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Intricacies of Professional Certifications for Quality Management (QM)

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INTRICACIES OF PROFESSIONAL CERTIFICATIONS FOR QUALITY
MANAGEMENT (QM)

A Thesis
Presented to
The Faculty of the Department of Architectural and Manufacturing Science
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science in Technology Management

By
Edmund R. Martelli

August 2010

INTRICACIES OF PROFESSIONAL CERTIFICATIONS FOR QUALITY
MANAGEMENT (QM)

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Directed by: Mark Doggett, Terry Leeper, and Stan Lightner

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The modern manufacturing marketplace is extremely complex and constantly changing. Career professionals often seek job placement, career advancement, and continuing education through professional certifications. Professional certifications in the United States (U.S.) have been evolving since 1911. In the 1950s, engineering groups established professional certifications and licenses. In the 1980s, administration of accreditation of certification programs proliferated, and by the 1990s, many government and professional organizations sought to standardize procedures for the industry. Currently, professional certifications are available for virtually every profession and issued by multitudes of organizations.

Quality management (QM) encompasses an extensive combination of professional abilities. Providers of professional certifications for quality management (QM) related occupations have increased as the demand for specialized employees increased. Certification can make professionals invaluable to their professions and offer substantial compensation. Return on the investment of personal development varies and requires consideration. Some non-accredited certification providers attempt to satisfy demand without conforming to consensual standards. Considering the accumulation of diverse sources of certification organizations introduces uncertainty. The acceptance of

professional certifications is subjective and industrial managers may consider them unnecessary, redundant of formal educations, or simply ineffective.

The dispute as to how certifications are advantageous for what industries and individuals requires continual review. This investigation attempted to identify the individual career advantages, enterprise expectations, and the range of certification programs for quality management (QM).

The design of research used was a mixed-method approach to scientific inquiry. Participants from industrial professionals and certification providers participated in an online survey designed to identify certification parameters and perceptions.

Survey responses were statistically analyzed using a variety of descriptive and inferential techniques. The techniques included measures of agreement, central tendency, and dispersion combined with open-ended responses to deductively and inductively formulate, analyze, and interpret a referenced conclusion.

The results indicated essential parameters of professional certifications including what certifications existed, how they are implemented, acquired value ranges, perceived attributes and effectiveness, and a comparison of experienced and certified professionals.

Chapter 1

Introduction

Background.

Certifications have been a method for personal and professional development for many years. Many Americans enroll in professional certification programs seeking to obtain a career. Moreover, many employees rely on career advancement and job security through professional certification. However, there is potential for misconception. Employers' perceptions of certifications appear to be arbitrary and variability within the certifying organizations promotes ambiguity and controversy in the subject.

The Council of Engineering and Scientific Specialty Boards (CESB) (2006) explains:

Certification began with licensed physician ophthalmologists in 1911 as a way to distinguish their unique and special training. . . . As a consequence, environmental engineers used it to distinguish themselves from other engineers beginning in 1955. . . . Some certifications became “the” credential to have. . . . Others were accepted by only a few. Overall, there are *more* than 1000 [1,000] occupational certifications programs available today (p. 5).

The statement above reflects the complexity of this issue. Certifications have distinguished professionals for almost a century. Both public and private organizations of professionals have implemented standards for accrediting certification programs to maintain minimum individual competency that protects the practice and assures clientele

Problem Statement.

In recent years, many technical and professional certifications have emerged as new technologies and business practices have developed. Many non-government organizations (NGOs) have entered the market providing certification programs in order to satisfy the increased demand. These include universities, institutions, and certification organizations. Employers and professions recognize certified individuals or require certification. Professionals may view certifications as futile and regard them as insignificant, considering experience and education as imperative. The purpose of this research was to evaluate issuing agencies, survey various professional certifications, and assess certification programs for quality management (QM) to determine their viability, complexity in the market, present benefits, and to propose explanation.

Significance.

The requirements of industry are constantly changing and success depends on knowledge and resourcefulness. Personnel competency is a critical factor for remaining successful in the market and employers seek individuals with skills and capabilities to achieve these goals. Individuals often seek career advancement and accomplishment through certification in special professions. Information reported by administrative authorities and alleged impending advantages lack a comprehensive analytically investigated description. This research sought to present information to reduce existing elusiveness and reveal perceived value of the related professional certifications.

Limitations and delimitations.

This research was restricted to the issue of professional certifications relating to quality management (QM) for industrial manufacturing sectors in the United States of

America (USA). Conclusions were limited by respondent deficit, partial responses, confines of the selected resources and methodology, intuitive deficits of statistical analysis, and narrative interpretation.

Assumptions.

This research presumed that: (a) individual motivations are normal; (b) industrial requirements are competitive and comparable; (c) market fluctuations are normal; (d) bias and risks are within normality; (e) and isolated instances of random variation occur throughout certification processes, managerial perceptions, and employment experiences.

Research questions.

Specific questions posed to *industrial professionals* were:

- What professional certifications are present within the organization?
- What professional certifications are required by the organization?
- What professional certifications are highly regarded by the organization?
- What certifications are acceptably issued internally or through affiliation?
- What general attributes are exceedingly associated with certified professionals?
- What approximate amount of compensation do certified professionals receive?
- How does the experienced professional compare against the certified professional?

Specific questions asked of *certification organizations* were:

- What professional certifications are issued by the organization?

- What accreditations does your organization maintain to ensure competency?
- What is the most current certification achievement rate?
- What is the average cost of tuition per certification program?
- What general attributes are exceedingly invested in certified professionals?
- How does the experienced professional compare against the certified professional?

Hypotheses.

(H_0) Attributes associated with professional certifications relevant to quality management (QM) are perceived no differently among certification providers and industrial professionals.

(H_A) Attributes associated with professional certifications relevant to quality management (QM) are perceived differently among certification providers and industrial professionals.

Definition of terms.

Accreditation: certification of a duly recognized body of the facilities, capability, objectivity, competence, and integrity, of an agency, service, or operational group or individual to provide the specific service or operation needed (Summers, 2009, p. 542).

Certification: a document certifying that one has fulfilled the requirements of and may practice in a field (Merriam-Webster Online, 2010).

Engineer: a person who carries through an enterprise by skillful or artful contrivance (Merriam-Webster Online, 2010).

Lean manufacturing: improvement initiatives that focus on the elimination of waste from systems and processes (Summers, 2009, p. 547).

Management of technology (MoT): the art and science of creating value by using technology together with other resources of an organization (Thamhain, 2005, p. 3).

Mixed-method: an investigative knowledge claim using both qualitative and quantitative design frameworks of research (Creswell, 2003, p. 21).

Professional: engaged in a specified activity as one's main paid occupation (Oxford University Press, 1995, p. 460).

Quality management (QM): the application of a quality management system in managing a process to achieve maximum customer satisfaction at the lowest overall cost to the organization while continuing to improve the process (Summers, 2009, p. 549).

Reliability: the probability of a product performing its intended function under stated conditions without failure for a given period of time (Summers, 2009, p. 550).

Six-sigma: a methodology that provides businesses with tools to improve the capability of their business processes by optimizing performance, reducing variation, improving profits, employee morale, and product quality (Summers, 2009, p. 551).

Type I error: determination of a statistical significant effect on an experimental group to test a hypothesis when in fact it is insignificant (Boslaugh & Watters, 2008, p. 100).

Type II error: determination of a statistical insignificant effect on an experimental group to test a hypothesis when in fact it is significant (Boslaugh & Watters, 2008, p. 100).

Chapter 2

Review of Literature

Approaches.

According to the Bureau of Labor Statistics (BLS) (2008), “Making informed career decisions requires reliable information about opportunities in the future” (p. 2).

This statement implies that individuals must evaluate and decide upon various and changing critical career factors. Industrial expansion and a variety of professional certifications have introduced trepidation regarding certification while organizations assure indefinite claims of conferred benefits.

Documentation representing of the potential earnings for various levels of professionalism is available. According to the spring 1993 BLS, average monthly earnings for persons vary according to specific industries and level of degree. The data also illustrates that degree of professionalism coincides with earnings but vary dependent upon industry, type of degree, and the individual. The degrees analyzed included all degrees, bachelor’s degree, and advanced degrees. Refer to Figure 1. (Bruno, 1995, p. 6).

1993 Average Monthly Earnings									
Field	All degrees			Advanced degrees			Bachelor's degrees		
	Persons	Mean earnings	Standard error	Persons	Mean earnings	Standard error	Persons	Mean earnings	Standard error
All persons	39,184	\$2,339	\$38	9,505	\$3,331	\$80	19,435	\$2,269	\$43
Agriculture/forestry	548	\$2,973	\$391	118	*	*	348	\$3,119	\$474
Biology	692	\$2,118	\$196	161	*	*	470	\$1,990	\$203
Business/management	7,575	\$2,426	\$69	1,187	\$3,525	\$165	4,302	\$2,626	\$81
Economics	630	\$3,330	\$496	135	*	*	495	\$2,923	\$372
Education	4,694	\$1,884	\$124	1,875	\$2,388	\$97	2,581	\$1,669	\$169
Engineering	3,495	\$3,117	\$124	725	\$3,996	\$263	2,160	\$3,189	\$131
English/journalism	1,108	\$2,331	\$372	169	*	*	880	\$2,032	\$146
Home economics	245	\$1,165	\$211	19	*	*	195	*	*
Law	1,075	\$4,353	\$352	859	\$5,062	\$347	95	*	*
Liberal arts/humanities	2,883	\$1,733	\$88	510	\$2,145	\$199	1,573	\$1,733	\$91
Mathematics/statistics	683	\$2,583	\$225	108	*	*	460	\$2,716	\$211
Medicine/dentistry	1,035	\$5,049	\$467	820	\$6,125	\$469	91	*	*
Nursing/pharmacy/technical health	3,602	\$1,889	\$80	420	\$2,480	\$221	1,272	\$2,080	\$136
Physical/Earth sciences	854	\$2,357	\$209	229	\$3,234	\$456	447	\$2,045	\$183
Police science/law enforcement	548	\$2,178	\$179	31	*	*	283	\$2,331	\$211
Psychology	1,133	\$2,236	\$172	431	\$2,826	\$257	642	\$1,974	\$175
Religion/theology	517	\$1,963	\$184	381	\$2,285	\$186	95	*	*
Social science	2,034	\$1,970	\$105	457	\$2,275	\$187	1,386	\$1,922	\$104
Vocational/technical studies	2,461	\$1,713	\$107	14	*	*	149	*	*
Other	3,373	\$2,327	\$142	855	\$3,294	\$388	1,511	\$2,340	\$129

Note: Numbers in thousands
Note: * base less than 200,00 persons

Figure 1. 1993 U.S. Census Bureau average monthly earnings (Bruno, 1995, p. 6).

According to the BLS in 1996, the median earnings for either sex increased as the educational level increased. The various degree levels analyzed included high school or less, some college, vocational, associate, bachelor, and advanced degrees. However, the average earnings between some college and vocational training were clearly proximate. (Bauman & Ryan, 2001, p. 8).

Trends from 1975 to 1992 indicate that on average Americans with specialized degrees continually experience substantially higher earnings as recorded by the U.S. Bureau of the Census (Kominski & Adams, 1994, pp. 99-101). Higher education does not provide direct relation to earnings. Other factors may cause earning differences, such as corresponding curriculums, inflation, personal attributes, and the needs of society. Refer to Figure 2 for extensive information (D'Amico & Judy, 1997, pp. 62, 66, 138).

