitude, good attendance, the ability to work with others (Martin, Carrier, & Hill, 1997).

In the field of Information Technology human resources executives ranked education (college degree) higher than industry credential when considering hiring new employees (Bartlett, 2002). Bartlett found that the majority of IT employers believe that "IT certifications (credentials) reduce the cost of training for their organizations, reduce the time for new employees to learn their jobs, and increase the chance of success for a new hire" (p. 59). Only 12.3% of IT employers, however, agree that industry sponsored IT credentials improve employees theoretical understanding of key issues related to the IT industry (Bartlett, 2002).

Employers of drafters also look for positive workplace skills along with specific training and experience in the field. Trent (2007) found that experience and/or education were the most often mentioned factors employers mentioned in online want ads. Mosher (1980) and Peters (1997) found that specific drafting skills were secondary to soft skills among employers they surveyed.

In 1996 the United States Department of Education joined forces with the Department of Labor to coordinate the Occupational Skill Standards Project, a set of voluntary skill standards for twenty-two different industries. Each of the projects identified what workers should know and be able to do to qualify for beginning-to-expert level occupations in various sectors of our nation's economy (U.S. Department of Education and U.S. Department of Labor, 1996). The CADD skill standards document:

> ...represents skills that are core to all CADD disciplines, generic to all software and entry levels. The standards include: fundamental drafting skills; fundamental computer skills; basic CADD skills; advanced CADD skills; related academic skills in communication, math, and science; employability skills; tools and

equipment for CADD training; recommended hours of instruction; and qualifications of the instructor. (p. 16)

These are very general standards, typical of most efforts to identify a skill set for drafters. In fact, the drafting industry is so diverse that it would be very difficult to produce a reliable and valid set of such skills. The researcher's undergraduate drafting instructor summed up his vision of drafting education by saying, "I'll teach you what you need to get a job. Your employer will teach you what you need to do on the job" (Farrington, C., personal communication, 1977).

Trends in Drafting Education and Industry

In 2006 there were approximately 253,000 drafting jobs in the United States with architectural and civil drafters holding 46% of the positions. Mechanical drafters comprised 31% of the drafting workforce and electrical and electronic drafters comprised another 14% of the jobs (Bureau of Labor Statistics, 2007). Job growth in these occupations is expected to be about 6% through 2016 which is a bit lower than the national average for all occupations. Opportunities should be best for individuals with at least two years of postsecondary training in a drafting program that provides strong technical skills and considerable experience with CADD systems (Bureau of Labor Statistics, 2007).

Attaining this training at a community college is becoming more difficult due to the closing of drafting programs. As a result of discussions with drafting instructors at peer conferences the researcher has identified four community colleges that have closed or plan to eliminate their drafting and design programs in the state under study. This is an interesting development given the projected 6% growth in need for qualified drafters and

the relatively high salary garnered by drafters (Bureau of Labor Statistics, 2007). In May of 2006 the median income for all drafters was between $42,000 and $47,000 annually (Bureau of Labor Statistics, 2007). The Bureau of Labor Statistics Occupational Outlook Handbook stated that:

> Industrial growth and increasingly complex design problems associated with new products and manufacturing processes will increase the demand for drafting services. Furthermore, drafters are beginning to break out of the traditional drafting role and do work traditionally performed by engineers and architects, also increasing demand. (para. 4)

Even though growth is predicted in the drafting industry, the news is not all good. The Occupational Outlook Handbook (2007) further stated:

> ...drafters tend to be concentrated in slow-growing or declining manufacturing industries. In addition, CADD systems that are more powerful and easier to use are also expected to limit demand for lesser skilled drafters because simple tasks will be made easier or able to be done by other technical professionals. Employment growth also should be slowed by the offshore outsourcing to other countries of some drafting work because some drafting can be done by sending CADD files over the Internet. (para. 4)

Civil drafting is the biggest expansion area in CAD. The advent of global positioning systems and electronic data collection has changed the way civil engineers and surveyors design structures and map topography. Mapping is not limited to terrain. Neuro-mapping, creating three dimensional maps of the nervous system, is helping drug companies discover how drugs move throughout the body and precisely how the drugs

function. Elsewhere in the biotechnology arena software is being developed that convert MRI imagery to point data and point data to CAD. These three dimensional scans can help create customized prosthetic devices that fit individual patients exactly. The medical industry uses CAD software to build artificial limbs and joints, create laboratory equipment and diagnostic machinery, and design simulations where doctors or doctors in training can take virtual tours of the human body or practice procedures in a simulated environment without risking the health of actual patients, according to ADDA Deputy Director Jeff Levy (Levy, J., personal communication, March 13, 2009).

The integration of CAD drawings into computer graphics affords many simulation opportunities. For instance the army has used computer simulations in their training exercises for some time. Today's CAD and graphics technology allow realistic training over terrain that has been scanned and mapped to a high degree of accuracy. Accurate hardware and military equipment can also be inserted into these simulations using the same technology.

Parametric modeling or three dimensional drawing knowledge and experience is becoming more prevalent in the field of drafting and design. Some believe that parametric modeling systems such as SolidWorks® and AutoDesk® Inventor are fundamentally changing the design process practiced in the industry today (Ilies, 2006). These powerful programs make the design of increasing complex projects much easier, especially in the area of tracking changes or modifications to the project.

Summary

The value and relevance of any certification depends upon the credibility of the credentialing organization and the willingness of those seeking the credential to "buy in"

to the process. Some professions demand licensure for entry (e.g., nursing), while others, such as drafting, have no requirements at all.

The drafting profession adheres to a variety of standards (e.g., ASME, ISO, SAE, IEEE) having never adopted its own. This observance of third party standards is similar to the manufacturing industry's model which existed until a few years ago. Manufacturing has become proactive in determining the skills that employers need and the education/training (certifications) that potential employees need to attain employment in that industry. The drafting industry today may be where the manufacturing world was a few years ago in terms of recognizing a need. Instructional programs in drafting have often existed in isolation and have sought out and received little input from industry. Visual representations and drafting methods were developed early in the industrial revolution on the drawing board by drafters to such a degree that "end users" of technical drawings and sketches were forced to approach the drafting industry or third party standards organizations to learn to read and interpret blueprints (Delaney, 2007).

Certifications evolve over time. Fifteen years ago very few Information Technology workers held any type of licensure or credential, primarily because few existed. Today certification is required for entry into many IT professions. Advanced certifications or credentials are often needed in order to advance in the career. In a relatively short time frame the IT industry embraced the certification process and now finds it essential as a tool for gauging employee proficiency. This development came about from the efforts of one or two large organizations within the industry. Perhaps AutoDesk® and the ADDA are on the cusp of bringing certifications to the drafting industry. The business of drafting is very diverse and fragmented and does not currently

have a single administrative authority capable of advancing a certification process to its constituents.

Professional drafting establishments reviewed their methodologies twenty years ago as new drawing technology (CAD) impacted the field. This introspective look addressed training issues (are schools creating CAD operators or engineers?), while the impacts on industries served by drafters were essentially ignored (Thilmany, 2002). Little research has been conducted to assess what industry wants, needs, or expects from drafters. This research means to fill this gap by interviewing community college CAD instructors and drafting supervisors. By gathering and analyzing data from different perspectives, desirable characteristics of entry level CAD drafters may be identified. These characteristics may then be addressed in curriculum design and incorporated into drafting programs. Educators should become more proactive in seriously assessing current skill sets required by industry and craft curricula to meet those proficiencies. Consulting industry concerning current needs and adjusting instruction accordingly should help students matriculate from the school environment into the drafting culture more quickly and effectively, reduce training costs for employers, and improve productivity for industry.

The following chapter will discuss the methods and procedures used to gather and analyze data. The population will be broken down into groups, the instrument design will be discussed, and a matrix of survey questions relating to the five Research Questions will be provided. Finally, a discussion of specific analytical procedures used in the study will be provided.

CHAPTER III

METHODS AND PROCEDURES

A descriptive research methodology was utilized to ascertain the effect of drafting certification on graduates of community college drafting programs in one southeastern U.S. state. Drafting instructors at all community colleges in that state were contacted and invited to participate in the study. These instructors played a pivotal role in the research as they were asked to identify the remaining participants. Instructors were asked to name the top two employers, by volume, of their drafting graduates. An assumption of this study is that this purposeful sample should be representative of drafting employers across the state.

Employers identified by drafting instructors were contacted by telephone and invited to participate in the study. Drafting supervisors or human resources personnel served as the initial point of contact. Only individuals who directly supervised drafters were asked to complete the survey. Additionally, a documents review was conducted in an effort to determine if employers actively seek drafters with industry recognized credentials. The job postings of the top online employment website in the United States were used to look at qualifications desired by industry in the state under study. This chapter briefly describes the population under study, the instrument design, the methods of collecting data, and the statistical analysis used to interpret the data.

Population

The subjects of this study were employers and instructors of graduates of drafting and design programs from community colleges in one southeastern U.S. state. Twenty-three community colleges were contacted. Nineteen active drafting or engineering

programs were identified. One school closed its CAD program over 20 years ago, while three schools have closed their CAD programs within the past five years. Three participating schools stated that their programs were slated for closure within the next one to three years. Four colleges declined to participate because the instructors did not feel that their programs reflected true computer aided drafting programs. These schools perceived their programs to be more focused on engineering or computer graphics. Two schools failed to respond to multiple letters, emails, and telephone calls. A total of 14 drafting instructors chose to participate in the study.

The sample of employers of drafters proved to be more difficult to obtain. Many employers were reluctant to participate in the study, even those who had strong relationships with the drafting instructors who recommended them. Most employers who declined cited "time" as the reason for choosing not to take part in the study. They felt that time spent on the survey would equate to the loss of productivity for the company.

When employers identified by the drafting instructors declined the invitation to participate, at least four alternate candidates in the service area of the college were contacted. In some rural areas this exhausted the supply of available participants. In areas having greater employer resources, the local telephone directory (the telephone directory covering the service area of each college) was consulted. Yellow pages advertising in both the physical directory and online telephone directories were utilized to solicit employer participants. A total of twelve employers participated in the study.

Instrument Design

Initial contact with fifteen community college drafting instructors was made at a Community College "Drafting Peer Group" meeting held on a state community college campus in November, 2008. This meeting afforded the researcher an opportunity to have a face to face meeting with drafting instructors from across the state. It helped to gain informal feedback on the topic of drafting certifications, to identify questions these instructors had about certification, and gave the researcher a means to explain ideas for researching the topic in more detail than might otherwise be possible.

Two instruments were developed to obtain data relative to the research objectives: the Instructor/Employer Survey Protocol (Appendix A) and the Drafting Credential Survey (Appendix B). The Instructor/Employer Survey Protocol sought information from community college drafting instructors and employers of community college drafting program graduates regarding their awareness of industry recognized drafting certifications and their attitudes toward such credentials. Each survey included open-ended questions regarding skills, training, and knowledge that instructors and employers believe that trained drafters should possess. The first three research questions developed to guide this study (do community college drafting instructors believe that certified drafters perform better on the job than non-certified drafters, do employers believe that certified drafters perform better on the job than non-certified drafters, and do employers seek CAD certified individuals to fill drafting positions?) were incorporated into these surveys. The fourth research question (is there a difference between the perceptions of community college drafting instructors and employers of community college drafting program graduates regarding the importance of drafting certification?) was addressed by

comparing the survey responses of each group. Employers were further asked to complete a Drafting Credential Survey (Appendix B). This was a Likert-type scale instrument utilizing five numeric choices for statements regarding the employer's perceptions of the importance of certification for drafters. Responses ranged from 1 (strongly disagree) to 5 (strongly agree). Separate from the survey, instructors were asked to provide contact information for the top two employers of drafting graduates from their program.

The quality of the instruments utilized in any research is of paramount importance since inferences, conclusions, and recommendations will be drawn from the data collected through them. Validity and reliability are key components in a quality research instrument (Levin & Fox, 2006). Validity is a measure of how well an instrument measures what it is meant to measure, while reliability is a measure of consistency of data collected (Patten, 2005). Reliable instruments should yield similar results when given to different groups or individuals with similar beliefs about the topic being investigated. CAD experts in the fields of education and industry reviewed each instrument and verified the validity and reliability of the instruments in this research. Retired CAD instructors from community colleges in the southeast U.S. and employers not participating in the study were asked to review the instruments for face validity and content validity. Results and recommendations from these individuals were used to adjust and modify the instruments before distribution to the population.

Technically, since the researcher polled the entire population, this was a census rather than a survey (Patten, 2005). The use of a census eliminated sampling error and improved reliability among drafting instructors. The use of an entire population can also

introduce the effect of power as an influence. Validity and reliability issues were similarly addressed for the other population being studied (employers of community college drafting graduates) by including employers in the development and review of the instruments.

Survey Validity Matrix

With the exception of Question 1, questions on the Instructor/Employer Survey Protocol (Appendix A) are related to each of the five research questions under investigation. Question 1 on the protocol asks questions of the respondents that relate to their background and experience. Question 2 (items a through h) involve respondents' views about drafting certifications. The third protocol question explores instructor and employer views on the drafting skills they feel are important for drafters to possess. Similarly, Question 4 explores the same individuals' opinions regarding non-drafting skills (soft skills) they feel are important for drafters. Protocol items are correlated to research questions in Table 1.

Questions on the Drafting Credentialing Survey (Appendix 2) are directly related to the research questions being investigated. The first 20 questions ask respondents to rate their degree of agreement or disagreement with each statement. The last16 questions are simple statements regarding certification. Respondents were asked to select their degree of agreement or disagreement with each statement using a five point Likert scale. A matrix of each survey question's association with the research questions is presented in Table 2 and Table 3.