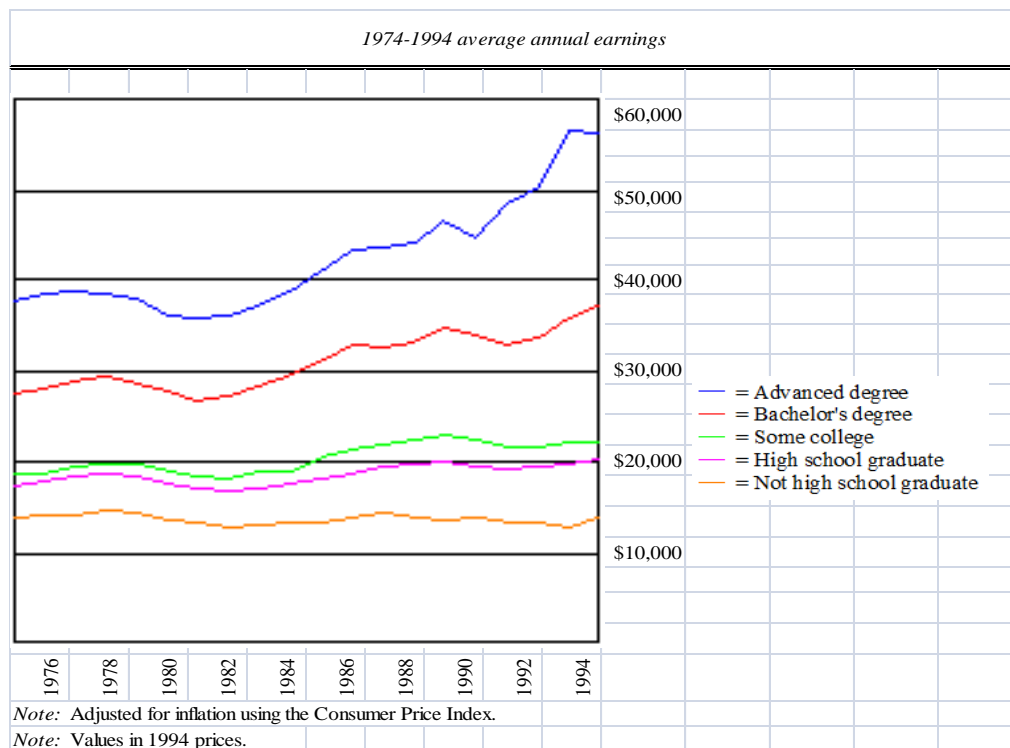


Figure 2. 1976-1994 trend average of education and earnings (replicated) (D'Amico & Judy, 1997, p. 62).

The Council of Engineering and Scientific Specialty Boards (CESB) is a private organization, funded from professionals, and licensed engineers. The CESB inaugurated the Engineering Certification Task Force (ECTF) to assess and validate professional certifications and certification programs. They determined that licensing and certification mutually seek to promote competency through knowledge, but are redundant, and deter objectives by introducing indecisiveness. Multitudes of diverse certifications compound variation. According to the CESB, many certifications “are not accredited by CESB or any other certification accrediting body”. (Council of Engineering and Scientific Specialty Boards, 2006, pp. 6-7).

In general, perception of certifications diverges. Certifications insinuate that a person has completed some type of training and has the knowledge and skills necessary to perform and complete job tasks, but it also has a negative connotation. Certification is arbitrary, as in the case studies for six-sigma certification programs. According to Drickhamer (2004), “Certified Six Sigma black belts are as useless in factories as they are in dark allies [*sic*]. They’re being churned out of two-week seminars that are offered by every business school in the country” (p. 61). This particular profession of quality management (QM) seems to be plagued with mystery and adversity, while proliferating dramatically. According to corporate director of Sears Sigma, T.M. Kubiak (2003), “companies hire less than qualified individuals . . . this has exuberated the problem Six Sigma professionals despise the most---*variation*” (p. 8). Kubiak also suggests an interesting method to six sigma certification describing five approaches. Kubiak’s simple approach has potential as a benchmark if universally applied to many professions seeking a strategy for certification.

Kubiak's methodology considers tradeoffs between six-sigma certification implementation from the perspective of both the institution and the professional, regarding efficiency, effectiveness, and internal factors. Refer to Table 8 in Appendix A.

Certifications.

Perhaps the most coveted professional certification among quality management (QM) professionals is the master black belt (MBB) certification offered by Accenture, Motorola, and Rath & Strong Management Consultants. Management functions and philosophies reducing process error, termed six-sigma, proliferate in many career ventures. Six-sigma training certifies individuals by levels of rigorous course completion corresponding to green belt (GB), black belt (BB), and the MBB. Evidence indicates that the demand for individuals possessing this special training will continue to increase (McGee, 2003, p. 65).

The American Society for Quality (ASQ) offers an array of professional certifications comprised of prescribed requirements. ASQ offers six-sigma green and black belt certifications. Currently, there is not a MBB designation offered by the ASQ. All ASQ certifications require proof of professionalism and the successful completion of a comprehensive examination. Other certification programs require an amount of experience or substitution of education. The ASQ's Book of Knowledge (BOK) guides all ASQ certification programs. Educational institutions endorsed by the ASQ may act to waive some experience requirements of ASQ certification programs. (ASQ, n.d.). Refer to Table A9.

The Institute of Industrial Engineers (IIE) offers similar certification programs to professionals with various instruction facilities including online programs,

sessions/seminars, and formal classroom instruction. The certification programs are configurable to corporate requirements. (IIE, n.d.). Refer to Table A10.

Management consultants Rath & Strong (2009) offer customizable ranges of six-sigma training including those specific to financial services. Similarly, Accenture offers certification programs to professionals integrated with various industries, including black belt, black belt for service, green belt, green belt for service, master black belt, and an executive/champion workshop.

Motorola offers six-sigma certification programs to professionals through the Motorola University. Motorola asserts that their certification programs are both reliable and valid to industry. Additionally, Motorola offers the emerging field of design for six-sigma (DFSS) for both product development and information technology (IT) (Motorola, 2009).

Complexity.

Certification is not without its difficulties. Certification facilitation at the consumption level has introduced the need to address a universal curriculum or standards to satisfy proprietary values and consensus. Variation between exam content creates inconsistency and harms credibility. Information compilation addressing core topics need establishment with optimization to promote validity of accepted practices. Arguably, to obtain such a contrivance, certification organizations could rely on the define-measure-analyze-improve-control (DMAIC) methodology accepted by quality management (QM) practitioners (DeRuntz & Meier, 2009, pp. 2-4, 8).

Although introducing further dimension of perplexity, evolving teaching methods have demonstrated innovative and adaptive configurations. Six Sigma eLearning, Inc.

offers trainees learning environments using Internet connectivity such as voice over internet protocol (VoIP) and interactive ecourse technology (IET). These programs offer flexibility and lenience to their students while accessing additional clientele (Robins, 2006, pp. 32-33).

Assessing opportunities to optimize training programs personalized to learners is critical. Merging various methods of instruction depends on personal expectations. Successful certification programs seek to motivate individuals in the learning process. Uniqueness of the learning experience should be result oriented, selecting course curriculum while considering course objectives, feasibility concerns, and facilitation of the learning environment (asynchronous and synchronous). Trends illustrate higher attrition rates to online and distance learning programs (Breyfogle III, 2008, pp. 46-52).

Philosophies and methodologies of vocations variously interconnect with one another, such as industrial engineering and lean sigma. This phenomenon can create opportunity for institutions to implement certification programs into education. Respectively, an initiative at the Ohio State University (OSU) to promote an experimental certification program aimed at industrial engineering students provided a structure and mechanism to administer the implementation of the program. Obstacles to the program included course sequencing, sponsorship, and student commitment. Results indicated a 72 percent increase in student competence and confidence, pragmatic application within industry, workplace error and variance reductions, improved forecasting, higher productivity, alignment of industry expectations to student abilities, and improved marketability of certified students (Sink, 2009, pp. 40-43).

Recruiting and retaining talented educators is another prominent issue. Various factors, including education/experience, unionization, tuition, private funding, and individual expectations account for competitive wage offerings to career professionals in higher education. Of these factors, experience developed during tenure aids to offset job dissatisfaction and personnel loyalty (Sutton & Ulmer & Wilson, 2009, pp. 2, 6).

Some extremely intensified industries struggle to stay current with training and education, providing opportunity for certification programs. One clear example is computer sciences. According to Karr (2001):

In the 1980's [*sic*], technologists were forced to cope with having to learn new fundamental skills every five years. Now, newer developments can occur within months. . . . The ever-faster pace of change has created a learning curve that is constantly shifting to accommodate new technologies. . . . IT education may be outdated by the time of delivery. . . . certification provides a way to "prove" to employers. . . that a job candidate or employee has the competency it takes to make a worthwhile contribution (pp. 60-61).

Often employers endeavor to decipher and decide upon optimum expertise associated with various certifications because of the absence of issued guidelines and regulations throughout accrediting organizations (Karr, 2001, p. 61).

Management of technology (MoT) and business administration (BA) share interests with industrial technology. On the contrary, accounting practices have had a reputation for being vague. Consequentially, recent business initiatives have adopted lean practices into their philosophies (Cunningham & Fiume, 2003, pp. vii, ix). Business

certifications range considerably. Some of the basic business certifications often sought by employers are certified financial management (CFM), certified management accountant (CMA), certified internal auditor (CIA), and certified fraud examiner (CFE). Certifications in the business function assess individual abilities that, when implemented correctly in the practice, create prosperity and versatility in the organization. Job seekers may be more confident and likely to receive a job with a business certification (Foy, 2000, pp. 35-36). Foy (2000) also explains, “the lack of a graduate degree could be a disadvantage that can be at least partially offset with financial certification” (p. 35). Employed personnel often seek certification to complement their previous knowledge and experience and may expect greater earnings because they feel secured within the organization. Foy concludes, “Does that cover all of the certification[s]? No !” (p. 36).

Companies benefit from huge savings when applying quality management (QM) philosophies into their corporate scheme. Companies such as American Express, Ford Motor Company, International Business Machines (IBM), General Electric (GE), Motorola, Proctor & Gamble, and Xerox have all expressed an ambition to implement quality management (QM) into business management. The return on investment is the assurance of sustainability and financial sustenance (Weistein & Petrick & Vokurka & Castellano, 2008, pp. 233-234).

Certification programs have proliferated due to the increase of specialized occupations within organizations. Specialized companies are not developing the certification programs simply to add credibility to their profession but so that they can offer assurance to their customers through indemnity. Insurance companies often require certification within the organization. Mark Carter (2007), owner of the Certified

Sweeping Company (CSC) states, “NAPSA [North American Power Sweeping Association] was having trouble getting insurance underwritten and we set about constructing a practice to set up a higher-quality product with a better class of companies based on specific business practices” (p. 15). In addition, specific certifications in specialized industries offer to complement individuals. Diversity and complexity is typical in many specialized industries. The need for insured professionals in various industries frequently requires specialized training, licensing, and/or certification. These certification programs promise an increased market, economic insurance coverage, and can be applicable to individuals as well as companies (Heydorn, 2007. pp. 14-15).

Regardless of the industrial environment, individuals obtaining certifications for personal development must procure intelligent traits. Inherent to the individual personality are a range of multiple aptitudes including verbal, spatial, and perceptual characteristics. These qualities are interrelated with subject knowledge and operational memory within the individual (Eggen & Kauchak, 2004, pp. 122, 546).

Chapter 3

Methodology

Participants.

Source information regarding organizational participants inclusive to manufacturing and quality management was derived from Internet inquiry, reference material, the review of literature, and conversation with the thesis committee. Source information provided a framework for the survey questions and a course for potential participants.

To test the hypotheses, two groups or independent variables, of participants completed a survey regarding perceptions related to certifications. The first group, industrial professionals, and the second group, certification providers, were contacted via telephone, electronic mail (e-mail), typed letter, or physically, to reveal potential candidates. Formal administration of the surveys was in the form of an e-mail message. Selection criteria included position of authority (responsibilities), years of experience, and credentials relating to the issue, quality management (QM) and/or industrial sciences. Refer to Figures B17-20.

To identify potential candidates for the first group, industrial professionals, and to ensure a cross sectional research design, inquiry into professional organizations and respective affiliates provided an assortment of contacts from industrial manufacturers.

Individuals qualified as professionals within the first group were asked to participate in a specific survey designed for the group. To eliminate bias and to ensure validity, survey questions included diversified certifications collectively configured for inclusive organizations.

To identify potential candidates from the second group, certification providers, and to ensure a cross sectional research design, the review of literature provided an assortment of specific organizations for consultation.

Individuals qualified as organizational recruiters, educators, or managers, within the second group were asked to participate in a specific survey designed for the group. Contacts within the organization voluntarily completed a specialized survey for the organization.

To reduce complexity, sample size (n) within the selected organizations was limited to 30 individual voluntary participants from each group. To eliminate bias and to ensure validity, survey questions for the certification providers were custom configured exclusively to the individual organization.

Organizations selected to participate from the first group, *industrial professionals*, were selected from the following:

- Association for Manufacturing Excellence (AME)
- Association for Manufacturing Technology (AMT)
- Association of Technology Management and Applied Engineering (ATMAE)
- Baldrige National Quality Program (BNQP)
- International Association for Lean Practitioners (IALP)
- National Association of Manufacturers (NAM)
- National Center for Manufacturing Sciences (NCMS)
- Society of Manufacturing Engineers (SME)

Organizations asked to participate from the second group, *certification providers*, were:

- American Society for Quality (ASQ)
- Breakthrough Management Group University (BMGU)
- Institute for Industrial Engineering (IIE)
- Motorola University
- Rath & Strong Associates
- SigmaPro
- The Juran Institute
- Villanova University

A single staged sample derived contact personnel, selecting potential participants based on qualification criterion, and eliminated irrelevant participants. Self-selected individuals from both groups participated in the survey. Sample selections from the industrial participants group were considered qualified according to job title. Categorical stratification included management, engineering, and maintenance. Random individual participation provided casual assignment within samples from each category.

All participants provided consent in accordance to the Institutional Review Board (IRB) specifications administered through Western Kentucky University's Human Subject Review Board. Refer to Figure B16.

Although demographic information (e.g., age, ethnicity, gender, etc.) is important for further research, this research was only concerned with education, certification completion, and employee status to determine participant eligibility.

Instrumentation.

A uniquely designed survey for each group was developed. Information from the literature review, including peer reviewed research articles and journals, constructed a

social theoretical perspective, or lens, of the research. The theoretical lens contrived the formulation of each question, intended to eliminate impartiality. Literature indicated anxiety and resolution of certification programs but with limited statistics, as previously represented in the review of literature. Refer to Figures 1-2.

The survey for each group contained both continuous and categorical scales, coinciding with the mixed-method research approach. Samples contained instructions and the questionnaire included informed consent. Designed questions solicited finite demographic information, individual disposition, and attribute values of professional certifications. Refer to Figures B21-24.

Procedure.

The administered survey process was conducted online using Easy Survey Package (ESP) offered through Western Kentucky University's (WKU) Academic Technology department. Corresponding to the cross sectional survey and to limit the complexities of examining exorbitant amounts of data, maximum participation from each organization was limited to thirty participants.

A preliminary, or pilot, survey review was performed by the graduate committee to assess validity. Prior to dispensing the official surveys, permission was obtained from Western Kentucky University's Institutional Review Board (IRB). The authorized survey administered to participants was refined to provoke specific statistical data and as a reference to monitor reliability. The allowable duration for participation was 30 days.

Variables.

The independent variables of the research was the two sample groups. The dependent variables were the survey questions and the interpreted responses.

Interpretation.

A descriptive analysis of continuously scaled responses combined with an inferential analysis of the categorical scaled responses tested the hypotheses.

The theoretical perspective concurrently interpreted responses from comparison of topics introduced in the review of literature. Statistical analysis included a chi-square analysis (χ^2), test of significance (t -test), and a test of variability (F -test).

Examination.

For industrial professionals, examinations included measurements of central tendency and dispersion for individual certifications required and issued either internally or externally. A probability of error (p -value) calculation ensured validity. Perceived effectiveness, exceeding attributes, and compensation factors were statistically analyzed according to the information type.

Cumulative examinations included measurements of central tendency and dispersion for individual certifications, achievement rates, and tuition issued through certification providers. A probability of error (p -value) calculation ensured validity. Exceeding attribute factors examined used a chi-square to make inference of expected value to observed values, a t -test to examine the difference of the means, and an F -test to examine the difference of variance. Open-ended responses collected were identified, coded, and summarized for collective comparisons. Content analysis provided inferential suggestions as to support the conclusion of the hypotheses tests. To test the hypotheses, measurements of central tendency and dispersion (z -distribution) considering a probability of error (p -value) produced a test of significance (t -test), used to derive conclusion to accept or reject the null hypothesis.

Threats to validity.

An assumed response bias affected survey responses. A respondent/unresponsive participant analysis, with the assumption that late respondents in the survey are similar to unresponsive participants provided additional bias. Responses from industrial professionals possessing various types of certifications may be inclined to overestimate their advantages such as effectiveness, compensation, and associated attributes. Responses from certification providers may be inclined to overrate advantages such as achievement levels, compensation, and associated attributes. Response bias may also include inclination to exaggerate the appearance of the organization and any response supplied without empirical data would constitute a biased response.

Chapter 4

Results

Although it is not possible under the design of research to accurately locate and describe every participant to present a discrete response ratio the following description provides an estimation of the response ratio. The primary factor to this indistinctness is due to the dissemination of surveys by recipients to alternative qualified individuals.

Industrial professionals.

Respondents from the industrial professionals sample group were from the AME, AMT, ATMAE, BNQP, IALP, NAM, NCMS, and the SME as listed in the methodology. Equal opportunity to participate in the survey was given to each organization. ATMAE provided an electronic mailing list (listserve) to administer surveys to their respective members. The derived response ratio was from multiple attempts to correspond with all listed potential organizations. Responses totaled 21 from industrial professionals.

Potential responses from the sample population of industrial professionals are as listed:

- ATMAE list serve submitted electronic mail (e-mail) requests totaling 1,113 were derived from the following professional members: 226 management; 289 manufacturing; 172 industrial; and 426 university
- AMT from 92 submitted e-mail requests
- AME from seven submitted e-mail requests
- Baldrige from two submitted e-mail requests
- IALP from two submitted e-mail requests
- NAM from two submitted e-mail requests
- NCMS from two submitted e-mail requests

- SME from four submitted e-mail requests

The response ratio from industrial professionals is 21 out of 1,222, considering the potential of sent e-mail survey requests. Participant inquiry was regarding what certifications were required, internally/affiliate issued, and utilized by the organization, rank of effectiveness within the organization, the rate of estimated compensation per year in thousands of United States (U.S.) dollars, and exceeding attributes associated with certified individuals. The survey additionally allowed for an open-ended response from participants to describe their perception of a comparison between experienced and certified individuals within the organization.

The summation of industrial professionals' survey response table derived from consensual data from individual respondents was used for various statistical analyses. On March 15, the surveys were dispensed and on April 13, 2010, a revised and condensed survey for industrial professionals was issued due to low response rate from the original survey. The extended survey ended on April 23, 2010. The revised survey categorized the original individual certifications into the following arrangement:

- Green Belt, Black Belt, Master Black Belt, and Silver Belt
- Six-Sigma, Six-Sigma Facilitator, Six-Sigma Green Belt, Six-Sigma Black Belt, Six-Sigma Gold Belt, and Six-Sigma Master Black Belt
- Design for Six-Sigma Green Belt, Design for Six-Sigma Black Belt, and Design for Six-Sigma Master Black Belt
- Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six-Sigma, Lean Six-Sigma Green Belt, Lean Six-Sigma Black Belt, Lean Six-Sigma Master, Lean Six-Sigma Master Black Belt, and Lean Supply Chain Management
- Master Six-Sigma, Master Six-Sigma Financial Services, and Master Six-Sigma Information Technology

- Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence
- Advanced Master Lean Six-Sigma
- Engineering Management
- Industrial Engineering Professional Skills
- Calibration Technician
- Reliability Engineer
- Juran Institute

Individual certifications containing the same initial designation, (i.e., six-sigma, six-sigma green belt, six-sigma black belt, etc.) constructed an overall certification category. Analysis of the provided data from the industrial professionals' surveys required cleaning the collected data. This included categorizing individual certification responses into grouped variables relevant to the revised survey. Certification parameters present in individual responses were translated in categories for each certification.

When summing survey responses a discrete count of one in either individual certification counted as a positive value for the group. Continuous values were summed and averaged for analysis. Precision of analysis for all data included rounding numbers into the tenths place unless more accuracy was needed (as prescribed by the university department), approximation of compensation in thousands place, and averaging individual responses from multiple respondents. Refer to Table 11-12.

Required certifications.

Considering the summed certifications categories, 51.9% of industrial professionals responded that professionals within the organization did not require

certifications. Required by the organization, 18.5% listed other certifications, quality certifications rated at 11.1%, lean certifications rated at 7.4%, green, black, master black, and silver belts as well as the reliability engineer and Juran Institute certification rated at 3.7%. The remainder of certifications had no cumulative response. Refer to Figure 3.

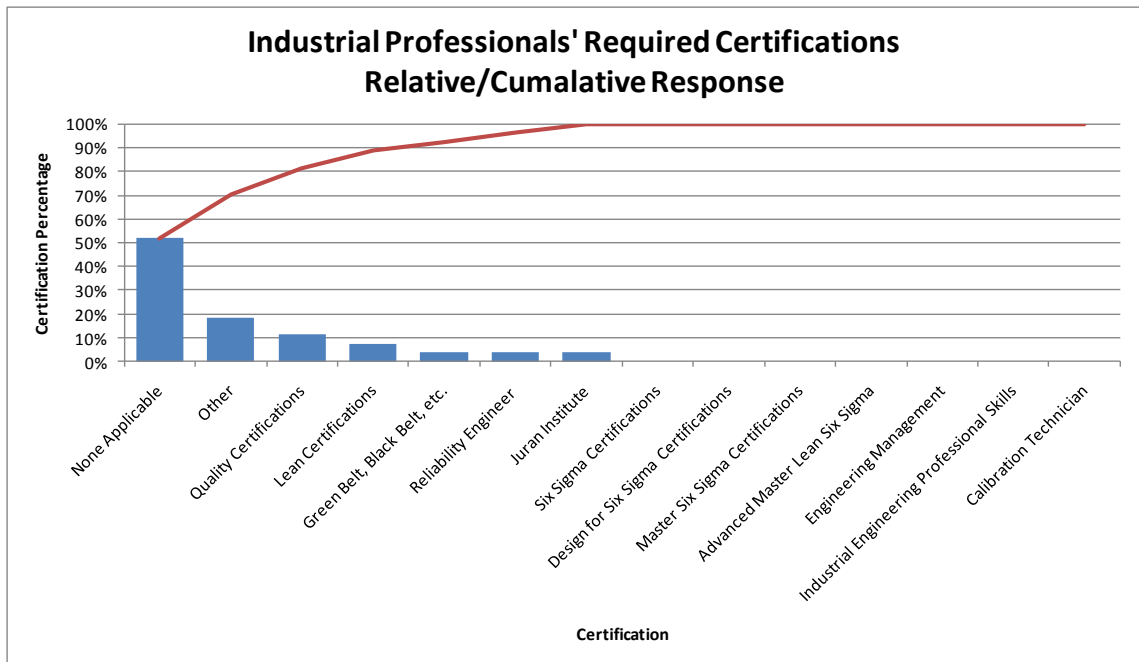


Figure 3. Industrial professionals required certification Pareto chart.

Utilized certifications.