Table 1

Instructor/Employer Survey Protocol Correlation to Research Questions

	1) Do community college drafting instructors believe that certified drafters perform better than non-certified drafters?	2) Do employers believe that certified drafters perform better on the job than non-certified drafters?	3) Do employers seek CAD certified individuals to fill drafting positions?	4) Is there a difference between the perceptions of drafting instructors and employers regarding the importance of drafting certification?	5) What do employers look for when hiring new drafters?
Question 1 – Demographic information					
Question 2 – Awareness, requirement, and opinion of industry recognized certifications			X	X	X
Question 3 – Rank drafting skills drafters need to succeed on the job			X	X	X
Question 4 – Rank non-drafting skills drafters need to succeed on the job			X	X	X

Methods of Data Collection

Data for this research were collected from three different sources. A documents review was conducted to identify characteristics employers from across the state desire when seeking to hire new drafters. Drafting instructors at community colleges with viable computer aided drafting programs were interviewed and surveyed to ascertain their views concerning the importance of industry recognized certifications. Employers who hire community college drafting program graduates were also interviewed and their views on certification were compared to those of drafting instructors. Detailed information relating to the documents review, college instructors, and employers follows in the next three sub-sections.

Table 2

Drafting Credentialing Survey – Research Question Matrix

	1) Do community college drafting instructors believe that certified drafters perform better than non-certified drafters?	2) Do employers believe that certified drafters perform better on the job than non-certified drafters?	3) Do employers seek CAD certified individuals to fill drafting positions?	4) Is there a difference between the perceptions of drafting instructors and employers regarding the importance of drafting certification?	5) What do employers look for when hiring new drafters?
Industry recognized credentials:					
Determine the needed knowledge and skills for drafting jobs			X		
Make it easier to identify applicant's knowledge and skills			X		
Reduce training costs for drafters	X	X		X	
Increase the chance of success for new hire	X	X		X	
Reduce the likelihood of turnover	X	X		X	
Are important to career success	X	X		X	
Rate importance of:					
High School Diploma or GED					X
Drafting experience					X
2-year vocational/technical college or community college degree					X
4 year degree in an engineering discipline					X
Any 4 year degree					X
Master's degree					X
Industry recognized certification/credential			X		X
Students w/ industry recognized credentials are:					
More likely to be hired	X	X	X	X	
More likely to be paid more	X	X		X	
More likely to have a successful career		X		X	
More likely to keep up with drafting technology	X	X		X	X
Less likely to quit their job	X	X		X	X
More likely to be satisfied with their job	X	X		X	X
More likely to advance in their career	X	X		X	X

Table 3

Drafting Credentialing Survey Item – Research Question Matrix

	1) Do community college drafting instructors believe that certified drafters perform better than non-certified drafters?	2) Do employers believe that certified drafters perform better on the job than non-certified drafters?	3) Do employers seek CAD certified individuals to fill drafting positions?	4) Is there a difference between the perceptions of drafting instructors and employers regarding the importance of drafting certification?	5) What do employers look for when hiring new drafters?
1-Holding a certification recognized by the drafting industry improves a graduates' probability of attaining employment	X	X		X	
2-Certified drafters perform better than non-certified drafters on the job	X	X	X	X	
3-Employers seek out industry certified individuals to fill drafting positions	X	X	X	X	X
4-Drafting certifications are worth the investment of time and money	X	X		X	
5-An industry recognized certification is a good measure of the drafting skill a drafter has attained	X	X		X	
6-An industry recognized certification is a good measure of the quality of the drafting program a drafter has completed	X	X		X	
7-Certified drafters are more proficient than non-certified drafters	X	X		X	
8- Certified drafters demonstrate better drafting skills than non-certified drafters	X	X		X	X
9-Certified drafters are better workers than non-certified drafters	X	X		X	X
10- Certified drafters demonstrate better work habits than non-certified drafters	X	X		X	X
11- Certified drafters complete assignments faster than non-certified drafters	X	X		X	X
12- Certified drafters have better problem solving skills than non-certified drafters	X	X		X	X
13- Certified drafters work better as part of a team than non-certified drafters	X	X		X	X
14- Certified drafters are better leaders than non-certified drafters	X	X		X	X

Documents Review

A review of drafting job want ads added a layer of complexity to the data that enriched the depth of understanding. In the documents review relevant records and documents were collected and reviewed. The raw data from this review were coded and organized into readable narrative descriptions with major themes, categories, and illustrative case examples extracted through content analysis. The themes, patterns, understandings, and insights that emerged from evaluation fieldwork and subsequent analysis are the fruit of qualitative inquiry (Creswell, 1998). Collecting data from diverse sources improved the reliability of the study and built an in depth-picture of the study. Multiple forms of data collection provide a more information-rich study and helps to convey the complexity of the research (Creswell, 1998). In this study the documents under review were electronic. A review of want ads posted in the same geographic location as the participants increased the amount of data under observation.

Job postings from the top general job search website in the United States as identified by the Careers.org (2009) website were selected as the sample for the documents review. Employment searches included jobs advertised only within the southeastern state under study. Job searches included the terms "drafter" or "draftsman" and "CAD." Where a category designation was required to proceed with an employment search, the terms engineering, design, or the most closely related phrase to engineering or design was selected.

The Conference Board (2009a) routinely conducts the type of research described above. The Conference Board is a global, independent membership organization working in the public interest that publishes information and analysis, makes economics-based

forecasts and assesses trends, and facilitates learning by creating dynamic communities of interest that bring together senior executives from around the world (Conference Board, 2009a). As part of its mission, the Board surveys help-wanted print advertising volume in over 50 major newspapers in the United States every month. Because ad volume has proven to be sensitive to labor market conditions, this measure provides a gauge of change in the local, regional, and national supply of jobs (Conference Board, 2009b). Regional want ads are a valuable source of raw data and the review of job postings in the selected southeastern state contributed to the depth and breadth of this study, particularly for research questions three (do employers seek CAD certified individuals to fill drafting positions?) and five (what do employers look for when hiring new drafters?).

Some of these postings included positions that are outside of the realm of engineering and CAD drafting. The job of "Patent Attorney," for instance, used the term drafting in a completely different context than engineering (i.e., drafting documents for legal contracts) and was not utilized in the documents review. The term "CAD" also proved to be problematic as the acronym is often used to describe Coronary Artery Disease. All jobs aligned with the medical profession were also eliminated from consideration.

College Instructors

All colleges in the community college system covered by the research were initially contacted to determine which colleges had closed their drafting programs, which colleges had viable drafting programs, and identify program leaders within those departments. Cover letters were sent to each instructor (see Appendix C) and follow-up telephone calls were made to each instructor to confirm their willingness to participate in

the study, verify contact information, and schedule a time for a telephone interview. Each participating instructor was contacted by telephone at his or her convenience to answer the survey questions. The researcher followed the Instructor/Employer Survey Protocol (Appendix A) reading the disclaimer, instructions, and each question to the drafting instructor to ensure consistency in collecting the data. Drafting instructor responses were recorded directly on the Instructor Survey Protocol sheet. The Drafting Credentialing Survey (Appendix B) was delivered to instructors after they had completed the telephone interview either by mail or email. This final survey gave instructors an opportunity to express their opinions regarding drafting certifications in a different format. Instructors were made aware that all information collected for this study would be kept completely confidential. No personal or private information about drafters, employers, instructors, colleges, or companies participating in the research would be shared or reported.

Employers

Employers identified by college drafting instructors were sent cover letters (Appendix D) via mail, contacted by telephone, and invited to participate in the research. After the study was explained to each employer and consent to participate obtained, follow-up telephone calls were scheduled for the actual survey interview. The researcher followed the Instructor/Employer Survey Protocol (Appendix A) reading the disclaimer, instructions, and every question to each employer to assure consistency in data collection. Employer responses were recorded directly on the Employer Survey Protocol sheet. Upon completion of the telephone interview employers were sent the Drafting Credentialing Survey (Appendix B) via mail or email. This final survey gave employers an opportunity to express their opinions regarding drafting certifications in a different format. Employers

were made aware that all information collected for this study would be kept completely confidential. No personal or private information about drafters, employers, instructors, colleges, or companies participating in the research was shared or reported. Once all employers completed the survey, data were compiled into tables assimilating the information into a simplified form. These data were compared to data collected from drafting instructors and the documents review.

Statistical Analysis

Statistical analyses of the survey results utilized the Statistical Package for the Social Sciences (SPSS) software. Research Questions 1, 2, and 4 (Do community college drafting instructors believe that certified drafters perform better on the job than non-certified drafters, do employers believe that certified drafters perform better on the job than non-certified drafters, and is there a difference between the perceptions of community college drafting instructors and employers of community college drafting program graduates regarding the importance of drafting certifications?) compared employer and instructor responses on the Drafting Credentialing Survey concerning their perceptions of certified and non-certified drafters. Single sample *t*-tests were conducted for each survey item and computed independently using a value of $\mu=3$ (the center of the scale) to determine the relative importance that instructors and employers assigned to each survey item. This statistical methodology is used when the standard deviation is unknown (Pallant, 2005). Research Questions 3 and 5 (Do employers seek certified individuals to fill drafting positions, and what do employers look for when hiring new drafters?) were examined by obtaining a list of desirable traits/qualities for new drafters from participating employers and from online employment postings. Desirable traits were

quantified by ranking them according to the frequency of which they were mentioned. Job qualifications or desirable qualities mentioned more often in want and were ranked higher than those mentioned less often. Actual numeric values reported from employment ads and from employers were used in data analysis.

The researcher was interested in determining if there is a difference in the perceptions of the importance of drafting certification between community college drafting instructors and employers of community college drafting program graduates (Research Question 4). Independent sample *t*-tests were used to investigate this relationship because the two groups are not related, each respondent was questioned only once, and outcome variables may be examined separate from the means (Salkind, 2004). A series of independent sample *t*-tests were conducted to explore differences between the two groups: drafting instructors and drafting supervisors. Etta square statistical procedures were employed to determine if the observed distribution frequencies could be explained by chance and to determine the effect strength of relationships between responses of drafting instructors and employers of drafters on the Drafting Credentialing Survey.

Summary

The researcher wished to investigate the perceptions of drafting instructors and drafting industry employers regarding certification. This descriptive study began with identifying and interviewing community college drafting instructors in a southwestern U.S. state. These instructors identified employers within the service area of their colleges who hired drafting graduates. These two groups represented the population from which data were collected. Additionally, a documents review of online drafting jobs within the

same state was conducted to add a layer of complexity to the data that increased the depth of understanding. Collecting data from diverse sources improved the reliability of the study and provided a more information-rich study.

Two instruments, the Instructor/Employer Survey Protocol and the Drafting Credential Survey, were developed to attain data relative to the research objectives. Single sample *t*-tests were conducted for each survey item using Statistical Package for the Social Sciences (SPSS) software to determine the relative importance that instructors and employers assigned to each survey item. Independent sample *t*-tests were also conducted to explore differences in perceptions between the drafting instructors and drafting employers.

Chapter IV will report data collected from the surveys and the documents review. Frequency tables present the raw data while appropriate tables and figures are utilized to succinctly present information gleaned from the statistical analyses conducted. Detailed explanations outlining the treatment of data and procedures utilized are also included.

CHAPTER IV

FINDINGS

A descriptive research methodology was utilized to ascertain the efficacy of drafting certification on graduates of community college drafting programs in one southeastern U.S. state. A second purpose was to determine which qualifications employers seek when hiring drafters. Instructor findings and demographics and employer findings and demographics are discussed in this chapter along with results from data collected via the drafting credentialing survey. Top drafting skills and non-drafting skills identified by drafting instructors and employers are revealed together with results from data collected from the documents review.

Instructor Findings and Demographics

Fourteen instructors from 13 different community colleges participated. The fourteen instructors had an average of 17 years of teaching experience. Three of the instructors had completed two years of teaching while the most senior participants had 37 and 39 years of teaching experience, respectively. Eleven of the instructors received their CAD training in college. All eleven of these instructors completed college degrees. One indicated a Bachelor's degree, one indicated a Master's degree, and one participant indicated a certificate of completion from a trade school in addition to his/her college training. Two participants received their training exclusively at trade schools, while one instructor was trained at an AutoCAD® training center.

The 14 community college instructors had an average of three years of experience working in industry as CAD drafters. Over half of the instructors (eight) had no CAD experience in industry. The six instructors who had worked in industry had an average of

seven years experience. Three of the participating instructors held industry recognized certifications: two from AutoDesk® and one from ADDA. Ten of the instructors were aware of at least one industry recognized certification but no instructor required students to attain certification as part of the graduation requirements for their respective programs. One instructor offered certification as an option and another "strongly recommended" that students become certified on their own. Five of the teachers stated that they may consider adding the certification requirement at some point in the future.

Employer Findings and Demographics

Sixty-four employers from the state under study were contacted and asked to participate. A total of 12 employers from 12 different companies agreed to take part in the study. This group had an average of 26 years of experience in the drafting industry. One participant did not disclose his experience, one had only 2.5 years experience, and one had 52 years of experience in industry. Ten of the 12 employers had at least 10 years of on-the-job drafting experience. Nine employers received their drafting training in college, two were trained on-the-job, one employer listed trade school in addition to college, and one employer failed to respond to the question regarding experience. Eight of the nine college trained drafting employers received a degree from their college.

None of the employers held any industry recognized drafting certification, and only one employer was aware of such certification. No employers required drafting certification as a prerequisite to hiring drafters. One employer had an in-house assessment program in place that functioned as a local certification. Drafters at this firm may participate in a four step program of advancement within the organization. The

employees must meet time on-the-job requirements and show advancement of drafting skills in order to be promoted.

Drafting Credential Survey

Instructors and employers were asked to complete the same Drafting Credential Survey. For the first section of the survey (Part 1), participants were asked to respond to 20 statements relating to drafting certification. Instructors and employers ranked their respective degrees of agreement or disagreement with each statement using a 5-point Likert-like scale. A score of 1 indicated strongly disagree, 2 indicated somewhat disagree, 3 equated to neither agree nor disagree, 4 denoted somewhat agree, and 5 signified strongly agree.

Question 1 asked to what extent respondents believed that industry recognized credentials determine the needed knowledge and skills for drafting jobs. Instructors indicated a lower mean score (M=3.08, SD=1.08) than employers (M=3.64, SD=0.67; $t(23)$=-1.45, p=0.16) indicating that instructors neither agreed nor disagreed with the statement, while employers somewhat agreed that industry recognized credentials determine the needed knowledge and skills for drafting jobs.