Industrial professionals responded that they utilized quality certifications rated at 28.6%. Green, black, master black, and silver belts as well as six-sigma type certifications and reliability engineer certification rated at 14.3%. Lean certifications rated at 10.7%. Calibration technician certification rated at 7.1%. Design for six-sigma certifications, engineering management, and industrial engineering professional skills certifications rated at 3.6%. The remainder of certifications had no cumulative response. Refer to Figure 4.

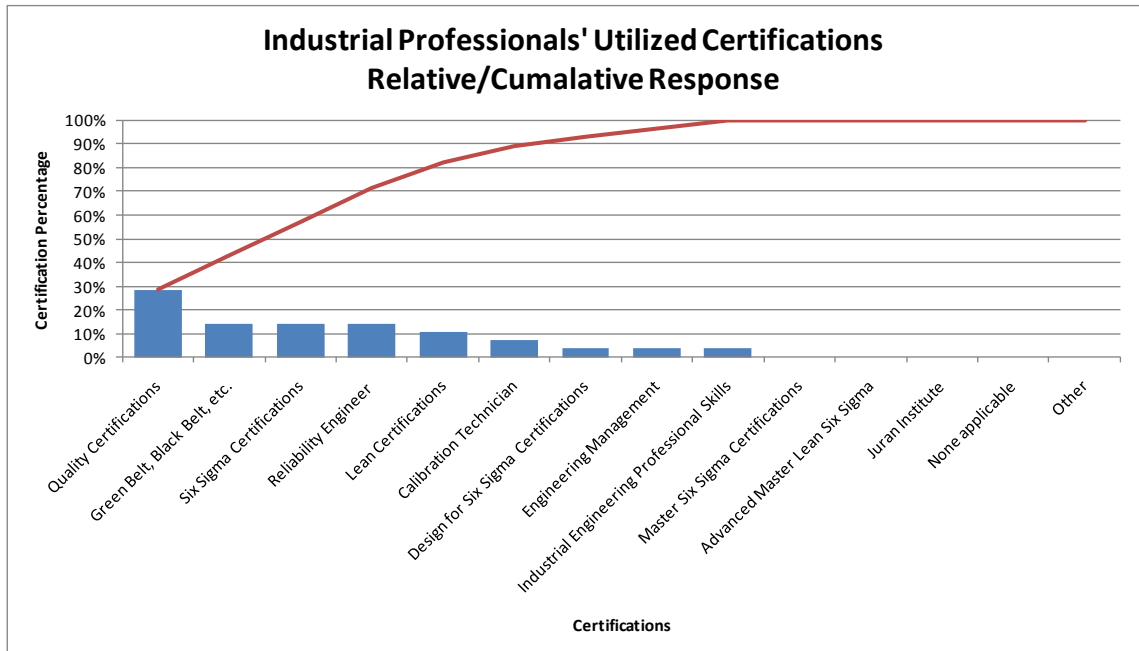


Figure 4. Industrial professionals utilized Pareto cart.

Internal certifications.

Of internally issued certifications, 26.3% of industrial professionals responded that no certifications were issued internally. Green, black, master black, and silver belts rated at 15.8% being internally issued. Lean certifications rated at 13.2%. Six-sigma and quality certifications rated at 7.9%. Calibration technician certification rated at 7.1%. Design for six-sigma certifications, engineering management, industrial engineering professional skills, and reliability engineer certification rated at 2.6%. Master six-sigma, advanced master lean six-sigma, and other certifications rated at 2.6%. The remainder of certifications had no cumulative response. Refer to Figure 5.

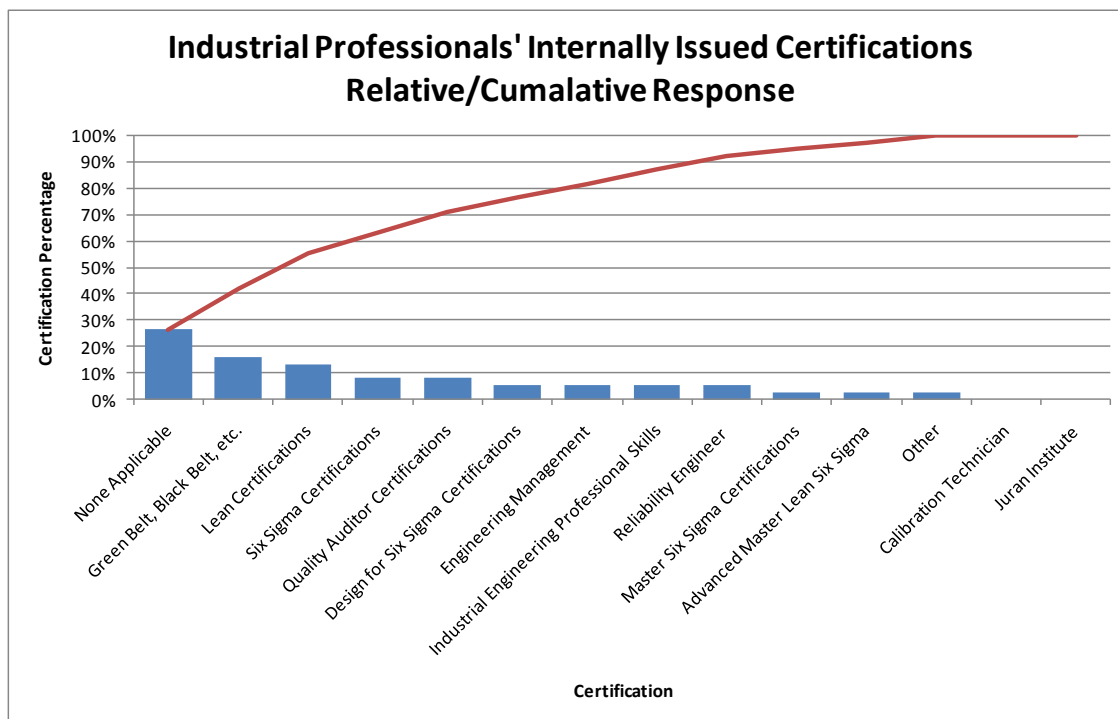


Figure 5. Industrial professionals internally issued Pareto chart.

Affiliated certifications.

Of affiliate issued certifications, 17.1% of industrial professionals responded that quality certifications were affiliate issued. Green, black, master black, and silver belts rated at 10.0% being affiliate issued. Six-sigma and reliability engineer certifications rated at 8.6%. Not affiliate certification rated at 8.6%. Advanced master lean six-sigma, industrial engineering professional skills, and lean certifications rated at 7.1%. Calibration technician certification rated at 5.7%. Design for six sigma, master six-sigma, engineering management, and Juran Institute certifications rated at 4.3%. Other certifications rated at 2.9%. The remainder of certifications had no cumulative response. Refer to Figure 6.

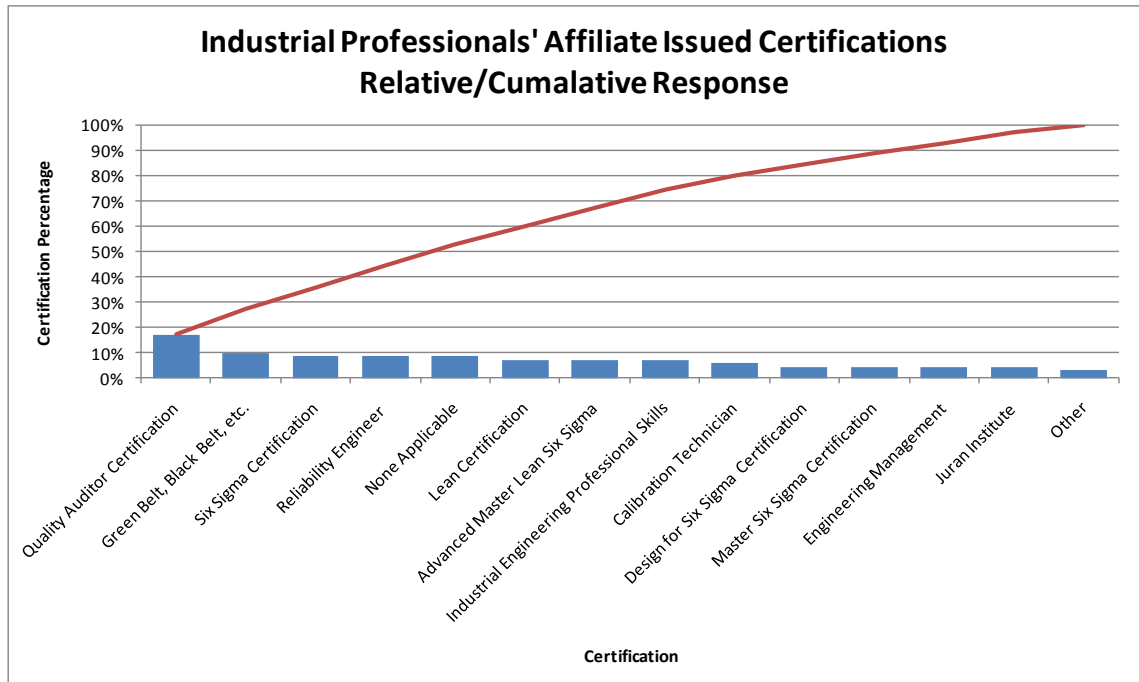


Figure 6. Industrial professionals affiliate issued Pareto chart.

Effectiveness.

Industrial professional's responses to certification effectiveness were summed and the average was then compared to the whole expressed in percentage terms as listed below:

- Master six-sigma certifications as 92% effective
- Design for six-sigma certifications as 89% effective
- Quality certifications as 87% effective
- Six-sigma certifications as 82% effective
- Advanced master lean six-sigma, lean, and reliability engineer certifications as 80% effective
- Green, black, master black, and silver belt as 78% effective
- Engineering management at 76% effective

- Industrial engineering professional skills certifications as 73% effective
- Calibration technician certification as 66% effective
- Juran Institute certification as 57% effective

Refer to Figure 7.

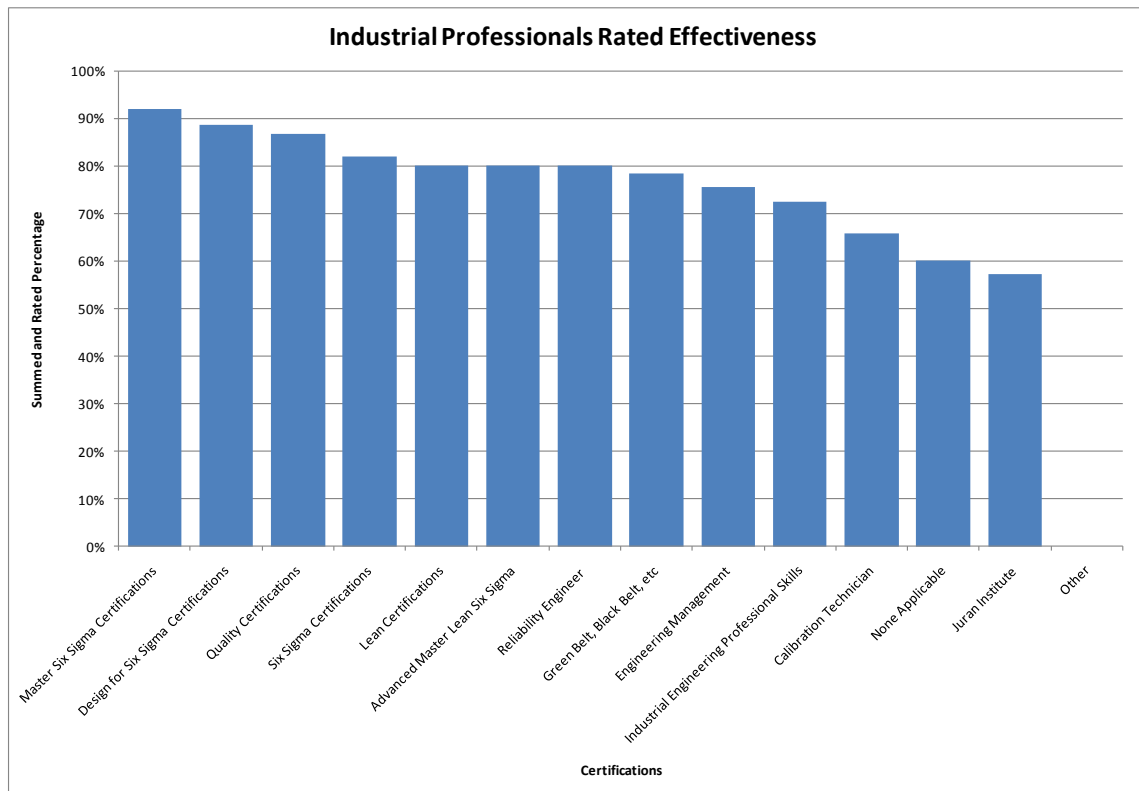


Figure 7. Industrial professionals' effectiveness bar graph.

Compensation.

Industrial professional's responses to certification compensation averaged expressed in United States (U.S.) dollars as listed below:

- Reliability engineer certification at \$112,000.00
- Quality certifications at \$91,000.00
- Six-sigma and engineering management certifications at \$75,000.00
- Lean certifications at \$71,000.00

- Design for six-sigma certifications at \$70,000.00
- Green, black, master black, and silver belt certification at \$68,000.00
- Industrial engineering professional skills certifications at \$65,000.00
- Master six-sigma certifications at \$60,000.00
- Calibration technician certification at \$35,000.00

Compensation averages for the Juran Institute certification, advanced master lean six-sigma, and the remainder of certifications calculated no value. Refer to Figure 8.

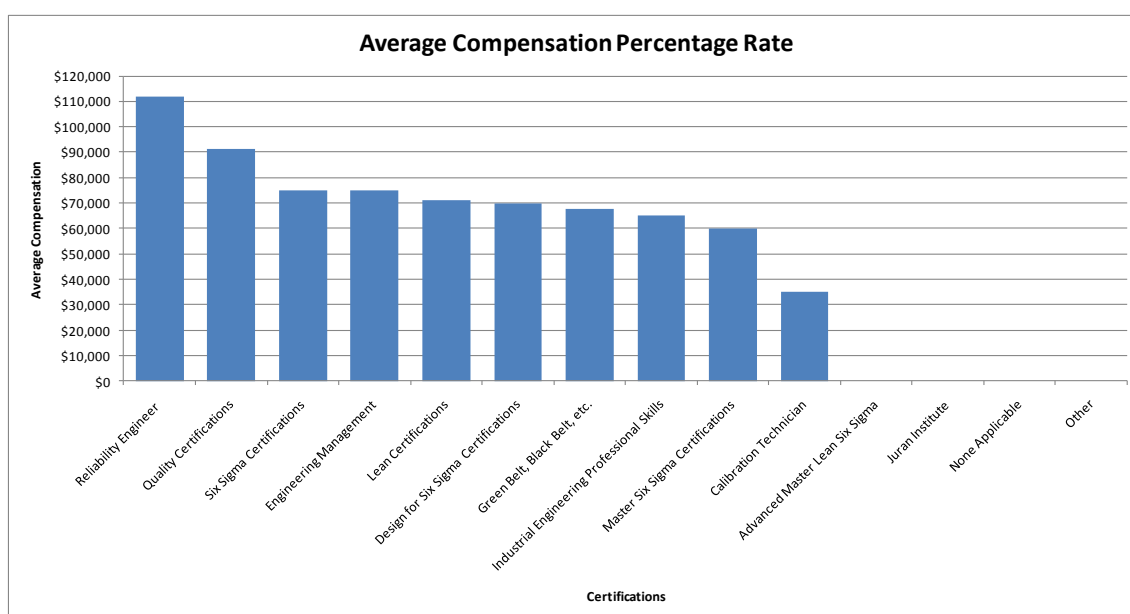


Figure 8. Industrial professionals average compensation of certifications.

Continuous data derived from industrial professionals regarding approximate compensation indicated a mean of \$74,000.00 and a standard deviation of \$21,000.00. Due to the relatively low response rates, a histogram of the data was not conclusive although the kurtosis was relatively normal for the set and range.

Attribute responses from industrial professionals were summed from individual binomial responses and tabulated for analysis. Analysis calculations assumed a

confidence level (α) of 95.0% from the summed responses among the 21 respondents. Attribute perception from industrial professionals' ranked cooperation as the highest quality of certified professionals, followed by equal regard to motivation, communication, and professionalism. Intrapersonal skills ranked next with efficiency ensuing. Refer to Table 1.

Table 1. Attribute ranked response from industrial professionals.

<i>Attribute Ranked Response from Industrial Professionals</i>	
<i>Attribute</i>	<i>Summed Response</i>
Cooperation	20
Motivation	19
Communication	19
Professionalism	19
Intrapersonal	18
Efficiency	17

A chi-square analysis at (α) of 0.05 (95.0% confidence) indicated values below upper critical values and above lower critical values for the corresponding degrees of freedom for all attributes. Based on the comparison convincing evidence indicates that the attributes are independent. (National Institute of Science and Technology, n.d.). Refer to Table 2.

Table 2. Attributes chi-square for industrial professionals.

<i>Chi-squared Attributes for Industrial Professionals</i>				
<i>Attribute</i>	<i>Chi-test</i>	<i>Chi-dist</i>	<i>Response</i>	<i>df</i>
	$\chi^2 = \sum_{i=1, j=1}^{rc} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$	$\chi^2 = \sum_{i=1}^k X_i^2$	<i>frequency (f)</i>	
Motivation	0.999	0.998	9	8
Communication	0.993	0.998	9	8
Cooperation	0.998	1.000	11	10
Intrapersonal	0.998	0.999	10	9
Efficiency	0.976	0.995	8	7
Professionalism	0.990	0.998	9	8
Degrees of freedom (df)= <i>k</i>				
Row= <i>r</i>				
Column= <i>c</i>				
Row total= <i>i</i> th				
Column total= <i>j</i> th				
<i>O</i> =observed				
<i>E</i> =expected				

Certification providers.

Respondents from the certification providers sample group were from the ASQ, IIE, and the Juran Institute. Response ratio was three from the eight selected organizations ($\approx 37.5\%$). Participant inquiry was regarding the verification of certification offerings, the rate of tuition in thousands of United States (U.S.) dollars, achievements rates describing individual pass/fail rates, and exceeding attributes associated with individuals certified in the offerings of certifications. The survey allowed for an open-ended response for participants to describe their perception of a comparison between experienced and certified individuals within the organization.

According to the response, the ASQ offers the following quality management certifications: (a) Calibration Technician; Manager of Quality/Organizational Excellence; (b) Quality Auditor; (c) Quality Engineer; (d) Quality Improvement Associate; (e) Quality Inspector; (f) Quality Process Analyst; (g) Quality Technician; (h) Reliability Engineer; (i) Six-Sigma Black Belt; (j) Six-Sigma Green Belt; and (k) Software Quality

Engineer. The ASQ declined to respond to what accreditation they maintained.

Exceedingly invested attributes of the ASQ's certifications varied per certification, which included motivation, communication, cooperation, intrapersonal, efficiency, and professionalism. Certifications' achievement rates varied per certification and the ASQ declined to respond to tuition rates. According to the ASQ (2010), "certified people have higher pay rates and positions". Refer to Table A13.

The IIE offers the following certifications: (a) Lean Six-Sigma Green Belt; (b) Lean and Six-Sigma Facilitator; (c) Lean Enterprise; (d) Lean Supply Chain Management; (e) Lean Enterprise Master Practitioner; (f) Six-Sigma; (g) Six-Sigma Green Belt; (h) Six-Sigma Black Belt; (i) Engineering Management; and (j) Industrial Engineering Professional Skills. The IIE responded that they maintained an International Association of Continuing Education & Training (IACET) accreditation. Exceedingly invested attributes of the IIE's certifications varied per certification, which included motivation, communication, cooperation, intrapersonal, efficiency, and professionalism. Certifications' achievement rates varied per certification as well as tuition rates. The survey allowed for an open-ended response for participants to describe their perception of a comparison between experienced and certified individuals within the organization. According to the IIE (2010), "individuals who have the certifications find themselves much more marketable. They also have a framework within which to apply the tools". Refer to Table A14.

The Juran Institute offers the following certifications: (a) Juran Certification; (b) Six-Sigma Green Belt; (c) Six Sigma-Black Belt; (d) Six-Sigma Master Black Belt; (e) Lean Master; and (f) Lean Expert. The Juran Institute responded that they maintained an

International Association of Continuing Education & Training (IACET) accreditation. Exceedingly invested attributes of the Juran Institute certification included motivation, communication, cooperation, intrapersonal, efficiency, and professionalism. The certification achievement rate was 70 percent for the Juran Certification and the Juran Institute declined to respond to a tuition rate. The survey allowed for an open-ended response for participants to describe their perception of a comparison between experienced and certified individuals within the organization. According to the Juran Institute (2010), "those certified understand more vital and critical tools utilized for performance excellence". Refer to Table A15.

Achievement rates varied between the individual certifications offered by the ASQ except for the Manager of Quality/Organizational Excellence and Six-Sigma Green Belt certifications. In descending order, the Quality Improvement Associate ranked the highest, followed by Six-Sigma Green Belt, Manager of Quality/Organizational Excellence, Quality Auditor, Quality Process Analyst, Six-Sigma Black Belt, Calibration Technician, Quality Engineer, Quality Inspector, Reliability Engineer, and Quality Technician as the lowest rank. Refer to Figure 9.

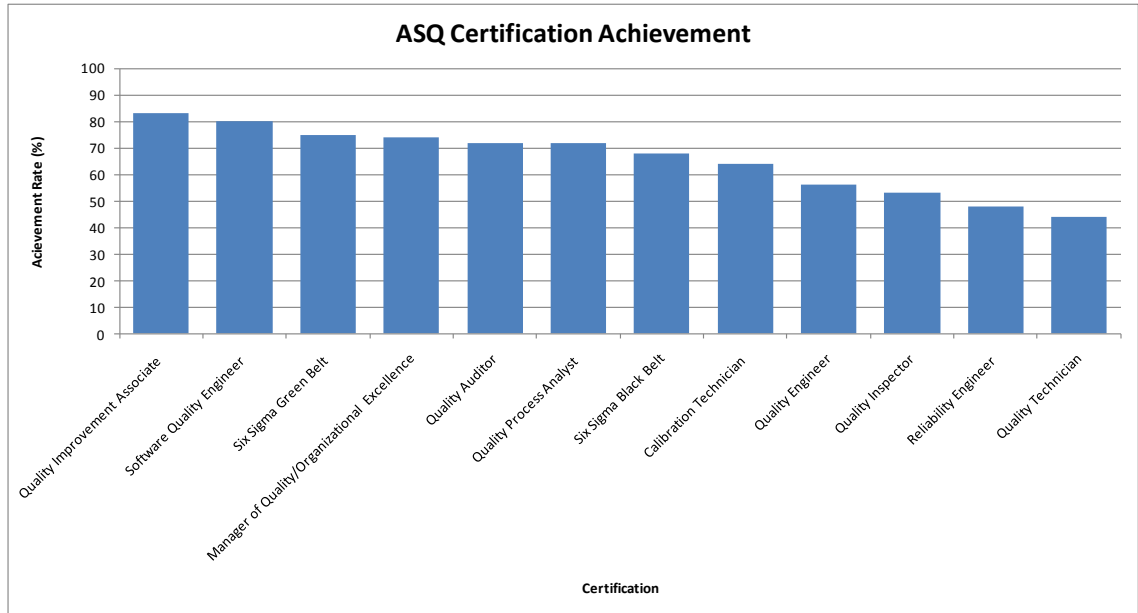


Figure 9. ASQ certification achievement.