Question 2 asked to what extent respondents believed that industry recognized credentials make it easier to identify an applicant's knowledge and skills. Instructors indicated a lower mean score (M=3.42, SD=1.24) than employers (M=4.09, SD=0.83; $t(23)$=-1.51, p=0.14) signifying that instructors neither agree nor disagree with the statement, while employers somewhat agree that holding an industry recognized credential would make it easier to assess a job applicant's drafting skills and knowledge.

Question 3 asked to what extent respondents believed that industry recognized credentials reduce training costs for drafters. Instructors (M=3.17, SD=1.34) and employers (M=3.18, SD=0.98; $t(23)$=-0.03, p=0.98) indicated essentially equal mean scores than employers revealing that neither group believe that industry credentialing equates to lower training costs.

Question 4 asked to what extent respondents believed that industry recognized credentials increase the chance of success for a new hire. Instructors indicated a lower mean score (M=3.42, SD=1.24) than employers (M=3.82, SD=0.87; $t(23)$=-0.89, p=0.38). Instructors neither agreed nor disagreed with this statement, while employers somewhat agreed that credentials improve the chance of success for newly hired drafters.

Question 5 asked to what extent respondents believed that industry recognized credentials reduce the likelihood of turnover. Instructors indicated a lower mean score (M=3.00, SD=1.21) than employers (M=3.45, SD=1.13; $t(23)$=-0.93, p=0.36). Again, neither group had strong feelings about industry recognized credentials lowering turnover among drafting employees.

Question 6 asked to what extent respondents believed that industry recognized credentials are important to career success. Instructors indicated a lower mean score (M=3.00, SD=1.48) than employers (M=3.45, SD=0.82; $t(23)$=-0.90, p=0.38). Instructors and employers neither agreed nor disagreed that holding an industry recognized credential improved a drafter's career success.

Question 7 asked respondents to rank the importance of an applicant holding a high school diploma or GED when making a decision concerning the hiring of a new drafter. Instructors indicated a lower mean score (M=4.45, SD=0.82) than employers

(M=4.58, SD=0.79; t(23)=-0.83, p=0.71) suggesting that instructors somewhat agree that holding a high school diploma is important for drafters. Employers, who actually do the hiring of drafters, strongly agree that a high school diploma or GED is important.

Question 8 asked respondents to rank the importance of an applicant having drafting experience when making a decision concerning the hiring of a new drafter. Instructors indicated a lower mean score (M=4.45, SD=0.52) than employers (M=4.67, SD=0.65; t(23)=-0.86, p=0.40). When looking for a new drafter experience is seen as somewhat important among drafting instructors, while employers strongly agree that experience is an important asset for a drafter to possess.

Question 9 asked respondents to rank the importance of an applicant holding a 2-year vocational/technical college or community college degree when making a decision concerning the hiring of a new drafter. Instructors indicated a significantly higher mean score (M=4.90, SD=0.30) than employers (M=4.42, SD=0.51; t(23)=2.83, p=0.01). Drafting instructors in this study, who have a stake in community colleges, strongly support drafters holding a 2-year degree. Employers somewhat agree.

Question 10 asked respondents to rank the importance of an applicant holding a 4-year degree in an engineering discipline when making a decision concerning the hiring of a new drafter. Instructors indicated a higher mean score (M=3.36, SD=1.29) than employers (M=3.09, SD=1.14; t(22)=0.53, p=0.60) suggesting that neither group agrees or disagrees that a bachelors degree in engineering is of benefit to drafting graduates.

Question 11 asked respondents to rank the importance of an applicant holding any 4-year degree when making a decision concerning the hiring of a new drafter. Instructors indicated a higher mean score (M=2.73, SD=0.79) than employers (M=2.42, SD=1.08;

$t(23)=0.78$, $p=0.44$). Employers somewhat disagreed that any 4-year degree benefited drafters, while instructors neither agreed nor disagreed. Mean values for this question were lower than the values for Question 10 implying that a 4-year degree in engineering, while not very important in the consideration of hiring new drafters, is superior to a 4-year degree in other disciplines.

Question 12 asked respondents to rank the importance of an applicant holding a Master's degree when making a decision concerning the hiring of a new drafter. Instructors indicated a higher mean score ($M=2.27$, $SD=1.01$) than employers ($M=2.17$, $SD=1.19$; $t(23)=0.23$, $p=0.82$). Instructors and employers somewhat disagreed that drafters should hold a Master's degree.

Question 13 asked respondents to rank the importance of an applicant holding an industry recognized certification or credential when making a decision concerning the hiring of a new drafter. Instructors indicated a lower mean score ($M=3.10$, $SD=1.20$) than employers ($M=3.64$, $SD=0.92$; $t(21)=-1.15$, $p=0.26$) suggesting that instructors neither agreed not disagreed that a drafting certification was an asset. Employers, however, somewhat agreed that certification was of value when hiring drafters.

Questions 14 through 20 asked respondents to compare drafters holding a 2-year community college degree to those holding an industry recognized credential. Question 14 asked if respondents if they believed a drafter with an industry recognized credential would be more likely to be hired. Instructors indicated a lower mean score ($M=3.08$, $SD=1.24$) than employers ($M=3.46$, $SD=0.97$; $t(25)=-0.85$, $p=0.40$) indicating that neither group agreed or disagreed that drafting credentials were more important than a 2-year degree when making hiring decisions.

Question 15 asked if respondents if they believed a drafter with an industry recognized credential would be more likely to be paid more. Instructors indicated a lower mean score (M=3.08, SD=1.16) than employers (M=3.54, SD=1.05; $t(25)$=-1.02, p=0.32). Instructors saw no differences in the pay rate for drafters holding a drafting credential versus a 2-year degree. Employers slightly agreed that drafters holding a certificate would be paid more than those who only held the 2-year degree.

Question 16 asked if respondents if they believed a drafter with an industry recognized credential would be more likely to have a successful career. Instructors indicated a lower mean score (M=3.00, SD=1.13) than employers (M=3.08, SD=1.04; $t(25)$=-0.18, p=0.86). Instructors and employers had no strong feelings about an industry recognized credential improving a drafter's career success.

Question 17 asked if respondents if they believed a drafter with an industry recognized credential would be more likely to keep up with drafting technology. Instructors indicated a lower mean score (M=3.00, SD=1.35) than employers (M=3.15, SD=1.07; $t(25)$=-0.32, p=0.75). Neither group of respondents believed that holding a drafting credential would increase the likelihood of a drafter keeping up with technology.

Question 18 asked if respondents if they believed a drafter with an industry recognized credential would be less likely to quit their job. Instructors indicated a higher mean score (M=2.92, SD=1.00) than employers (M=2.83, SD=0.72; $t(24)$=0.24, p=0.82), however neither group expressed strong feelings about this question.

Question 19 asked respondents if they believed a drafter with an industry recognized credential would be more likely to be satisfied with their job. Instructors (M=3.00, SD=1.04) and employers (M=3.00, SD=0.91; $t(25)$=0.00, p=1.00) indicated

identical mean scores for this question. Both groups neither agreed nor disagreed that a drafting certification would improve job satisfaction.

Question 20 asked respondents if they believed a drafter with an industry recognized credential would be more likely to advance in their career. Instructors indicated a lower mean score (M=2.92, SD=1.00) than employers (M=3.23, SD=0.83; $t(25)$=-0.86, p=0.40). Again, both groups of respondents neither agreed nor disagreed that drafting certification would improve career advancement.

Fourteen of the survey items were ranked higher by employers than by instructors based on mean scores. In five cases instructors mean scores were higher than those of employers. Four of these questions (9, 10, 11, and 12) investigated the perceived importance of education for drafters. Table 4 shows all of the mean scores for both groups on each survey item.

Table 4

Mean Values of Instructors and Employers on Drafting Credentialing Survey

	Instructor		Employer	
Survey Question	N	Mean	N	Mean
To what extent do you believe that industry recognized credentials:				
1 – Determine needed knowledge for job	12	3.0833	11	3.6364
2 – Identify applicant's knowledge	12	3.4167	11	4.0909
3 – Reduces training costs	12	3.1667	11	3.1818
4 – Increases success for new hire	12	3.4167	11	3.8182
5 – Reduces turnover	12	3.0000	11	3.4545

Table 4 (continued)

Survey Question	Instructor N	Instructor Mean	Employer N	Employer Mean
How important are the following credentials in your decision to hire a new drafter?				
6 – Important to career success	12	3.0000	11	3.4545
7 – High school diploma	11	4.4545	12	4.5833

Survey Question	Instructor N	Instructor Mean	Employer N	Employer Mean
How important are the following credentials in your decision to hire a new drafter?				
8 – Drafting experience	11	4.4545	12	4.6667
9 – 2-year trades/college degree	11	4.9091	12	4.4167
10 – 4-year degree in engineering	11	3.3636	11	3.0909
11 – any 4-year degree	11	2.7273	12	2.4167
12 – Master's degree	11	2.2727	12	2.1667
13 – Industry recognized credential	10	3.1000	11	3.6364
When comparing drafters with a 2 year community college degree to those with an industry recognized credential, I believe that those with an industry recognized credential are:				
14 – More likely to be hired	12	3.0833	13	3.4615
15 – More likely to be paid more	12	3.0833	13	3.5385
16 – Likely to have successful career	12	3.0000	13	3.0769
17 – Likely to keep up w/drafting technology	12	3.0000	13	3.1538
18 – Less likely to quit job	12	2.9167	12	2.8333
19 – Likely to be satisfied with job	13	3.0000	13	3.0000
20 – Likely to advance in career	13	2.9167	13	3.2308

The second section of the Drafting Credential Survey asked participants to respond to 14 different statements relating to industry recognized drafting certification. Specifically, instructors and employers were asked to respond to survey questions reflecting their opinions related to their perceptions of the performance of certified drafters as compared to non-certified individuals. The same 5-point Likert-like scale was used as in the previous section.

Question 1 asked respondents to rate how strongly they agreed or disagreed that holding a certification recognized by the drafting industry improves graduates' probability of employment. Instructors indicated a significantly lower mean score (M=2.85, SD=1.41) than employers (M=4.00, SD=0.91; $t(26)$=-2.48, p=0.02). This shows that instructors neither agree nor disagree with the statement, while employers somewhat agree that industry certification improves a drafter's probability of finding a job.

Question 2 asked respondents to rate how strongly they agreed or disagreed that certified drafters perform better than non-certified drafters on the job. While instructors indicated a lower mean score (M=2.85, SD=1.21) than employers (M=3.15, SD=0.55; $t(26)$=-0.83, p=0.42), neither group indicated strong feelings regarding the performance of certified versus non-certified drafters.

Question 3 asked respondents to rate how strongly they agreed or disagreed that employers seek out industry certified individuals to fill drafting positions. Instructors indicated a lower mean score (M=2.62, SD=1.04) than employers (M=3.15, SD=0.99; $t(26)$=-1.35, p=0.19). Neither group of respondents agreed nor disagreed that employers look for certified drafters when hiring.

Question 4 asked respondents to rate how strongly they agreed or disagreed that drafting certifications are worth the investment of time and money. Instructors indicated a lower mean score (M=3.30, SD=1.38) than employers (M=3.69, SD=1.11; $t(26)$=-0.78, p=0.44). Instructors neither agreed nor disagreed with this statement, while employers somewhat agreed that certification was worth the time and money required.

Question 5 asked respondents to rate how strongly they agreed or disagreed that an industry recognized certification is a good measure of the drafting skill a drafter has attained. Instructors indicated a lower mean score (M=3.23, SD=1.36) than employers (M=3.77, SD=0.83; $t(26)$=-1.22, p=0.24). Instructors neither agreed nor disagreed with this statement while, employers somewhat agreed that certification was a good skills assessment tool.

Question 6 asked respondents to rate how strongly they agreed or disagreed that an industry certification is a good measure of the quality of the drafting program a drafter has completed. Instructors indicated a lower mean score (M=3.23, SD=1.36) than employers (M=3.62, SD=0.65; $t(26)$=-0.92, p=0.37). Again, instructors neither agreed nor disagreed with this statement (perhaps not wishing to be assessed by industry recognized credentialing organizations), while employers somewhat agreed that certification was a good assessment tool for measuring the quality of a drafting program.

Question 7 asked respondents to rate how strongly they agreed or disagreed that certified drafters are more proficient than non-certified drafters. Instructors indicated a lower mean score (M=2.77, SD=1.09) than employers (M=3.15, SD=0.55; $t(26)$=-1.13, p=0.27). Neither group agreed or disagreed that certified drafters were more proficient at drafting than non-certified drafters.

Question 8 asked respondents to rate how strongly they agreed or disagreed that certified drafters demonstrate better drafting skills than non-certified drafters. Instructors indicated a significantly lower mean score (M=2.69, SD=1.11) than employers (M=3.62, SD=0.65; $t(26)$=-2.59, p=0.02) indicating that drafting instructors neither agreed nor disagreed with this statement, while employers somewhat agreed that certified drafters show better drafting skills than their non-certified counterparts.

Question 9 asked respondents to rate how strongly they agreed or disagreed that certified drafters are better workers than non-certified drafters. Instructors indicated a lower mean score (M=2.46, SD=1.33) than employers (M=2.92, SD=0.76; $t(26)$=-1.09, p=0.29) indicating that instructors somewhat disagreed that certified drafters were better workers. Employers indicated that they neither agreed nor disagreed with this statement.

Question 10 asked respondents to rate how strongly they agreed or disagreed that certified drafters demonstrate better work habits than non-certified drafters. Instructors indicated a lower mean score (M=2.46, SD=1.20) than employers (M=2.85, SD=0.80; $t(26)$=-0.96, p=0.35). Instructors somewhat disagreed that certified drafters demonstrate better work habits than their non-certified colleagues. Employers indicated that they neither agreed nor disagreed with this statement.

Question 11 asked respondents to rate how strongly they agreed or disagreed that certified drafters complete assignments faster than non-certified drafters. Instructors indicated a lower mean score (M=2.69, SD=1.18) than employers (M=2.92, SD=0.49; $t(26)$=-0.65, p=0.53), however instructors and employers neither agreed nor disagreed that certified drafters demonstrate better work habits than non-certified drafters.