Based on supplied responses, according to the IIE average tuition cost is \$2,460.00 with a standard deviation of \$1,578.00. The highest tuition cost was the Six-Sigma certification at \$6,445.00. The lowest cost of tuition was the Six-Sigma Green Belt certification at \$795.00. The Engineering Management and Industrial Engineering Professional Skills certifications were equally at \$2,449.00. A \$4,750.00 range existed between certifications. Refer to Figure 10.

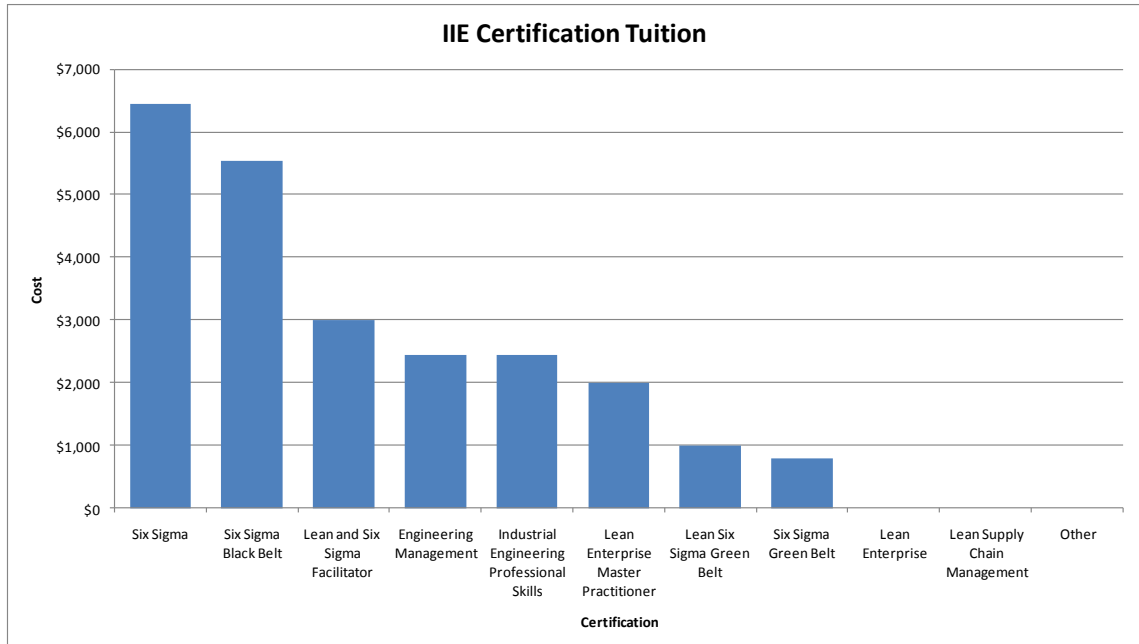


Figure 10. IIE certification tuition.

Achievement rates varied among the individual certifications offered by the IIE except for the Lean Six-Sigma Green Belt, Lean and Six-Sigma Facilitator, Engineering Management, Industrial Engineering Professional Skills certifications. In descending order, the Lean Six-Sigma Green Belt, Lean and Six-Sigma Facilitator, Engineering Management, Industrial Engineering Professional Skills ranked the highest. Followed by Six-Sigma Green Belt, Six-Sigma, Six-Sigma Black Belt. Lean Enterprise, Lean Supply Chain Management, Lean Enterprise Master Practitioner had no response. Refer to Figure 11.

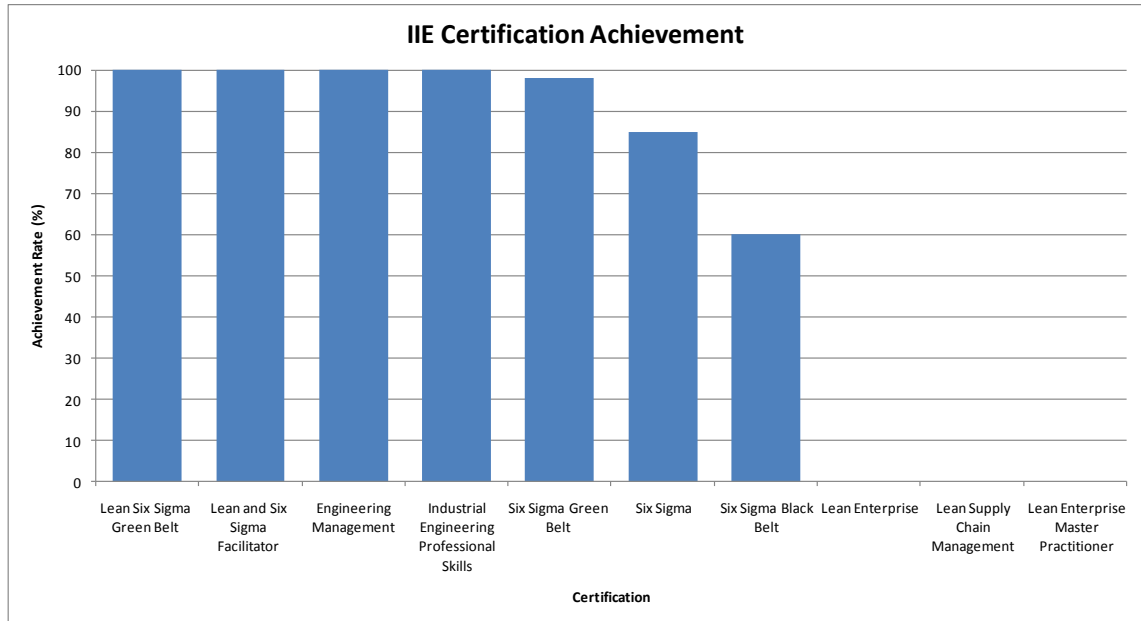


Figure 11. IIE certification achievement.

Initial research indicated that the Juran Institute website only asserted one certification as an offering. The achievement rate for the Juran Institute certification was responded to at 70%. The Juran Institute declined to respond regarding a tuition rate for the certification.

Attribute responses from certification providers were summed from individual binomial responses and tabulated for analysis. Analysis calculations assumed a confidence level (α) of 95.0% from the summed responses among the three respondents. Attribute perception from certification providers' ranked communication and professionalism as the highest quality of certified professionals, followed rank in descending regard to efficiency, cooperation, intrapersonal skills with motivation ensuing. Refer to Table 3.

Table 3. Attribute ranked response from certification providers.

<i>Attribute Ranked Response from Certification Providers</i>	
<i>Attribute</i>	<i>Summed Response</i>
Communication	21
Professionalism	21
Efficiency	19
Cooperation	17
Intrapersonal	14
Motivation	9

A chi-square analysis at (α) of 0.05 (95.0% confidence) indicated values below upper critical values and above lower critical values for the corresponding degrees of freedom for all attributes. (National Institute of Science and Technology, n.d.). Based on the comparison convincing evidence indicates that the attributes are independent. Refer to Table 4.

Table 4. Attributes chi-square for industrial professionals.

<i>Chi-squared Attributes for Certification Providers</i>				
<i>Attribute</i>	<i>Chi-test</i> $\chi^2 = \sum_{i=1, j=1}^{rc} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$	<i>Chi-dist</i> $\chi^2 = \sum_{i=1}^k X_i^2$	<i>Response frequency (f)</i>	<i>df</i>
Motivation	0.989	0.963	6	5
Communication	1.000	0.995	8	7
Cooperation	1.000	0.986	7	6
Intrapersonal	1.000	0.910	5	4
Efficiency	1.000	0.995	8	7
Professionalism	1.000	0.995	8	7
Degrees of freedom (df)= k				
Row= r				
Column= c				
Row total= i th				
Column total= j th				
O =observed				
E =expected				

Hypothesis test.

To test the null hypothesis, “attributes associated with professional certifications relevant to quality management (QM) are perceived no differently among certification providers and industrial professionals”, a chi-square analysis (kappa [κ]) between the two groups was performed to evaluate independence between the groups.

- Industrial professionals’ perception of certification attributes degrees of freedom (df) is 5, upper critical value is 11.070, and the chi-test is 0.859, so the variables can be assumed independent at 95% confidence (0.05α).
- Certification providers’ perception of certification attributes degrees of freedom (df) is 5, upper critical value is 11.070, and the chi-test is 0.830, so the variables can be assumed independent at 95% confidence (0.05α).

Refer to Table 5.

Table 5. Hypothesis chi-square analysis.

<i>Summed Response of Attributes from Industrial Professionals and Certification Providers</i>									
	<i>Industrial Professionals</i>				<i>Certification Providers</i>				
	<i>Observed</i>	<i>Expected</i>	<i>Difference</i>	<i>Squared Difference</i>	<i>Observed</i>	<i>Expected</i>	<i>Difference</i>	<i>Squared Difference</i>	<i>Attribute Sum</i>
Motivation	19	15	4	1	9	13	4	1	28
Communication	19	21	2	0	21	19	2	0	40
Cooperation	20	19	1	0	17	18	1	0	37
Intrapersonal	18	17	1	0	14	15	1	0	32
Efficiency	17	19	2	0	19	17	2	0	36
Professionalism	19	21	2	0	21	19	2	0	40
<i>Sum</i>	112				101				213
<i>Chi-test</i>	0.859				0.830				
<i>Chi-distribution</i>	0.354				0.362				

The two samples were tested for homogeneity to measure the variance among the summed responses, assisting the validation of the data. The F -test for variation of two

samples were calculated and analyzed and variance was minimal between the two samples. Refer to Table 6.

Table 6. Hypothesis variance analysis.

<i>F-Test Two-Sample for Variances</i>		
	<i>Industrial Professionals</i>	<i>Certification Providers</i>
Mean	18.6	18.4
Variance	1.3	8.8
Observations	5	5
<i>df</i>	4	4
<i>F</i>	0.1	
<i>P (F <=f) one-tail</i>	0.0	
<i>F</i> Critical one-tail	0.2	

A two-tailed test of significance for both samples was performed with an expected mean of zero or no difference. The means for both samples were relative with a range of 0.2. The variance was substantially different between groups, with a range of 7.5. Probability of a Type I Error was relatively low, at 0.4 as well as the probability of a Type II Error, at 0.9 (*p*-value). A test of exceeding the expected mean translates as significant as was a test of being lesser than the expected mean was significant (*t*-test). Refer to Table 7.

Table 7. Hypothesis significance analysis.

<i>Significance Test</i>		
<i>t-Test: Paired Two Sample for Means</i>		
	<i>Industrial Professionals</i>	<i>Certification Providers</i>
Mean	18.6	18.4
Variance	1.3	8.8
Observations	5	5
Pearson Correlation	0.1	
Hypothesized Mean Difference	0	
<i>df</i>	4	
<i>t</i> Stat	0.1	
<i>P</i> ($T \leq t$) one-tail	0.4	
<i>t</i> Critical one-tail	2.1	
<i>P</i> ($T \leq t$) two-tail	0.9	
<i>t</i> Critical two-tail	2.8	

Based on this evidence, the null hypothesis should be accepted. The variable attributes of professional certifications are valid and independently in agreement with expected results. The overall perceived value derived from the samples concludes that inherent individual qualities are associated with certified professionals, but are not significantly distinguishable. Refer to Figure 12-13.

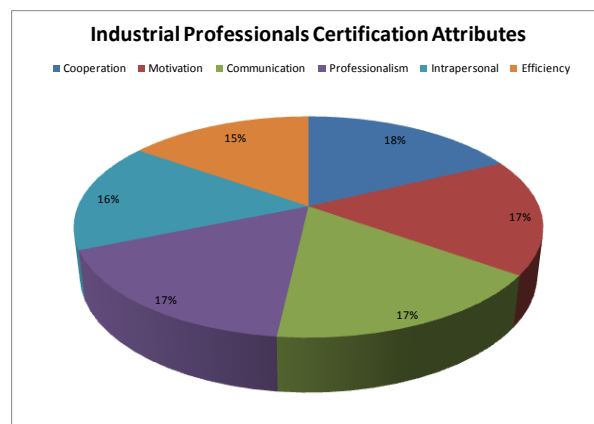


Figure 12. Industrial professionals attributes percentage.

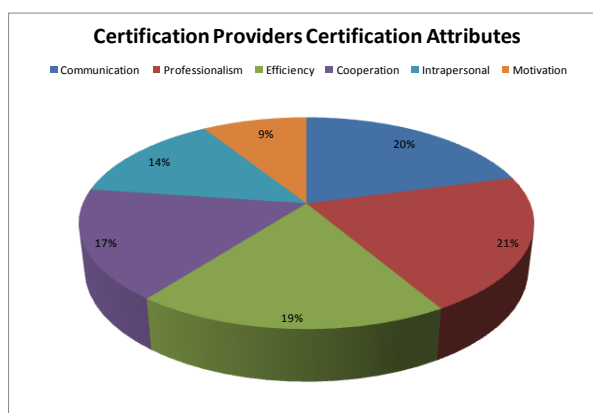


Figure 13. Certification providers attributes percentage.

Comparing the perceived percentage of attributes between the two groups only motivation as an exceeding attribute was insufficient between the two groups due to certification providers listing it as the lowest associated attribute among certified professionals. Refer to Figure 14.

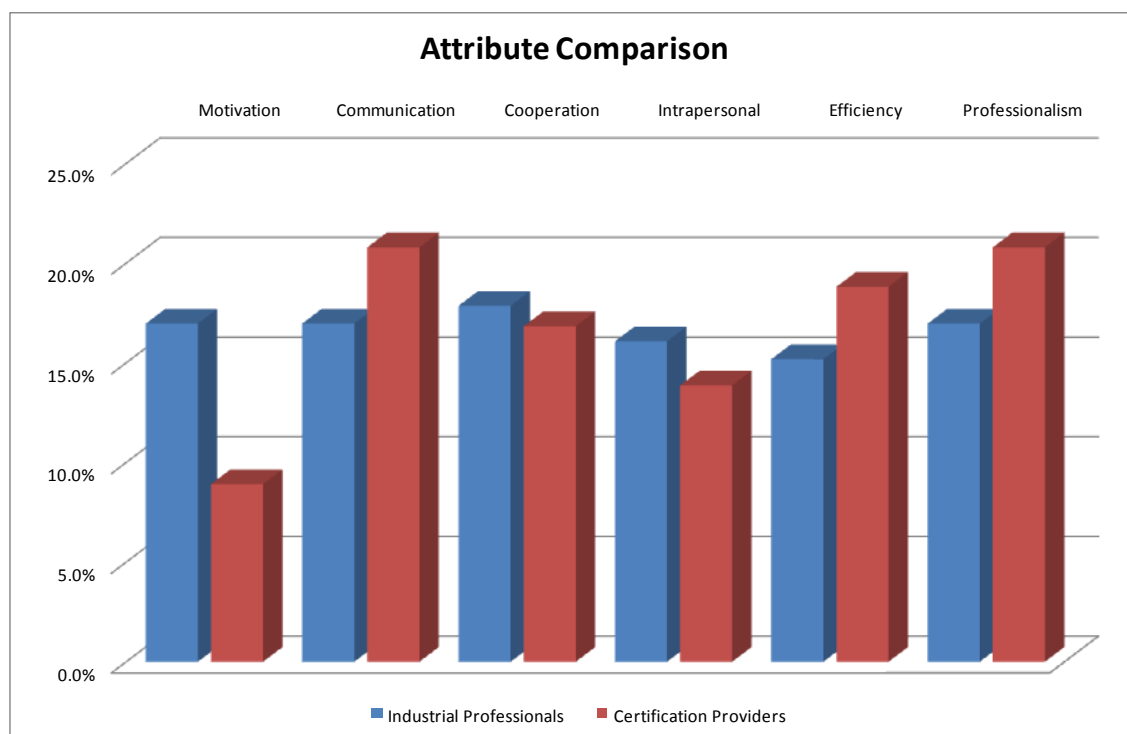


Figure 14. Exceedingly associated attribute comparison.

Opinions.

Considering the open-ended responses from the surveys, the coded responses either supported experience, certification, situational implicitness, or equality. Fifty percent of respondents consider the comparison of experienced individuals to certified individual situational. Experience rated at 25% with certification rated at 20%. Only one respondent stated equal consideration. Refer to Figure 15 and Table A16.

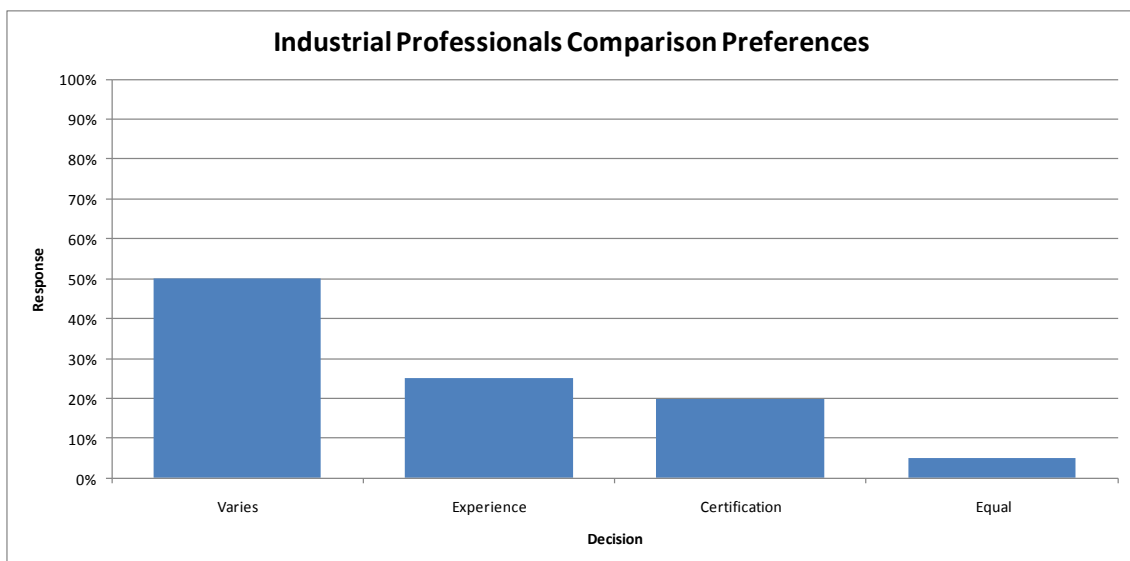


Figure 15. Experience to certification comparison of preference.

Chapter 5

Conclusion

Researching this topic involved identifying residing certifications offered by institutions and employed within industries. According to this research, various advantages are inherent to professional certifications and confer profound personal traits. Differences expressed by industrial professionals aided to reinforce the dispute presented in the review of literature. Monetary incentives described by industrial professionals may offer the most insight into professional certifications but it cannot negate the view that industrial professionals are sensitive to what certifications are acceptable within the organization and how they are achieved, perceived, and fulfilled.

Professional certifications for quality management use elaborate, and often obscure, terms to describe the certification. From this experience, the reluctance of survey participation combined with the urgency to recruit individuals may introduce doubt of the motives and values of certification providers. Certification providers ascertain that certifications promise increased awareness, mobility, pay, and promotion but consumer demands are the critical component of certifications. Core values of the diverse institutions offering certification remains a variable.

Public opinion often condescend quality management certifications in comparison to business type certifications. The reputation of quality management certifications becomes indignant by the failure to determine consensus among issuing agencies and further aggravated by individual preference among industrial professionals. Potential dismissal of possibly valid professional certifications by industrial professionals could serve as the demise of the reputation of certification providers. Without research and dialog, the sanctity of the certification process could exaggerate their efforts in attempt to

recollect their prestige, simply due to the basis of rhetorical declarations. Arguably, without the intrinsic epistemology, intellectual cultures within industry are jeopardized and the altruistic institution of human development may become fallacious.

Like other accomplishments, professional certification indicates that a person has received formal training and possesses certain attributes. Successful personal development requires that the individual is committed to education and training. Many employees and career-seeking individuals depend on education and training, ensuring suitability of candidacy or reinforcing professional significance, respectively. From the certification providers' respondents, a "trait deficit" exists among individuals regarding motivation. Perhaps personal motivation is negatively affected by external factors, such as increasing tuition costs, or internal factors, such as publicity. From a psychological aspect, individuals should consider the potential consequences of certification including reimbursement and the challenges. Certification providers should continually monitor and adjust learning activities to satisfy industrial needs and to ensure a compelling curriculum for individuals. Industrial professionals could collaborate with certification providers to address the functionality of professional certifications in their respective field and design corresponding curriculums to optimize educational results.

Professional certification programs are relatively obtainable, as presented by achievement rates and tuition costs. Considering the investment, professional certifications balance individual deficiencies diverging between education and experience. Individual accomplishment may be inept to distinguish experience from certification but either suggests that an individual possess certain attributes including

motivation, communication, cooperation, intrapersonal, efficiency, and professionalism. All these attributes are beneficial to systems thinking and organizational effectiveness.

Experience and education are complimentary to one another. Certification without experience is as appealing as experience without certification. Experience without education can only be beneficial when utilized by the employed organization. Workforce mobility depends on accomplishment and attitude. The evidential distinction between experience and certification is highly considered by industrial professionals. Situational circumstances are the most determining factor in the comparison.

Industrial professionals are the end user of certified professionals. Certifications are often not necessary for a position, yet effectiveness ratings suggest that they are a crucial component to the organization. Combined with experience, professional certifications reinforce theory with practice, accelerating personal achievement while enhancing organizational benefits. Based on this research, industrial professionals' value certified professionals by offering substantial compensation for their services. Similar rewards may be alternatively offered to those with experience. Only a minority of industrial professionals perceived certification as a substitute for experience and vice versa. Circumstantial conditions seemed to be the most influential concern among industrial professionals. Accuracy of this testimony is entirely situational and may vary according to the evolution of industry and professionalism.

Certification providers facilitate the learning with motivation as the crucial component of success. Due to the assortment of certifications, selection of certification is appropriately inherent and imperative to the individual. Selecting a certification may depend on advertisement, availability, coercion, procedure, or solicitation as well as

individual expectations and experience. Industrial standards within certification programs combined with accreditation assist individual confidence to choose an institution.

Certifications are more than simply a frame with a fancy document on the wall. Certifications represent one's personal commitment to their profession. The irrefutable factor is that both certification providers and industrial professionals agree that certified professionals possess the attributes to make potential recompense in the workforce. The willingness to meet or exceed personal expectations is detrimental to certification providers, industrial professionals, or those seeking professionalism. Beyond being a source of recognition, the bottom line on black belts and professional certifications is that they are valuable to the organizations in that they reside. Situational conditions are integral to industrial professionals and to individuals when discerning certifications. Certification contributions may only be available from finite institutions but the evolution of human learning remains constant as the core of education, hence human progress.

Recommendations

Personally, persuaded inquisitiveness initially investigated this thesis. No one research can offer authority only theory. This research is limited and is not absolute. From a sociological perspective with introspect for the individual, this research was an experiment and expedition into impending awareness. From the perspective of certification providers, the competitive interactions of certification programs and satisfaction of consumers is precedent to the process. From the perspective of industrial professionals, deterministic choices from candidates for employment endowed with various qualifications can be established through continued inquiry and research.