Question 12 asked respondents to rate how strongly they agreed or disagreed that certified drafters have better problem solving skills than non-certified drafters. Instructors indicated a lower mean score (M=2.46, SD=1.27) than employers (M=3.08, SD=0.76; $t(26)$=-1.50, p=0.15). Instructors somewhat disagreed that certified drafters had better problem solving skills than non-certified drafters. Employers indicated that they neither agreed nor disagreed with this statement.

Question 13 asked respondents to rate how strongly they agreed or disagreed that certified drafters work better as part of a team than non-certified drafters. Instructors indicated a lower mean score (M=2.31, SD=1.32) than employers (M=3.00, SD=0.91; $t(26)$=-1.56, p=0.13). Instructors somewhat disagreed that certified drafters were better team players than non-certified drafters. Employers neither agreed nor disagreed with this statement.

Question 14 asked respondents to rate how strongly they agreed or disagreed that certified drafters are better leaders than non-certified drafters. Instructors indicated a lower mean score (M=2.38, SD=1.19) than employers (M=3.00, SD=0.91; $t(26)$=-1.48, p=0.15). Instructors somewhat disagreed that certified drafters are better leaders than non-certified drafters. Employers indicated that they neither agreed nor disagreed with this statement.

Employer mean scores were higher than instructor mean scores for every item in this section. The largest differences in mean scores appeared on two statements: employer and instructor attitudes concerning industry recognized drafting certification improving program graduates' probability of attaining employment (instructor mean = 2.8462, employer mean = 4.0000), and certified drafters drafting skills being better than

non-certified drafters (instructor mean = 2.6923, employer mean = 3.6154). Table 5 details the mean scores of both groups for each statement.

Table 5

Mean Values of Instructors and Employers on Certified Drafters

Survey Question	Instructor N	Instructor Mean	Employer N	Employer Mean
1 – Certification improves probability of employment	13	2.8462	13	4.0000
2 – Certified drafters perform better than non-certified drafters	13	2.8462	13	3.1538
3 – Employers seek certified individuals	13	2.6154	13	3.1538
4 – Certifications are worth the time and money	13	3.3077	13	3.6923
5 – Certification is good measure of drafting skill	13	3.2308	13	3.7692
6 – Certification is a good measure of quality of a drafting program	13	3.2308	13	3.6154
7 – Certified drafters are more proficient	13	2.7692	13	3.1538
8 – Certified demonstrate better drafting skills than non-certified drafters	13	2.6923	13	3.6154
9 – Certified drafters are better workers	13	2.4615	13	2.9231
10 – Certified drafters have better work habits	13	2.4615	13	2.8462
11 – Certified drafters complete assignments faster than non-certified drafters	13	2 6923	13	2.9231
12 – Certified drafters are better problem solvers than non-certified drafters	13	2.4615	13	3.0769
13 – Certified drafters are better as part of a team	13	2 3077	13	3.0000
14 – Certified drafters are better leaders	13	2.3846	13	3.0000

Independent sample *t*-tests were conducted to determine if there was a difference in the perceptions of the importance of drafting certification between community college drafting instructors and employers of community college drafting program graduates (Research Question 4) based on responses to the survey questions on the Drafting Credential Survey. There were few meaningful differences in scores for instructors and employers. Only three survey questions produced significant results; one significant result on Part 1 of the survey and two significant results on Part 2. Equal variances were assumed for all survey questions except for Question 9 on Part 1 of the survey.

Part 2 of the Drafting Credential Survey revealed a significant result for Question 1 stating that holding an industry recognized certification improves graduates probability of attaining employment. Instructors indicated a lower mean score (M=2.85, SD=1.41) than employers (M=4.00, SD=0.91; $t(24)$=-2.48, p=0.02). A significant result was also seen for Question 8 stating that certified drafters have better drafting skills than their non-certified counterparts. Instructors again indicated a lower mean score (M=2.69, SD=1.11) than employers (M=3.62, SD=0.65; $t(24)$=-2.59, p=0.02). Values for all survey questions are reported in Table 6 (Part 1 of the Drafting Credential Survey) and Table 7 (Part 2).

The effect size or strength of association that indicates the relative magnitude of association of the differences between means was calculated using etta square. The researcher was interested in determining whether the difference between the groups (instructors and employers) was statistically significant and not likely to have occurred by chance. An etta square score of .01 is considered a small effect, a score of .06 is a moderate effect, and a score of .14 is a large effect (Cohen, 1988). On the first section of the Drafting Credential Survey only one large effect was found (r=0.28) on Question 9

regarding the importance of 2-year vocational/technical college or 2-year community college degree in impacting the decision to hire drafters. On the Part 2 of the survey

Table 6

Mean Values of Instructors and Employers on Drafting Credentialing Survey

Survey	Instructor			Employer				
Item	N	Mean	SD	N	Mean	SD	*t*	*p*
1	12	3.08	1.08	11	3.64	0.67	-1.45	0.16
2	12	3 42	1.24	11	4.09	0.83	-1.51	0.14
3	12	3 17	1.34	11	3.18	0.98	-0.03	0.98
4	12	3 42	1.24	11	3.82	0.87	-0.89	0.38
5	12	3.00	1.21	11	3.45	1.13	-0.93	0.36
6	12	3.00	1.48	11	3.45	0.82	-0.90	0.38
7	11	4.45	0.82	12	4.58	0.79	-0.83	0.71
8	11	4.45	0.52	12	4.67	0.65	-0.86	0.40
9	11	4.90	0.30	12	4 42	0.51	2.83	**0.01***
10	11	3.36	1.29	11	3.09	1.14	0.53	0.60
11	11	2.73	0.79	12	2.42	1.08	0.78	0.44
12	11	2.27	1.01	12	2.17	1.19	0.23	0.82
13	10	3.10	1.20	11	3.64	0.92	-1.15	0.26
14	12	3.08	1.24	13	3.46	0.97	-0.85	0.40
15	12	3.08	1.16	13	3.54	1.05	-1.02	0.32
16	12	3.00	1.13	13	3.08	1.04	-0.18	0.86
17	12	3.00	1.35	13	3.15	1.07	-0.32	0.75
18	12	2.92	1.00	12	2.83	0.72	0.24	0.82
19	12	3.00	1.04	13	3.00	0.91	0.00	1.00
20	12	2 92	1.00	13	3.23	0.83	-0.86	0.40

*denotes a significant difference between instructor and employer perceptions

Table 7

Mean Values of Instructors and Employers on Drafting Credentialing Survey 2

Survey	Instructor			Employer				
Item	N	Mean	SD	N	Mean	SD	*t*	*p*
1	13	2.85	1.41	13	4.00	0.91	-2 48	**0.02***
2	13	2.85	1.21	13	3.15	0.55	-0.83	0.42
3	13	2.62	1.04	13	3.15	0.99	-1.35	0.19
4	13	3.30	1.38	13	3.69	1.11	-0.78	0.44
5	13	3.23	1.36	13	3.77	0.83	-1.22	0.24
6	13	3.23	1.36	13	3.62	0 65	-0.92	0.37
7	13	2.77	1.09	13	3.15	0.55	-1.13	0.27
8	13	2.69	1.11	13	3.62	0 65	-2.59	**0.02***
9	13	2.46	1.33	13	2.92	0.76	-1.09	0.29
10	13	2.46	1.20	13	2.85	0.80	-0.96	0.35
11	13	2.69	1.18	13	2.92	0.49	-0.65	0.53
12	13	2.46	1.27	13	3.08	0.76	-1.50	0.15
13	13	2.31	1.32	13	3.00	0.91	-1.56	0.13
14	13	2.38	1.19	13	3.00	0 91	-1.48	0.15

*denotes a significant difference between instructor and employer perceptions

two large effects were indicated. Question 1 relating to drafting certification improving the probability of finding employment, an etta square score of 0.20 was found. Question 8 stating that certified drafters demonstrate better drafting skills than their non-certified counterparts had an effect size of 0.22. Twelve of 34 survey questions received a moderate effect (r=0.04 to 0.09). The remaining 20 items indicated a small effect (etta square values of 0.00 to 0.03). All etta square values are reported in Table 8 (Part 1 of the survey) and Table 9 (Part 2).

Table 8

Effect Size of Responses on Drafting Credentialing Survey

Survey Statement	Etta Square	Effect Size
To what extent do you believe that industry recognized credentials:		
1 – Determine needed knowledge for job	0.08	Moderate
2 – Identify applicant's knowledge	0.09	Moderate
3 – Reduces training costs	0.00	Small
4 – Increases success for new hire	0.04	Moderate
5 – Reduces turnover	0.04	Moderate
How important are the following credentials in your decision to hire a new drafter?		
6 – Important to career success	0.04	Moderate
7 – High school diploma	0.01	Small
8 – Drafting experience	0.03	Small
9 – 2-year trades/college degree	0.28	Large
10 – 4-year degree in engineering	0.01	Small
11 – any 4-year degree	0.03	Small
12 – Master's degree	0.00	Small
13 – Industry recognized credential	0.02	Small
When comparing drafters with a 2 year community college degree to those with an industry recognized credential, I believe that those with an industry recognized credential are:		
14 – More likely to be hired	0.03	Small
15 – More likely to be paid more	0.04	Moderate
16 – Likely to have successful career	0.00	Small
17 – Likely to keep up w/drafting technology	0.00	Small
18 – Less likely to quit job	0.00	Small
19 – Likely to be satisfied with job	0.00	Small
20 – Likely to advance in career	0.03	Small

Table 9

Effect Size Between Instructors and Employers

Survey Statement	Etta Square	Effect Size
1 – Certification improves probability of employment	0.20	Large
2 – Certified drafters perform better than non-certified drafters	0.03	Small
3 – Employers seek certified individuals	0.07	Moderate
4 – Certifications are worth the time and money	0.02	Small
5 – Certification is good measure of drafting skill	0.02	Small
6 – Certification is a good measure of quality of a drafting program	0.03	Small
7 – Certified drafters are more proficient	0.01	Small
8 – Certified demonstrate better drafting skills than non-certified drafters	0.22	Large
9 – Certified drafters are better workers	0.05	Moderate
10 – Certified drafters have better work habits	0.04	Moderate
11 – Certified drafters complete assignments faster than non-certified drafters	0.02	Small
12 – Certified drafters are better problem solvers Than non-certified drafters	0.09	Moderate
13 – Certified drafters are better as part of a team	0.09	Moderate
14 – Certified drafters are better leaders	0.08	Moderate

Top Drafting Skills Identified by Instructors and Employers

Drafting instructors and employers were asked to identify the top drafting skills needed by drafters in order to be effective on the job. Participants were asked to list and

rank their top five choices from one (the most important skill) to five (the fifth most important skill). Eleven different drafting skills were identified by drafting instructors as the most important skill drafters should possess. The aptitudes of CAD skills, hand or board drafting, accuracy/attention to detail, and sketching ability were each identified by two instructors. Knowledge of standards/conventions, views/visualize in 3D, set up drawings, computer skills, quality, dependable, and building construction/materials were identified by one instructor each. The complete list of drafting skills identified by instructors as the most important is detailed in Table 10.

Table 10

Top Drafting Skill Identified by Drafting Instructors (n=14)

Drafting Skill	Frequency
CAD skills	2
Hand or board drafting	2
Accuracy/attention to detail	2
Sketching ability	2
Knowledge of standards/conventions	1
Views/visualize in 3D	1
Set up drawings	1
Computer skills	1
Quality	1
Dependable	1
Building construction/materials	1

Employers of drafters identified nine different drafting skills as the most important characteristic that should be possessed by drafters. Views/visualization in 3D

was the most often mentioned drafting skill needed by drafters according to three employers. CAD skills, knowledge of standards/conventions, education/training, print reading, multi-tasking, output, line weights, and learn how to learn were each mentioned once. The complete list of drafting skills identified by employers as being most important is detailed in Table 11.

Table 11

Top Drafting Skill Identified by Employers of Drafters (n=12)

Drafting Skill	Frequency
Views/visualize in 3D	3
CAD skills	1
Knowledge of standards/conventions	1
Education/training	1
Print reading	1
Multi-tasking	1
Output	1
Line weights	1
Learn how to learn	1

The term "CAD skills" was mentioned by members of both groups as the top ranked skill that drafters need in order to be successful on the job. Two instructors and one employer believed that CAD skills were the most important drafting skill. Knowledge of drafting standards or knowledge of drafting conventions was cited by one instructor and one employer as the top skill required. Understanding views and the ability

to visualize in 3D was also mentioned by one instructor and one employer. Seventeen other drafting skills were named by one instructor or one employer to round out the list. A total of 21 drafting skills received a ranking of one from both groups as the top drafting skill necessary for drafters to possess.

The term "CAD skills" was mentioned by ten instructors and three employers as one of the top five drafting skills needed by drafters in industry, making it the most cited of all drafting skills. Dimensioning/annotation was mentioned by nine different instructors, but no employers. Accuracy/attention to detail was listed by six instructors and one employer making it the third most mentioned drafting skill. Hand or board drafting was selected by three instructors and three employers. Seventeen drafting skills identified by two or more individual instructors or employers are listed in Table 12. The complete list of the 46 drafting skills and the rank of importance each skill was assigned by instructors and employers is detailed in Table 13.

Top Non-Drafting Skills Identified by Instructors and Employers

Ten different non-drafting skills were identified by drafting instructors as the most important soft skill that drafters should possess. Being a team player was cited by two instructors as the top non-drafting skill. Communication, attention to detail, and conduct research also received two votes each. People skills/deal with customers, punctuality/promptness, open-minded, patient, self-initiative/drive, spreadsheet, and conduct research each received one vote by instructors as the top non-drafting skill that drafters should exhibit on the job. The complete list of non-drafting skills identified by instructors as most important is detailed in Table 14.

Table 12

Top Drafting Skills Identified by Instructors and Employers of Drafters

Drafting Skill	Overall Frequency	Instructors	Employers
CAD skills	13	10	3
Dimensioning/annotation	9	9	0
Accuracy/attention to detail	7	6	1
Hand or board drafting	6	3	3
Views/visualize in 3D	5	2	3
Knowledge of standards/conventions	5	4	1
Speed/time	5	2	3
Sketching ability	4	4	0
Multiview/orthographic projection	4	4	0
Communication	4	1	3
Education/training	3	0	3
Math skills	3	1	2
Experience	3	1	2
Computer skills	2	1	1
Dependable	2	1	1
Knowledge/technical[ly] savvy	2	2	0
Parametric modeling	2	2	0

Employers of drafters identified six different traits as the single most important non-drafting skill that should be possessed by drafters. People skills/deal with customers was the most often mentioned non-drafting skill needed by drafters according to five different employers. Communication, problem solving skills, self initiative/drive, understand product/process, and math skills were named as non-drafting skills required of drafters receiving one vote each. A complete list of non-drafting skills identified by employers as being most important is detailed in Table 15.

Table 13

Drafting Skills Ranked by Instructors and Employers

Attribute	Grand total	Instructors					Instructor total	Employers					Employer total
		Rank Assigned						Rank Assigned					
		1	2	3	4	5		1	2	3	4	5	
CAD Skills	13	2	1	2	4	1	10	1	1		1		3
Dimensioning/Annotation	9		3	3	1	2	9						0
Accuracy/Attention to Detail	7	2	1	1	1	1	6					1	1
Hand or Board Drafting	6	2	1				3		1	1	1		3
Knowledge of Standards/Conventions	5	1	2	1			4	1					1
Speed/Time	5		2				2			1	2		3
Views/Visualize in 3D	5	1	1				2	3					3
Communication	4			1			1		1		1	1	3
Sketching Ability	4	2	1			1	4						0
Multi-View/Orthographic Projection	4		2	1	1		4						0
Math Skills	3					1	1		1	1			2
Experience	3					1	1		1			1	2
Education/Training	3						0	1			1	1	3
Knowledge/Technical Saavy	2		1	1			2						0
Parametric Modeling	2				1	1	2						0
Computer Skills	2	1					1			1			1
Dependable	1	1					1						0
Quality	1	1					1						0
Set Up Drawings	1	1					1						0
Fast Learner	1		1				1						0
Learn How to Learn	1						0	1					1
Degrees (Arcs)	1			1			1						0
Abbreviations	1			1			1						0
Assemblies	1					1	1						0
Ability to Detail	1					1	1						0
Versatility	1				1		1						0
Neatness	1					1	1						0
Thorough	1						0			1			1
Dependable	1						0			1			1
Multi-Tasking	1						0	1					1
Print Reading	1						0	1					1
Output	1						0	1					1
Line Weights	1						0	1					1
Building Construction/Materials	1	1					1						0
Rapid Prototyping	1					1	1						0
Understand Item Being Drawn	1						0				1		1
Mechanical Comprehension	1						0		1				1
Understand 2D Work	1			1			1						0

Table 14

Top Non-Drafting Skill Identified by Drafting Instructors

Drafting Skill	Frequency
Team player	2
Communication	2
Attention to detail	2
People skills	1
Punctuality/promptness	1
Open minded	1
Patient	1
Self initiative/drive	1
Spreadsheet	1
Conduct research	1

Table 15

Top Non-Drafting Skill Identified by Employers of Drafters

Drafting Skill	Frequency
People skills/deal with customers	5
Communication	1
Problem solving	1
Self initiative/drive	1
Understand product/process	1
Math Skills	1

The attribute of team player received a total of 12 responses as an important soft skill that drafters should possess. It was the most often mentioned non-drafting skill in the overall survey with nine instructors and three employers voting for this skill. Communication was the second most named non-drafting skill needed by drafters with four instructors and four employers naming it. Problem solving and people skills/dealing with customers garnered seven votes each, and self initiative/self-starter/drive earning six votes. Time management was mentioned four times, followed by attention to detail, punctuality/promptness, Microsoft, and listen/follow directions with three votes each. Eight soft skills were named by two instructors and/or employers as being a top five non-drafting skill important to drafters. A total of eighteen skills received one vote from instructors and employers in this category. Non-drafting skills receiving more than one vote are presented in Table 16. The complete list of the 36 non-drafting skills and the rank of importance each skill was assigned by instructors and employers is detailed in Table 17.

Documents Review

A documents review was conducted using the online job search site CareerBuilder.com. Searches for jobs within the entire state under study were performed under the job category of engineering utilizing the search terms: CAD, CADD, AutoCAD®, drafter, CAD drafter, CAD designer, CAD operator, CAD technician, and CAD manager. Sixty-one jobs were identified during the week long (7 days) search. The majority of the jobs did not fall under the category of CAD drafters. Some jobs were in the medical field using the acronym CAD to represent Coronary Artery Disease. Many of the positions required Professional Engineer (PE) licensure, qualifications well beyond

the credentials of community college drafting graduates. Seventeen drafting jobs were identified that fit the criterion for 2-year drafters.

Twenty-three different qualifications were named in the job postings. The broad term "experience" was named by 12 potential employers. Most employers (4) wanted two years of experience from job applicants. Three years of experience was mentioned twice,

Table 16

Top Non-Drafting Skills Identified by Instructors and Employers of Drafters

Drafting Skill	Overall Frequency	Instructors	Employers
Team player	12	9	3
Communication	8	4	4
Problem solving	7	3	4
People skills/deal[s] with customers	7	2	5
Self initiative/Self starter/drive	6	5	1
Time management	4	2	2
Attention to detail	3	3	0
Punctuality/promptness	3	3	0
Drive/motivation	3	2	1
Microsoft [Office®]	3	2	1
Listen/follow directions	3	3	0
Conduct research	2	2	0
Understand product/project	2	1	1
Math skills	2	1	1
Open minded	2	2	0
Respect co-workers	2	1	1
Positive attitude	2	1	1
Ask[s] questions	2	0	2
Organization	2	0	2

Table 17

Non-Drafting Skills Ranked by Instructors and Employers

Attribute	Grand Total	Instructors					Instructor total	Employers					Employer total
		Rank Assigned						Rank Assigned					
		1	2	3	4	5		1	2	3	4	5	
Team Player	12	2	2	2	1	2	9	1		1		1	3
Communication	8	2	1	1			4		2	2			4
Problem Solving	7			2	1		3	1	2		1		4
People Skills/ Deal With Customers	7	1		1			2	5					5
Self-Initiative/ -Starter/Drive	6	1	2	1	1		5	1					1
Time Management	4			1		1	2			2			2
Attention to Detail	3	2			1		3						0
Punctuality/Promptness	3	1	1		1		3						0
Microsoft	3		1			1	2		1				1
Listen/Follow Directions	3		1	2			3						0
Conduct Research	2	1				1	2						0
Understand Product/Process	2		1				1	1					1
Math Skills	2			1			1	1					1
Open Minded	2	1				1	2						0
Respect Co-Workers	2		1				1					1	1
Positive Attitude	2					1	1				1		1
Ask Questions	2						0		1	1			2
Organization	2						0		1		1		2
Patient	1	1					1						0
Spreadsheet	1	1					1						0
Comprehension	1						0		1				1
Courteous	1		1				1						0
Practice	1		1				1						0
CAD Skills	1		1				1						0
Reliable	1			1			1						0
Critical Thinking	1			1			1						0
Work Independently	1				1		1						0
Public Speaking/Presentation	1				1		1						0
Risk Taker	1				1		1						0
Employment of Job	1				1		1						0
Sense of Economic Impact	1				1		1						0
Honest	1						0				1		1
Appearance	1					1	1						0
Dedicated to Company/Job	1					1	1						0
Continuous Professional Development	1					1	1						0
Don't Worry About Money	1					1	1						0

and 6 years or 7-10 years was mentioned by two of the ads. Specific types of experience (electrical, design, and multi-family residential) were mentioned by four postings. Proficiency in CAD or AutoCAD® was mentioned 11 times, and an education requirement was noted by six employers. Three firms required Associate's degrees and three required Bachelor's degrees from their drafting applicants. Communication and presentation skills were mentioned four times in the listings. A complete list of all required skills found in the documents review may be found in Table 18 on the following page.

Table 18

Skill Identified in the Online Document Review

Drafting Skill	Detail Frequency	Overall Frequency
Experience		12
2 years	4	
3 years	2	
6 years	1	
7-10 years	1	
Experience in Electrical	2	
Experience in Design	1	
Multi-Family Residential	1	
Proficient in CAD or AutoCAD®		11
College Degree		6
AAS degree	3	
4-Year degree	3	
Communication/ Presentation Skills		4
3 D CAD		3

Table 18 (continued)

Skill Identified in the Online Document Review

Drafting Skill	Detail Frequency	Overall Frequency
Revit		3
Problem solving or Analytical		3
Multi-tasking		3
U.S. Citizen		2
Department of Defense Clearance		2
ASME Y14 Drafting Standards		2
Microsoft Office		2
SolidWorks(R) or Inventor		2
Background Check/Drug Screen		1
Knowledge of Military Standards		1
Organized		1
Team Member		1
Self-motivated		1
Time/Deadline Oriented		1
Punctual		1
Advanced Commands		1
Know Multiple Drafting Applications		1
Customer Service		1

Fourteen drafting instructors from 13 different community colleges and 12 employers from 12 different companies participated in this study that investigated the effect of drafting certification on graduates of community college drafting programs in one southeastern U.S. state. Each group completed the same two-part Drafting Credential Survey. Independent sample *t*-tests were conducted to determine if there was a difference

in the perceptions of the importance of drafting certification between the groups. On the first section only Question 9, which asked respondents to rank the importance of an applicant holding a 2-year vocational/technical college or community college degree when making a decision concerning the hiring of a new drafter, indicated a significantly higher mean score (M=4.90, SD=0.30) than employers (M=4.42, SD=0.51; $t(23)$=2.83, p=0.01).

On the second section of the survey two questions yielded significant findings. Question 1 asked respondents to rate how strongly they agreed or disagreed that holding a certification recognized by the drafting industry improves graduates' probability of employment. Instructors indicated a significantly lower mean score (M=2.85, SD=1.41) than employers (M=4.00, SD=0.91; $t(26)$=-2.48, p=0.02). Question 8 asked respondents to rate how strongly they agreed or disagreed that certified drafters demonstrate better drafting skills than non-certified drafters. Instructors indicated a significantly lower mean score (M=2.69, SD=1.11) than employers (M=3.62, SD=0.65; $t(26)$=-2.59, p=0.02). Employer mean scores were higher than instructor mean scores for every question in section two. Large etta square effects indicating the relative magnitude of association of the differences between means were found for all three of these questions.

When asked to identify the single most important drafting skill a drafter should possess community college drafting instructors indicated the aptitudes of CAD skills, hand or board drafting, accuracy/attention to detail, and sketching ability most frequently. These four skills were each identified by two distinct instructors. Views/visualization in 3D was the most often mentioned drafting skill needed by drafters according to employers.

Being a team player, communication, attention to detail, and the ability to conduct research were cited by two instructors each as the top non-drafting skill required by new drafters. Five employers named people skills as the top non-drafting skill needed by beginning drafters. The documents review indicated that experience and proficiency in CAD are the most often mentioned entry levels skills required by employers.

Chapter V will summarize the study and findings for each Research Question in detail. Conclusions drawn from the data will be discussed and recommendations for the industry and for further research will be proposed.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the perceived effect of industry recognized drafting certification on job performance among drafting instructors within a southeastern U.S. state community college system and drafting industry employers from the same state. Five research questions were developed to investigate whether or not drafting instructors and employers of drafters believe that certified drafters perform better than their non-certified counterparts (RQ 1 and 2), whether or not employers seek certified individuals when hiring drafters (RQ 3),whether or not there is a difference in the perceptions of these two groups concerning certifications (RQ 4), and what drafting skills and non-drafting skills employers look for when hiring drafters (RQ 5).

A summary of the study follows, followed by conclusions gleaned from the data itemized according to the five Research Questions. Finally recommendations based on the findings are proposed, along with suggestions for future research.

Summary

The Perkins Act of 2006 mandates that institutions of higher education offer career and technical education (CTE) courses "that lead to technical skill proficiency, an industry recognized credential, a certificate or degree" (Brustein, 2006, p. 14). This mandate has led to a surge in certification purveyors seeking to capitalize on the perceived need among educational programs. This manufactured demand is financially beneficial to those providing certification, but there is little evidence to show that students, programs, or industry receives any benefit from certification. No research is

presented in the Perkins Act to support the presumption that industry certification is a valid indicator of effective instruction or of student learning across all professions, including drafting. The purpose of this study was to fill this gap in research by determining the perceived effect of drafting industry certification on job performance among drafting instructors within a southeastern U.S. community college system and drafting industry professionals.

Legislators are demanding more accountability for recipients of government funds and one method for measuring accountability in education is the attainment of a certificate by program completers. A certification component was first introduced through the School-to-Work opportunities Act of 1994 (CFDA No. 84.278) with the newly defined term "skill certificate" as:

> ...a portable, industry-recognized credential issued by a School-to-Work Opportunities program under an approved State plan, that certifies that a student has mastered skills at levels that are at least as challenging as skill standards endorsed by the National Skill Standards Board established under the National Skill Standards Act of 1994, except that until such skill standards are developed, the term "skill certificate" means a credential issued under a process described in the approved State plan (United States Code, 1994, § 6103, Definitions, #22).

The School-to-Work Act (STW) was built into the 1990 Perkins Act by creating articulated programs that link academics and vocational/CTE content. The Core Performance Indicator Plan of STW states, "All youth earn a high school diploma or equivalency tied to challenging academic standards, have the opportunity to receive a skills certificate, and are prepared for postsecondary education and careers" (School to

Work Opportunities Act, 1994, Chapter 410-8, Objective 2). The skills certificate outlined in 1994 has evolved into specific credentialing and postsecondary certificates or degrees.

There are no industry, state, or federally mandated licensure or certification requirements associated with the drafting profession. There are, however, four fairly well known certifying organizations. It is important to note that being well known does not mean there is research evidence of the quality of the certification or of industry acceptance. These include: Brainbench, an inexpensive online test, of the National Occupational Competency Testing Institute (NOCTI), AutoDesk,® and the American Design Drafting Association (ADDA), SolidWorks.® Each certifying organization claims that its certification gives completers a reliable validation of their skills and knowledge and can lead to accelerated professional development, improved productivity, and enhanced credibility. None of the groups, however, provide any data or evidence to support these claims.

The U.S. Department of Education and U.S. Department of Labor (1996) developed a set of voluntary skill standards for twenty-two different industries. Each of the projects identified what workers should know and be able to do to qualify for beginning-to-expert level occupations in various sectors of our nation's economy. The CADD skill standards document states that CADD instruction:

> ...represents skills that are core to all CADD disciplines, generic to all software and entry levels. The standards include: fundamental drafting skills; fundamental computer skills; basic CADD skills; advanced CADD skills; related academic skills in communication, math, and science; employability skills; tools and

> equipment for CADD training; recommended hours of instruction; and qualifications of the instructor. (p. 16)

These are very general standards, typical of most efforts to identify a skill set for drafters. In fact, the drafting industry is so diverse that it would be very difficult to produce a reliable and valid set of such skills.

While the efficacy of industry recognized certifications is questionable in the field of drafting and in many other areas, other disciplines rely heavily upon certifications to measure the competency or skill levels of industry practitioners. The Information Technology field has built a certification program that assures an acceptable level of competence for those working in the industry (Dean, 2001). Microsoft® certification is a well known and respected business certification. Others include the Society of Automotive Engineers (SAE), who focus on aerospace, construction, and motor vehicle standards (Society of Automotive Engineers, 2008), and the IEEE (formerly the Institute of Electrical and Electronic Engineers, Inc.) that has a Standards Association (ISEE-SA) who develops industry standards in a broad-range of industries such as power and energy, information technology, telecommunications, transportation, medical and healthcare, nanotechnology, and green technology (IEEE, 2011), the American Society of Mechanical Engineers (ASME), and The National Association of Manufacturing (NAM) which has built a certification model based upon the framework of competencies for the advanced manufacturing industry from the Department of Labor, Education, and Training Administration.

In 2006 there were approximately 253,000 drafting jobs in the United States with architectural and civil drafters holding 46% of the positions. Mechanical drafters

composed 31% of the drafting workforce and electrical and electronic drafters comprised another 14% of the jobs (Bureau of Labor Statistics, 2007). Job growth in these occupations is expected to be about 6% through 2016 which is lower than the national average for all occupations. Opportunities should be best for individuals with at least two years of postsecondary training in a drafting program that provides strong technical skills and considerable experience with CADD systems (Bureau of Labor Statistics, 2007).

Attaining this training at a community college is becoming more difficult as one of the trends is the closing of drafting programs at community colleges. Four community colleges in the state under study have closed or plan to eliminate their drafting and design programs among the 23 community colleges in that state. This is an interesting development given the projected 6% growth in need for qualified drafters and the relatively high salary garnered by drafters. In May of 2006 the median income for all drafters was between $42,000 and $47,000 annually (Bureau of Labor Statistics, 2007).

Civil drafting is the biggest expansion area in CAD. The advent of global positioning systems and electronic data collection has changed the way civil engineers and surveyors design structures and map topography. Mapping is not limited to terrain. Neuro-mapping, creating three dimensional maps of the nervous system, is helping drug companies discover how drugs move throughout the body and precisely how the drugs function. Elsewhere in the biotechnology arena software is being developed that convert MRI imagery to point data and point data to CAD. These three dimensional scans can help create customized prosthetic devices that fit individual patients exactly. The medical industry uses CAD software to build artificial limbs and joints, create laboratory equipment and diagnostic machinery, and design simulations where doctors or doctors in

training can take virtual tours of the human body or practice procedures in a simulated environment without risking the health of actual patients (Levy, J., personal communication, March 13, 2009).

The integration of CAD drawings into computer graphics affords many simulation opportunities. For instance the army has used computer simulations in their training exercises for some time. Today's CAD and graphics technology allow realistic training over terrain that has been scanned and mapped to a high degree of accuracy. Accurate hardware and military equipment can also be inserted into these simulations using the same technology.

Two instruments were developed to attain data relative to the research objectives: the Instructor/Employer Survey Protocol and the Drafting Credential Survey. These instruments sought information from community college drafting instructors and employers of community college drafting program graduates regarding their awareness of industry recognized drafting certifications and their attitudes toward such credentials. Each instrument included open-ended and closed questions regarding skills, training, and knowledge that instructors and employers believe that trained drafters should possess.

Data for this research were collected from drafting instructors, employers of drafters, and online job listings (documents review). The online documents review was conducted to identify desirable drafting and non-drafting skills from additional employers (those who may not have been contacted or invited to participate in the study) from across the state under study who were seeking to hire new drafters. Sixty-one online CAD related jobs were found within the state under study. This list was pared down to seventeen jobs that fit the criterion for community college drafting graduates. Drafting

instructors at community colleges across the state were interviewed and surveyed to ascertain their views concerning the importance of industry recognized certifications. Employers who hire community college drafting program graduates were also interviewed and their views on certification were recorded and compared to those of drafting instructors. Fourteen instructors from 13 different community colleges and 12 employers from 12 different companies participated in the study.

Conclusions

Research Question 1 polled community college drafting instructors to see if they believed that certified drafters perform better on the job than non-certified drafters. Questions 3, 4, 5, 6, 14, 15, 17, 18, 19, and 20 on Part 1 and all 14 questions on Part 2 of the survey were used to answer Research Question 1. Mean scores for 19 of the 24 survey items fell within plus or minus 0.5 points of the neutral score of 3 (2.5 to 3.5) indicating that, on average, most community college drafting instructors did not have strong feelings either way regarding these survey statements. Two instructors, however, appear to have strong opinions about the survey items: one instructor rated all survey items at the highest level possible (5), while another gave all survey items the lowest possible score of one. Five of the questions revealed mean values below the mid-point range of neutral indicating instructors somewhat disagreed with the statements. Questions 9, 10, and 12 had identical mean values of 2.4615 (n=13). These three questions fell only 0.0385 below the 2.5 point neutral range. The three questions stated that certified drafters are better workers (Question 9), had better work habits (Question 10), and were better at problem solving (Question 12) than their non-certified counterparts. Two questions indicated

4.0000, Question 4 (drafting certifications are worth the investment of time and money) *M*=3.6923, Question 5 (an industry recognized certification is a good measure of the drafting skill a drafter has attained) *M*=3.7692, Question 6 (an industry recognized certification is a good measure of the quality of the drafting program a drafter has completed) *M*=3.6154, and Question 8 (certified drafters demonstrate better drafting skills than non-certified drafters) *M*=3.6154. No mean values were found among these questions indicating employers strongly disagreed, somewhat disagreed, or strongly agreed with the statements presented. These data indicate that employers do not believe that certified drafters perform better on the job than non-certified drafters.

Questions 1, 2, 13, and 14 on Part 1 and Questions 2, 3, and 4 on Part 2 of the Drafting Credentialing Survey, along with Questions 2b, 2f, 2g, 3, and 4 on the Instructor/Employer Survey Protocol, were used to address Research Question 3 which asked if employers seek CAD certified individuals to fill drafting positions. Question 1 (industry recognized credentials determine the knowledge and skills for drafting jobs) yielded a mean value among employers of 3.6364 (N=11) indicating that employers somewhat agree that a certificate would be of value in assessing an applicant's drafting knowledge and skill. Question 2 (industry recognized credentials make it easier to identify an applicant's knowledge and skills) received a mean score of 4.0909 (N=11) suggesting that employers might use a drafting certification as a quick means of assessing an applicant's qualifications.

When asked to rank the importance of industry recognized certifications or credentials when hiring a new drafter (Question 13) the employers' mean score was 3.6364 on the 5-point scale. This indicates that employers find industry recognized

certifications somewhat important. Question 14 asked employers if certified drafters were more likely to be hired than their non-certified counterparts. The mean score for this item among employers was 3.4615 indicating a neutral ranking. Part 2 of the Drafting Credentialing Survey asked if employers seek out industry certified individuals to fill drafting positions (Question 3) and if they believed certified drafters performed better that non-certified drafters on the job (Question 2). The responses to these two questions indicated a mean score of 3.1538 on the 5-point scale among employers, again indicating a neutral position.

On the Instructor/Employer Survey Question 2b asked employers if they require drafting certifications of their drafting applicants. None did. Question 2f asked if employers planned to require certifications in the future. Once again, no employer is planning to require industry recognized certification in the future. None of the employers who mentioned their current employees during the initial interview foresaw any benefit in spending time or money in preparing drafters already in their employment to take any certification examinations. This is somewhat counter to responses that employers gave on Question 4 (drafting certifications are worth the investment of time and money) when the mean value (M=3.6923) indicated that they somewhat agree that certifications are valuable.

Perhaps the survey items asking employers to rank the top five drafting skills and non-drafting skills they look for when hiring drafters was most telling of all the data collected. No employer mentioned certification when describing attributes that they seek when hiring drafters. These data are supported by the documents review which revealed that none of the online job postings mentioned drafting certification as a qualification for

any of the drafting positions, nor did it appear in a similar, previous study (Trent, 2007). In fact, ongoing research of online job listings for the past four years has never revealed a reference to CAD certification in any drafting job posting (Trent, 2011). Even though they somewhat agree that drafting certifications improve the probability of a drafting graduate of finding employment, employers do not seek CAD certified individuals to fill drafting positions. Within the state under study they are far more likely to look for applicants who have experience and/or education in the drafting profession.

Independent samples *t*-tests were conducted to determine if there were significant differences in the perceptions of the efficacy of certifications for drafting graduates between drafting instructors and employers of drafters (Research Question 4) in a southeastern U.S. state. Both groups were asked to rank the degree to which they agreed with or disagreed with a series of statements relating to industry recognized drafting certifications and their perceptions of the performance of certified drafters. Employers generally ranked the survey items higher than instructors, however instructors rated five items out of 34 higher than employers: Question 9, 10, 11, and 12 all related to education requirements of drafters, and Question 18 stating that certified drafters are less likely to quit their job.

For the most part, there were few meaningful differences in scores for instructors and employers. According to the *t*-tests, only three questions produced significant results; one significant result (Question 9) on Part 1 of the survey and two significant results (Questions 1 and 8) on Part 2. These data indicate that there are no significant differences in the perceptions of instructors and employers on the survey items utilized in this study. Though employers tended to rate most survey items slightly higher than instructors, the

overall consensus appears to be that each group is in agreement when it comes to the importance, or lack of importance, of industry recognized drafting certifications.

A significant difference between the perceptions of the two groups concerning the importance of 2-year vocational/technical college or 2-year community college degrees (Question 9) was identified in Part 1 of the survey. Both groups are in agreement that this survey question is important with instructors generally valuing this education almost half a point higher on the 5-point scale (M=4.91, SD=.30) and employers (M=4.42, SD=0.51; $t(18)$=2.83, p=0.01). The magnitude of the differences in the means was large (etta square = 0.28). Equal variances were not assumed for Question 9. Employers' actions may speak louder than their words, so to speak, as the online documents review listed education/2-year or associates degree in drafting as the second most desirable trait a potential drafter could have (experience was the number one factor). Community college drafting instructors (who have a stake in this instruction), however, perceive a 2-year vocational/technical college or community college degree to be significantly more important than employers.

A significant, opposing perception was revealed in Part 2 of the Drafting Credential Survey regarding the importance of an industry recognized certification improving a graduate's probability of attaining employment (Question 1). Instructors indicated a lower mean score (M=2.85, SD=1.41) than employers (M=4.00, SD=0.91; $t(24)$=-2.48, p=0.02). This item resulted in the largest difference in mean scores among all survey questions; a 1.15 mean difference. Employer respondents assigned greater value to certification than instructors. Employers, however, may not understand what is involved in drafting certification. During the initial interview process (the

Instructor/Employer Survey Protocol) several employers confused industry recognized drafting certifications with one-year or two-year certificate programs at community colleges. One employer confessed to having never heard of certifications. Another employer assumed that certification demonstrates a base knowledge while another mirrored this view by stating that certification might help to determine how much training would be necessary for the newly hired drafter.

Employers were almost evenly divided when asked if there were any benefits to drafting certification. One employer who saw no value in certification stated that "Certifications are too unpredictable – some good, some not so good. We look at design experience, not certification." Another employer said, "For (sic) certification to be valued it would have to be narrowly tailored to specific needs and protocols."

Instructors were more negative when asked about the benefits of drafting certification. Three gave positive comments such as: "Helps them (students) to get a job," "Employers like certification," and "Very beneficial. Verifies skills in drafting. Certification is a 'must have' credential." Other instructors were more reserved in their praise for certifications with phrases like "somewhat beneficial," "could be beneficial if standardized," and "... if they cover the right material." Others were completely opposed, "Not worth the time or money. No employer asks for it," "Resume asset, but no employer has ever asked us for it," and "certifications are a knee jerk reaction to Perkins funding requirements. They are not beneficial at all in their current form." Some instructors indicated that most employers who hire their graduates have their own performance tests for placement. This view was confirmed by at least four of the employers who indicated that they "test" the skills of potential drafters as part of the application process.

The final significant result was seen on Question 8 (Part 2) stating that certified drafters have better drafting skills than their non-certified counterparts. Instructors again indicated a lower mean score (M=2.69, SD=1.11) than employers (M=3.62, SD=0.65; $t(24)$=-2.59, p=0.02). It is important to note that this question was asking participants to provide their perceptions about this survey item since no employer was aware of any certified drafter in their employ and no instructor required certification of their graduates. Intuitively, one might assume that individuals who achieve certification might have better skills. Taking the extra step of sitting for a certification exam might indicate more confidence on the part of the drafter. There is no evidence to support these perceptions, but employers appear to have more faith in certifications than do instructors.

Demographically the two populations (instructors and employers) were similar in several ways. Three quarters of the employers and instructors received their drafting training in college. Instructors averaged 17 years teaching and employers averaged 26 years in industry. Fewer than half of the instructors who participated in the study had industrial work experience. The instructors who had worked in industry had an average of seven years on the job. Thus, similar views regarding certification among the two populations may be a function of their college training.

Both groups agreed that a 2-year college degree is a very important component of a drafter's repertoire. There was a significant difference in this perception with employers feeling more strongly than college instructors that this degree was important. Employers felt significantly stronger regarding certification improving the probability of a drafter attaining employment. This finding is based on responses to survey items. None of the employers participating in the study and none of the documents reviewed for this study

indicated a preference for certified applicants. This is contrary to responses given by employers on Question 1 on the Drafting Credentialing Survey. They say that they perceive certification to be a positive attribute for drafters, but they do not use this criterion in their own hiring.

Similarly, employers differed in their views from instructors on Question 8 stating that certified drafters demonstrate better drafting skills than non-certified drafters. None of the employers who participated in this study, however, were aware of any employees within their respective companies who had drafting certifications. No side-by-side comparisons were made to verify this statement. Employers and instructors based their responses on intuition rather than fact. A complete comparison of instructor mean values and employer mean values for Part 1 of the survey may be found in Table 19 and Part 2 of the survey in Table 20.

Though employers tended to rate most survey items slightly higher than instructors, there is little difference in the perception of instructors and employers regarding the importance, or lack of importance, of industry recognized drafting certifications. Employers somewhat agree that certifications improve a graduate's probability of attaining employment and certified drafters have better drafting skills than non-certified drafters. Instructors are neutral in these areas. With these exceptions, these data indicate that there are no significant differences in the perceptions of instructors and employers on the survey items utilized in this study.

Table 19

Difference in Mean Values of Instructors and Employers on Drafting Credentialing Survey Part 1

Survey Question	Instructor Mean	Employer Mean	Difference
To what extent do you believe that industry recognized credentials:			
1 – Determine needed knowledge for job	3.0833	3.6364	+.5531
2 – Identify applicant's knowledge	3.4167	4.0909	+.6742
3 – Reduces training costs	3.1667	3.1818	+.0151
4 – Increase success for new hire	3.4167	3.8182	+.4015
5 – Reduces turnover	3.0000	3.4545	+.4545
How important are the following credentials in your decision to hire a new drafter?			
6 – Important to career success	3.0000	3.4545	+.4545
7 – High school diploma	4.4545	4.5833	+.1288
8 – Drafting experience	4.4545	4.6667	+.2122
9 – 2-year trades/college degree	4.9091	4.4167	-.4924
10 – 4-year degree in engineering	3.3636	3.0909	-.2727
11 – any 4-year degree	2.7273	2.4167	-.3106
12 – Master's degree	2.2727	2.1667	-.1060
13 – Industry recognized credential	3.1000	3.6364	+.5364
When comparing drafters with a 2 year community college degree to those with an industry recognized credential, I believe that those with an industry recognized credential are:			
14 – More likely to be hired	3.0833	3.4615	+.3782
15 – More likely to be paid more	3.0833	3.5385	+.4552
16 – Likely to have successful career	3.0000	3.0769	+.0769

Table 19 (continued)

Survey Question	Instructor Mean	Employer Mean	Difference
When comparing drafters with a 2 year community college degree to those with an industry recognized credential, I believe that those with an industry recognized credential are:			
17 – Likely to keep up w/drafting technology	3.0000	3.1538	+.1538
18 – Less likely to quit job	2.9167	2.8333	-.0834
19 – Likely to be satisfied with job	3.0000	3.0000	0000
20 – Likely to advance in career	2.9167	3.2308	-.3141

Do employers look for specific skills when hiring new drafters (Research Question 5)? The data collected from employers and in the documents review for this research confirm previous research (Trent 2007) finding experience is the primary attribute employers seek. In 2007 the researcher reviewed over 250 job postings from six different job search websites across the same state under study and found that experience was the most oft mentioned qualification for drafting jobs with one to two years experience being the most named amount of experience required. Problem solving skills were mentioned most often as a soft skill required of drafters, followed by working independently and working with others. Being friendly, having good math skills, the ability to multi-task and communication skills rounded out the non-drafting skills requested by potential employers.

For this research the highest mean value attained from employer responses was on Question 8 reporting the importance of experience for drafters. Nine of the 12 employers

Table 20

Difference in Mean Values of Instructors and Employers on Drafting Credentialing Survey Part 2

Survey Question	Instructor Mean	Employer Mean	Difference
1 – Certification improves probability of employment	2.8462	4.0000	+1.1538
2 – Certified drafters perform better than non-certified drafters	2.8462	3.1538	+.3076
3 – Employers seek certified individuals	2.6154	3.1538	+.5384
4 – Certifications are worth the time and money	3.3077	3.6923	+.3846
5 – Certification is good measure of drafting skill	3.2308	3.7692	+.5384
6 – Certification is a good measure of quality of a drafting program	3.2308	3.6154	+.3846
7 – Certified drafters are more proficient	2.7692	3.1538	+.3846
8 – Certified demonstrate better drafting skills than non-certified drafters	2.6923	3.6154	+.9231
9 – Certified drafters are better workers	2.4615	2.9231	+.4616
10 – Certified drafters have better work habits	2.4615	2.8462	+.3847
11 – Certified drafters complete assignments faster than non-certified drafters	2.6923	2.9231	+.2308
12 – Certified drafters are better problem solvers than non-certified drafters	2.4615	3.0769	+.6154
13 – Certified drafters are better as part of a team	2.3077	3.0000	+.6923
14 – Certified drafters are better leaders	2.3846	3.0000	+.6154

rated this item at 5, two employers ranked experience at 4, and one employer rated it at 3 (N=12, Mean = 4.6667). This study found proficiency in CAD or AutoCAD® was a high priority among employers. Employers also named attributes such as communication,

math skills, speed, visualization, experience, and education as important when asked to name and rank drafting skills that they look for when hiring drafters. Non-drafting skills that were preferred by employers include people skills, problem solving ability, communication, motivation, and organization. Specific software applications were mentioned by some participants and in the documents review. Notably missing from the list of desirable characteristics for drafters was certification.

According to data collected for this study, employers look for individuals who can visualize in 3D and have mastery of views in orthographic projection. Views/ visualization in 3D was named the top drafting skill needed by new drafters by three employers. It was the only drafting skill named by multiple employers. Eight other skills were named by other employers as being most important: CAD skills, knowledge of standards/conventions, education/training, print reading, multi-tasking, output, line weight, and learn how to learn were all ranked number one by an employer.

Five other attributes were named by three different employers as being in the group of top five drafting skills needed by new drafters. CAD skills, hand or board drafting, speed/time, communication. and education/training each received three votes. Experience and math skills were each named by two employers as top five drafting skills. Six drafting skills received one vote each: accuracy/attention to detail, computer skills, thorough, dependable, understand item being drawn, and mechanical comprehension. Two of the drafting skills named by employers may not necessarily be drafting skills. The terms multi-tasking and computer skills may be more suited for the non-drafting skills category.

The most important non-drafting skill named by employers was people skills/deal with customers. This characteristic was named by five different employers as the number one non-drafting skill. Other soft skills receiving one vote from the group of employers included team player, problem solving, self-initiative/self-starter/drive, understand product/process, and math skills. Communication and problem solving skills each received four votes as top five non-drafting skills. Team player received three votes from employers, while ask questions, organization, and time management received two votes each. Each of the following skills received one vote from employers: comprehension, honest, Microsoft [Office®], positive attitude, and respect co-workers.

The documents review revealed 23 different attributes named by prospective employers searching for drafters. The most oft mentioned item was experience. Almost all of the ads required two or more years of drafting experience, some in specific fields such as electrical or multi-family residential. Proficiency in CAD or AutoCAD® was named 11 times in the documents review. College degree was named six times with three of the ads requiring a 2-year degree and the other three asking for a 4-year degree. Four ads named communication/presentation skills as a requirement for the position. Problem solving/analytical and multi-tasking were mentioned in three ads, as were the specific CAD software applications of REVIT® and 3D CAD. Other software (SolidWorks®/ Inventor® and Microsoft®) was mentioned in two ads, as were the qualities of being a U.S. citizen, ability to attain Department of Defense clearance, and familiarity with ASME Y14 drafting standards. Nine other qualities were mentioned one time each in the online job postings. They were: background check/drug screen, knowledge of military standards, organized, team member, self-motivated, time/deadline oriented, punctual,

advanced (CAD) commands, know multiple drafting applications, and customer service. The full list of skills and their rankings may be found in Table 21.

Table 21

Essential Skills Needed by Drafters

Training/Experience Requisites	Soft Skills	Software	Other
1. 1-2 years experience	1. Problem solving	1. AutoCAD(R)	1. Eligible for Secret Service Clearance
2. Specialty applications	2. Work independently/ Self-starter	2. Solid Works	2. Eligible for Navy/Defense Dept. screen
3. Two year degree	3. Work with others/ teamwork	3. Solid Edge	3. Pass drug screen
4. B.S. degree	4. Friendly	4. Inventor	4. Eligible to work in U.S.
5. High school drafting	5. Math skills	5. MicroStation	
6. Detail	6. Multi-task	6. GIS	
7. Trade school	7. Communication/ oral and written	7. Medusa	
8. Design	8. Physical abilities	8. Cadkey	
6. 3-D			
10. Administrative duties			
11. Production			
12. Weldments			
13. Sketch			
14. Layout			

Education was also an important element for drafters to possess according to employers. Three questions regarding education and experience received mean scores in the strongly agree range from employers. These statements asked employers their opinions regarding the importance of a high school diploma or GED (Question 7, n=12, Mean=4.5833), the importance of experience (Question 8, n=12, Mean = 4.6667), and the importance of a 2-year vocational/technical college or community degree (Question 9, n=12, Mean = 4.167).

Two questions regarding the education of drafters fell into the somewhat disagree range. Question 11 rating the perceived importance of any 4-year degree for drafters among employers had a mean value of 2.4167 (N = 12). Question 12 asked about the perceived importance of a master's degree for drafters. This item received a mean value of 2.1667 among the 12 respondents. These data indicate that employers of drafters do not believe that a bachelor's or master's degree is a very important credential for drafters to have when entering the drafting workforce.

Recommendations

This study found that drafting instructors and employers of drafters in this sample do not believe that certified drafters perform better than their non-certified counterparts. There is little significant difference in the perceptions of the two groups in this regard. Employers of CAD drafters do not seek certified individuals to fill drafting positions. They look for applicants with experience, education, CAD proficiency, and people skills when hiring

drafters. Ulmer (2010) found similar results in the manufacturing sector with no significant differences in certified and non-certified employees.

Currently there is no single industry recognized credential for drafters. Almost every software manufacturer offers their own product specific certification, possibly as a "knee jerk reaction to Perkins funding," as one participant stated. The value and validity of such certification is questionable and needs further research. Based on these findings, a recommendation of this study is to examine the "industry recognized credential" portion of the Perkins legislation to determine the strength of the relationship between these credentials and a given program's effectiveness. For this study, regarding the drafting profession, no such correlation was found indicating that the pursuit of an industry recognized credential may be a waste of time and resources, given that employers do not require or desire them. Further experimental research is needed in other career and technical education program areas to determine the effectiveness of credentialing in those areas.

For the drafting industry, the American Design Drafting Association is working on a broad based drafting certification program at this time. The organization has grown in recent years and is seeking to partner with AutoDesk® and other CAD software manufacturers to share in the development of "software neutral" certification instruments (J. Levy, personal communication, March 14, 2011). Momentum, or at least awareness, seems to be growing for this certification, and it may emerge as the industry leader in years to come. The drafting industry is still many years from attaining wide acceptance of a certification program such as that used in the information technology industry. The

ADDA, or some other organization, must embark on a large scale advertizing/education program if wide acceptance of any certification program is to occur.

This study should be replicated in other states to increase the validity of the findings. The comparison of the online job postings from Trent (2007, 2011) indicate that employers advertized criterion for hiring new drafters has remained essentially the same over the time period. It is important to investigate if drafting employers from different regions of the country have similar perceptions of CAD certification and if they seek similar drafting and non-drafting skill sets from their drafting applicants.

An experimental study identifying a large sample of drafters who finish an identical college program, then dividing the sample in half with one group becoming certified and the other group entering the workforce with only the college degree would eliminate much of the sampling error. While this recommendation may not be realistic, or at least very difficult to find, imagine what differences could be simply and clearly identified with a side-by-side comparison of these groups?

A study using CAD employers should be conducted to identify more workplace readiness skills, so called "soft skills," for drafters. Employers in this study named 14 non-drafting skills as being important. These identified skills could be incorporated into drafting curricula similar to Virginia's 13 Workplace Readiness Skills curriculum or the Partnership for 21st Century Skills (2009) framework to ultimately produce better drafting graduates.

Finally, research needs to be conducted to determine why so many drafting programs are closing despite a projection of solid growth of 6% in drafting industry through 2016 (Bureau of Labor Statistics, 2007). Three schools in the state under study

have closed their CAD programs within the past five years and three other schools are planning to close their programs within the next one to three years. The loss of six programs out of 23 is significant, representing 26% of all CAD programs in the state. It is important to determine if this loss is an anomaly related only to this state or if there is a nationwide trend in this direction. Other factors may be at work that are diminishing enrollments in community college drafting programs. Some possible factors may be the proliferation of for profit institutions (University of Phoenix, ITT Technical, etc.) offering drafting courses; drafting software may have become so intuitive and simple to master that high school students in career and technical programs may have all the skills they need to enter the drafting workforce; or drafting chores may be outsourced to offshore locations where labor costs are lower.

Intuitively, certification appears to be perceived as having some value, though not enough value to warrant the time and expense required to attain it. The two groups under study had similar views of the attributes needed by new drafters. The drafting industry is so diverse there is no "one size fits all" answer. Educators try to teach a broad variety of skills to help students find employment. Employers seek well trained drafters and will still need to invest significant time and effort to train new hires. Does having an industry recognized CAD certification benefit the CAD graduate? Based on the research in one southeastern U.S. state the researcher has concluded that there is no significant benefit to attaining such certification. This may change over time if additional research provides empirical evidence to support certifications.

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Appendix A

INSTRUCTOR/EMPLOYER SURVEY PROTOCOL

Opening script:

Thank you for agreeing to talk with me today. This interview will probably take about 15 to 20 minutes. As I indicated in my original correspondence, I would like to know more about your experiences as a drafting instructor or drafting supervisor. I would like to discuss your experiences as they relate specifically to your drafting students or drafting employees. The information from these interviews will be organized and used as part of my dissertation research. I will be interviewing other drafting instructors and employers across the state so I will be reading from this script to ensure that all interviews are conducted in the same manner. You are free to withdraw from the study at any time.

I would like to tape record our conversation if that is okay with you. This will help me make sure I have an accurate record of what we discuss. Our conversation will be completely confidential. I will not use your name, your students', or employees' names, or your school or business name in any discussions or in any writings related to the research and I will not share your comments with your supervisor, your students, drafters, or anyone else at the college or business. Are you willing to participate in this study? Is it okay to record our conversation?

After I conclude the study, all recordings will be erased and all documents containing any information that could be used to identify persons, schools or businesses associated with this study will be destroyed. I will be happy to share the results of this research with you if you wish. Again, let me reiterate that you are free to withdraw from the study at any time including right now.

Before we begin, do you have any questions or concerns?

Participant: _____ Date: _____ Beginning time: _____

1. Please share with me a little background information about yourself:
   a. What is your job title? _____
   b. How long have you been a drafting instructor/supervisor here? _____ years
   c. Were you a drafter before becoming an instructor/supervisor? Yes No
      Where? _____ For how long? _____years
   d. Where did you get your drafting training? College Trade school
      Somewhere else _____
   e. Did you complete a program? Degree Certificate Something else?
   f. Have you worked anywhere as a drafter or drafting supervisor? Yes No
      Where? _____ How long? _____years
   g. Do you hold any drafting certifications? Yes No
      What types? _____
   h. Is there any other background information you would like to share with me?

Please continue on the next page

2. I'd like to talk a little bit about industry recognized drafting certifications
   a. Are you aware of any industry recognized drafting certifications? Yes No
      Which ones? _____
      _____
   b. Do you require your students/employees to attain any of these certifications?
      Yes No Don't know
      Which ones? _____
   c. Do you get students/employees who have had drafting experience in their secondary education, either in trade schools, career and technical centers or somewhere else? Yes No From where _____
   d. Does your college have articulation agreements with local high schools for dual enrollment or Tech Prep? Yes No Don't know
      What types and with whom? _____
   e. Do any schools that you partner with offer any drafting certifications? Yes No
      Which ones? _____
   f. Do you plan to offer or require any certifications in the future? Yes No
      Which ones? _____
   g. What do you think of drafting certifications? Are they beneficial? How?
      _____
      _____
   h. Is there anything else you would like to share with me about certifications?

3. Now I would like to talk about the kind of drafting skills that you feel are important for your students to have in order to find a job and perform well in the drafting field.

   When thinking about drafting skills, what is the most important thing that you think that your students should know in order to function in a drafting job?

   _____

   a. What other drafting skills should your graduates/drafters possess in order to do well on the job?
      _____
      _____
   b. Can you rank the top 5 drafting skills you believe a drafter should have in order to be effective on the job? Prompts: Lettering, sketching, dimensioning, etc.
      1. _____
      2. _____
      3. _____
      4. _____
      5. _____
   c. Is there anything else you would like to share with me about drafting skills?
      _____

4. Now I would like to talk about non-drafting skills that your students/drafters might need in the performance of their job.
   a. When thinking about non-drafting skills, what is the most important thing that you think that your students should know in order to function in a drafting job?
      _____

Please continue on the next page

b. What other non-drafting skills should your graduates possess in order to do well on the job?

_____

c. Can you rank the top 5 non-drafting skills you believe a drafter should have in order to be effective on the job? Prompts: problem solving, working with others.
   1. _____
   2. _____
   3. _____
   4. _____
   5. _____

d. Are there any other non-drafting skills you would like to add?

Is there anything else you'd like to tell me about your view of industry recognized drafting credentials? Any concerns you have?

That's all the questions I have for you. Thank you very much for your time and for all the information you have shared with me.

Ending time: _____

Appendix B

DRAFTING CREDENTIAL SURVEY

Please indicate your level of agreement by selecting the number that best reflects your feelings.

To what extent do you believe that industry recognized credentials (please circle your response):

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
Determine the needed knowledge and skills for drafting jobs	1	2	3	4	5
Make it easier to identify applicant's knowledge and skills	1	2	3	4	5
Reduce training costs for drafters	1	2	3	4	5
Increase the chance of success for a new hire	1	2	3	4	5
Reduce the likelihood of turnover	1	2	3	4	5
Are important to career success	1	2	3	4	5

How important are the following credentials/certifications in your decision to hire a new drafter?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
High School Diploma or GED	1	2	3	4	5
Drafting experience	1	2	3	4	5
2-year vocational/technical college or community college degree	1	2	3	4	5
4 year degree in an engineering discipline	1	2	3	4	5
Any 4 year degree	1	2	3	4	5
Master's degree	1	2	3	4	5
Industry recognized certification or credential	1	2	3	4	5

When comparing drafters with a 2 year community college degree to those with an industry recognized credential, I believe that those with an industry recognized credential are:

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
More likely to be hired	1	2	3	4	5
More likely to be paid more	1	2	3	4	5
More likely to have a successful career	1	2	3	4	5
More likely to keep up with drafting technology	1	2	3	4	5
Less likely to quit their job	1	2	3	4	5
More likely to be satisfied with their job	1	2	3	4	5
More likely to advance in their career	1	2	3	4	5

Do you prefer or require drafting certifications or credentials for certain drafting positions?

For the next few questions I would like for you to rank how strongly you agree or disagree with each statement. We will be using a scale of 1 to 5 to rank your opinion on each statement with a ranking of 1 representing the low end of the scale or strongly disagree and 5 being the high end of the scale or strongly agree. Again, 1 = strongly disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree, and 5 = strongly agree. Do you understand the scale? Okay, let's get started.

Please continue on the next page

Please circle your response to each question

1. Holding a certification recognized by the drafting industry improves graduates' probability of attaining employment.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

2. Certified drafters perform better than non-certified drafters on the job.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

3. Employers seek out industry certified individuals to fill drafting positions.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

4. Drafting certifications are worth the investment of time and money.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

5. An industry recognized certification is a good measure of the drafting skill a drafter has attained.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

6. An industry recognized certification is a good measure of the quality of the drafting program a drafter has completed.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

7. Certified drafters are more proficient than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

Please continue on the next page

8. Certified drafters demonstrate better drafting skills than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

9. Certified drafters are better workers than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

10. Certified drafters demonstrate better work habits than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

11. Certified drafters complete assignments faster than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

12. Certified drafters have better problem solving skills than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

13. Certified drafters work better as part of a team than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

14. Certified drafters are better leaders than non-certified drafters.

Strongly Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Strongly agree
1	2	3	4	5

Please continue on the next page

15. Can you rank the top 5 drafting skills you believe a drafter should have in order to be effective on the job?

1. _____
2. _____
3. _____
4. _____
5. _____

16. Can you rank the top 5 non-drafting skills you believe a drafter should have in order to be effective on the job? Prompts: problem solving, working with others.

1. _____
2. _____
3. _____
4. _____
5. _____

Any comments that you wish to make regarding industry recognized drafting certifications are welcome! Please write comments below or on an attached sheet. Your comments will remain completely confidential. Thank you.

Appendix C

151 Cherry Stone Avenue
Bluefield, Virginia 24605
<Date>

Dear <Community College Instructor>,

My name is Dan Trent and I am conducting research concerning community college drafting programs across the Commonwealth. Specifically, I am interested in the value (or lack thereof) of industry recognized certifications as perceived by drafting instructors and employers. This is dissertation research as I complete my PhD from Old Dominion University in Norfolk, Virginia. I have submitted and defended my dissertation prospectus and have undergone review by the Institutional Review Board at ODU. All survey data will be completely confidential and presented only in aggregate form so that no individuals, institutions, or employers will be identified.

I will contact all community college drafting instructors across the state and hope to achieve 100% participation. I am interested in interviewing you by telephone at a day and time that is most convenient for you. I will contact you by telephone within the next week or so to schedule an interview time. Should you agree to participate in this important study I will be happy to send you copies of the two survey instruments for you perusal. You are certainly free to decline to participate in the study (although I hope that you will be willing to share your opinions). You may also end your participation in the study at any time. I will be happy to address any concerns you may have regarding this research. You can reach me at (662) 254-3414 or by email: dan.trent@mvsu.edu . You may also contact my dissertation committee chair, Dr. Philip Reed, at ODU by calling (757) 683-4305 or by email: preed@odu.edu.

I look forward to speaking with you about this important research and hope that you will agree to help. Thank you for your kind attention to this matter,

Dan Trent, Program Leader for CADD
Mississippi Valley State University

Appendix D

151 Cherry Stone Avenue
Bluefield, Virginia 24605
<Date>

Dear <Employer>,

My name is Dan Trent and I am conducting research concerning community college drafting programs across the Commonwealth. Specifically, I am interested in the value (or lack thereof) of industry recognized certifications as perceived by drafting instructors and employers. This is dissertation research as I complete my PhD from Old Dominion University in Norfolk, Virginia. I have submitted and defended my dissertation prospectus and have undergone review by the Institutional Review Board at ODU. All survey data will be completely confidential and presented only in aggregate form so that no individuals, institutions, or employers will be identified.

I will contact a cross section of drafting employers across the state. You have been identified by your local community college instructor as an employer who hires, or has hired, community college drafting students/graduates. I am interested in interviewing you by telephone at a day and time that is most convenient for you. I will contact you by telephone within the next week or so to schedule an interview time. Should you agree to participate in this important study I will be happy to send you copies of the two survey instruments for you perusal. You may end your participation in the study at any time. I will be happy to address any concerns you may have regarding this research. You can reach me at (662) 254-3414 or by email: dan.trent@mvsu.edu . You may also contact my dissertation committee chair, Dr. Philip Reed, at ODU by calling (757) 683-4305 or by email: preed@odu.edu.

I look forward to speaking with you about this important research and hope that you will agree to help. Thank you for your kind attention to this matter,

Dan Trent, Program Leader for CADD
Mississippi Valley State University

Appendix E

OLD DOMINION UNIVERSITY
DARDEN COLLEGE OF EDUCATION
OFFICE OF THE DEAN
NORFOLK, VIRGINIA 23529-0156
PHONE: 757) 683-3958
FAX: (757) 683-5063

December 14, 2009 Proposal Number 200901047

Dr. Reed:

Your proposal submission titled, **"Efficacy of Drafting (CAD) Certification"** has been deemed EXEMPT by the Human Subjects Review Committee of the Darden College of Education. If any changes occur, especially methodological, notify the Chair of the DCOE HSRC, and supply any required addenda requested of you by the Chair. You may begin your research.

PRIOR TO THE START OF YOUR STUDY, **you must send a signed and dated hardcopy of your exemption application submission to the address below.** Thank you.

Edwin Gómez, Ph.D.
Associate Professor
Chair, Human Subjects Review Committee, DCOE
Human Movement Studies Department
Old Dominion University
2010 Student Recreation Center
Norfolk, VA 23529-0196
757-683-6309 (ph)
757-683-4270 (fx)

CURRICULUM VITAE

Daniel L. Trent
151 Cherry Stone Avenue
Bluefield, Virginia 24605
276-322-3911 (home)
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dtrent@comcast.net
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EDUCATION

Doctorate of Philosophy, in Education, expected June 2011
Old Dominion University
Dissertation: Efficacy of Computer Aided Drafting (CAD) Certifications
Advisor: Philip A. Reed, Ph.D.

Master of Science, Educational, Vocational and Technical Education, December 1998
Virginia Tech
Includes cognate in **Industrial and Systems Engineering**

Bachelor of Science, Industrial Arts Education, June 1993
Virginia Tech

Associate of Applied Science, June 1979
Southwest Virginia Community College
Graduated Magna Cum Laude

EXPERIENCE

Mississippi Valley State University, Itta Bena, Mississippi, 2009 – current
Assistant Professor & CADD Program Leader, Applied Technology
Develop, implement, and manage state of the art CADD curriculum and facility. Building a new program in a brand new building with all new equipment (dual monitors, etc.) Software includes AutoDesk AutoCAD titles, SolidWorks, ProEngineer, Envisioneer, Chief Architect and more.

New River Community College, Dublin, Virginia, 2005 – current
Adjunct Faculty in Workforce Development
Teach contractor licensing course and building trades code update training required by the state for plumbers, electricians, gas fitters, and mechanical (HVAC) contractors. Developed online format for these courses now being offered statewide.

Southwest Virginia Community College, Richlands, Virginia, 1990 – current
Adjunct Faculty in Engineering Division
Over 20 years experience teaching drafting courses (AutoCAD, Inventor, Revit, SolidWorks, etc.). Involved in on-site industrial training, trades recertification courses, computer literacy courses, and displaced worker retraining. Assisted in launching the Construction Academy at SWCC (U.S. Department of Labor funding).

Miracle Construction Company, LLC. 1993 – current
President/Owner
Residential and commercial building construction and renovation along with industrial design work for this limited liability company.

EIMCO Corporation, 1997 – 1998
Design Engineer
Designed and developed a low-seam continuous coal miner, a two million dollar piece of sophisticated heavy equipment. Primary design responsibilities included gear case, pan, coal loading arms, all hydraulics, and fire suppression system.

Tazewell County Schools, Tazewell, Virginia, 1986 – 1993
Public School
Developed and taught Technology Education Program for Middle School Students

PROFESSIONAL MEMBERSHIPS

- Association of Career and Technical Education (ACTE)
- Association of Technology, Management, and Applied Engineering (ATMAE)
- Epsilon Pi Tau – International Honorary for Professions in Technology
- Iota Lambda Sigma – National Honor Society in Workforce Development
- International Technology and Engineering Educators Association (ITEEA)
- Golden Key International Honour Society

PROFESSIONAL LICENSURE

- Commonwealth of Virginia Class A Contractor (2705 033503A)
- Instructional Design for Online Learning (IDOL) Certification from Virginia Community College System, 2009
- Managed Ongoing Awareness Tools (MOAT). Internet Information Security Awareness, 2011
- OSHA 1910 (General Industry) 10-hour certification
- National Center for Construction Education and Research (NCCER)
  Certified NCCER Instructor of:
  NCCER Core Curriculum, Carpentry, HVAC, Project Supervision, Plumbing, Electrical, and Management Education