Complex topics coincide with professional certifications for quality management. The topics generated included demographics, perception, and sociological concerns. The magnitude of various certifications offered by the multitudes of certification providers and the dispersion among industrial professionals all contribute to this effect.

Individuals need to discern between certification providers when considering personal development. Motives for becoming certified may include compensation, recognition, proficiency, and coercion, although there may be intuitive reasons. Monitoring certification offerings requires perseverance and analytical strategies to select an appropriate institution, this assumption can only benefit from continued research.

Certification providers should openly divulge in research regarding quality management. Certification providers may attempt to ensure proposed benefits through sustained action in addressing industrial perspectives and exactness of certification endorsement. Responsive collaboration between industrial professionals and certification providers could be used to derive a practical instrument for certification development. Honest efforts liberate assumptions, offer consensual assessment, and promote understanding between industrial professionals, certification providers, and certified individuals. Practice of this approach, confined by honesty, openness, and willingness, encourages the realization of the benefits while minimizing the risks associated with professional certifications.

The dynamics of the topic demand frequent review of the statistics to describe and append the nature of professional certifications, industry, and individual aspirations. Research of professional certifications for quality management would benefit from further demographics solicited from professional members combined with intimate

accounts. Qualified and willing candidates provide revelations of experience and attitude. This research exhorted to gather sufficient respondents but the response ratio was marginal, hindering the design of research. Survey format issues, the complexity of the surveys, the recipient knowledge of the content, along with uninterested or preoccupied individuals may have affected participation and caused outliers.

Attempts to obtain more samples from the population of interest would assist future inferences. Inquiry revisions matching pairs of data would provide correlative analysis supplemental to the results. Information derived from explicit inquiry of the samples or reaction to ethnographic stimuli in a qualitative design of research would be additionally beneficial. Appraised examination of this research by certification providers, industrial professionals, and individuals seeking professionalism assists clarification of available certifications, publicity and introspect of certification programs, and the benefits incurred with their deployment to all associates.

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Appendices

Appendix A

Tables.

Table 8. Kubiak's approaches to six sigma certification (Kubiak, 2003, p. 8).

<i>Option</i>	<i>Advantages and disadvantages</i>
Do nothing	Maintains the status quo. Continues to promote variability in skills and abilities among black belts and master black belts. Limits opportunities for personal growth and development. Represents the null option and does not address the issue of certification.
Develop own certification	Time consuming and costly to develop. Stabilizes and minimizes variation in skills and capabilities. Costly and difficult to administer. Meets company specific needs. May require high maintenance; training materials should be under configuration control. Subject to in-house political pressure and organizational change.
Recognize self-developed programs from other companies	Perceived skills and abilities contingent upon certifying company--for example, General electric or Honeywell. (Many companies that have chosen this option did so before options 4 and 5 became available or viable.) Provides little confidence in experience and qualifications. Difficult to verify supporting body of knowledge. Limited, if any, access to educational materials. Acceptability of certifications must be determined on a case by case basis. This option is viable only when hiring from the outside.
Purchase certifications from other for-profit organizations	Perceived skills and abilities contingent upon certifying third-party organization. Certification may be perceived as being "bought," rather than earned. May provide some degree of confidence in qualifications. In some instances, may be obtained without experience. Educational materials may be costly. Acceptability of certifications must be determined in a case by case basis.
Adopt professional, independent certification program (usually from non-profit organization).	Variation is controlled; minimum threshold established for technical competence. Low cost and easy to administer. Well-defined and readily accessible body of knowledge. Educational materials readily available at low cost. Provides confidence in skills and abilities. Not subject to in-house political pressure. Educational independent (certification doesn't require a specific educational curriculum). Developed by experts.

Table 9. ASQ certifications (ASQ, n.d.).

<i>Certification</i>	<i>Designation</i>
Biomedical Auditor	CBA
Calibration Technician	CCT
HACCP Auditor	CHA
Manager of Quality/Organizational Excellence	CMQ/OE
Pharmaceutical GMP Professional	CPGP
Quality Inspector	CQI
Quality Auditor	CQA
Quality Engineer	CQE
Quality Improvement Associate	CQIA
Quality Process Analyst	CQPA
Quality Technician	CQT
Reliability Engineer	CRE
Six Sigma Black Belt	SSBB
Six Sigma Green Belt	SSGB
Software Quality Engineer	CSQE

Table 10. IIE certifications (IIE, n.d.).

<i>Certification programs/education</i>	<i>Description</i>
Engineering Management Certificate Program	This program provides you with the basic management skills necessary for leading teams, departments and organizations.
Health Care Certificate Program	This series of seminars will provide you with the basics of the industrial engineering toolbox as applied to health care and introduce you to the fundamental management skills required in this industry.
Industrial Engineering Professional Skills Certificate Program	This series of seminars presents the basics of the industrial engineering toolbox and introduces you to the fundamental management skills you will need to take on demanding tasks in the industry.
Lean Enterprise Certificate Program	This series of seminars is for individuals new to lean who need to understand and apply the basic tools for lean transformation. Courses will assist individuals in all types of businesses, including service, manufacturing, health care, government, finance and education.
Lean Enterprise Master Practitioner Certificate Program	This strategic Lean Black Belt certificate program, for individuals seeking advanced lean concepts and skills, presents tools and techniques to implement lean successfully across the enterprise. Individuals taking this certificate program are expected to have a good working knowledge of the basic lean tools presented in the Lean Enterprise Certificate Program.
Six Sigma Certificate Program	The IIE Six Sigma certificate program requires you to complete a total of 19 days of training delivered in three seminars. Completion of the certificate program will earn you both green belt and black belt certificates as well as the Six Sigma certificate.
<i>Practitioner certificate programs</i>	
Lean and Six Sigma Facilitator Certificate	Equip yourself with the knowledge and skills to facilitate transformation in office, service and technology-based organizations in this project-based program, delivered in two four-day sessions.
Lean Six Sigma Green Belt	Learn how to integrate principles of business, statistics, waste reduction, and engineering to achieve tangible results in this five-day seminar, the introductory course in Lean Six Sigma. You will gain a thorough understanding of Lean Six Sigma and its focus on eliminating defects through fundamental process knowledge.
Six Sigma Black Belt Certificate	Learn the advanced problem-solving skills you'll need to measure a process, analyze the results, develop process improvements and quantify the resulting savings in this program

presented in the classroom in three five-day sessions over a three-month period or online in 10 weeks.

Six Sigma Green Belt Certificate	This program offered both in the classroom and online, will give you a thorough understanding of Six Sigma and its focus on eliminating defects through fundamental process knowledge. Topics covered in addition to DMAIIC and Six Sigma philosophy include basic statistics, statistical process control, process capability, financial implications and root cause analysis.
<i>Specialized certificate courses. The following IIE courses offer a certificate on completion and may require an exam:</i>	
Lean Supply Chain Management Certificate	
Six Sigma Green Belt for Health Care Certificate	
<i>Certification preparation courses. These courses prepare you for specific certification exams:</i>	
Project Management for PMP Certification	
Six Sigma Green Belt for Process Improvement for ASQ Certification	

Table 11. Conversion table of individual to grouped certification.

<i>Individual Certification</i>	<i>Grouped Certification</i>		<i>Individual Certification</i>	<i>Grouped Certification</i>
Green Belt	Green Belt, Black Belt, Master Black Belt, and Silver Belt		Master Six Sigma	Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology
Black Belt			Master Six Sigma Financial Services	
Master Black Belt			Master Six Sigma Information Technology	
Silver Belt			Quality Auditor	Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence
Six Sigma	Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt		Quality Engineer	
Six Sigma Facilitator			Quality Improvement Associate	
Six Sigma Green Belt			Quality Inspector	
Six Sigma Black Belt			Quality Process Analyst	
Six Sigma Gold Belt			Quality Technician	
Six Sigma Master Black Belt			Software Quality Engineer	
Design for Six Sigma Green Belt	Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt		Manager of Quality/Organizational Excellence	
Design for Six Sigma Black Belt			Advanced Master Lean Six Sigma	same as individual
Design for Six Sigma Master Black Belt			Engineering Management	same as individual
Lean Facilitator	Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management		Industrial Engineering Professional Skills	same as individual
Lean Black Belt			Calibration Technician	same as individual
Lean Enterprise			Reliability Engineer	same as individual
Lean Enterprise Master Practitioner			Juran Institute	same as individual
Lean Master				
Lean Six Sigma				
Lean Six Sigma Green Belt				
Lean Six Sigma Black Belt				
Lean Six Sigma Master				
Lean Six Sigma Master Black Belt				
Lean Supply Chain Management				

Table 13. Survey response from ASQ.

Certification	Offered	Accreditation	Attributes						Tuition	Comparison
			Motivation	Communication	Cooperation	Intrapersonal	Efficiency	Professionalism		
Calibration Technician	Yes			Yes	Yes	Yes	Yes	Yes	64%	
Manager of Quality/Organizational Excellence	Yes		Yes	Yes	Yes	Yes	Yes	Yes	74%	
Quality Auditor	Yes			Yes	Yes	Yes	Yes	Yes	72%	
Quality Engineer	Yes			Yes	Yes	Yes	Yes	Yes	56%	
Quality Improvement Associate	Yes			Yes	Yes	Yes	Yes	Yes	83%	
Quality Inspector	Yes			Yes	Yes	Yes	Yes	Yes	53%	
Quality Process Analyst	Yes			Yes	Yes	Yes	Yes	Yes	72%	
Quality Technician	Yes			Yes	Yes	Yes	Yes	Yes	44%	
Reliability Engineer	Yes			Yes	Yes	Yes	Yes	Yes	48%	
Six Sigma Black Belt	Yes			Yes	Yes	Yes	Yes	Yes	68%	
Six Sigma Green Belt	Yes			Yes	Yes	Yes	Yes	Yes	75%	
Software Quality Engineer	Yes			Yes	Yes	Yes	Yes	Yes	80%	
Other										

"Certified people have higher pay rates and positions"

Table 14. Survey response from IIE.

Certification	Offered	Accreditation	Attributes						Tuition	Comparison
			Motivation	Communication	Cooperation	Intrapersonal	Efficiency	Professionalism		
Lean Six Sigma Green Belt	Yes	IACET		Yes	Yes			Yes	\$995	"Individuals who have the certification find themselves much more marketable. They also have a framework within which to apply the tools"
Lean and Six Sigma Facilitator	Yes		Yes	Yes	Yes		Yes	Yes	\$2,995	
Lean Enterprise			Yes	Yes				Yes		
Lean Supply Chain Management										
Lean Enterprise Master Practitioner										
Six Sigma			Yes	Yes			Yes	Yes	\$1,995	
Six Sigma Green Belt	Yes		Yes	Yes			Yes	Yes	\$6,445	
Six Sigma Black Belt	Yes		Yes	Yes	Yes	Yes	Yes	Yes	\$795	
Engineering Management	Yes		Yes	Yes	Yes	Yes	Yes	Yes	\$5,545	
Industrial Engineering Professional Skills	Yes		Yes	Yes	Yes	Yes	Yes	Yes	\$2,449	
Other	Yes								\$2,449	

Table 15. Survey from the Juran Institute.

			Attributes								
Certification	Offered	Accreditation	Motivation	Communication	Cooperation	Intrapersonal	Efficiency	Professionalism	Achievement	Tuition	Comparison
Juran Certification	Yes	IACET	Yes	Yes	Yes	Yes	Yes	Yes	70%		"Those certified understand more vital and critical tools utilized for performance excellence"
Six Sigma Green Belt	Yes										
Six Sigma Black Belt	Yes										
Six Sigma Master Black Belt	Yes										
Lean Master	Yes										
Lean Expert	Yes										

Table 16. Open ended responses.

Open Response from Industrial Professionals					
	"How would you describe the comparison between individuals with certification and the experienced individual?"	Comparison Preference			
Respondent	Response	Certification	Experience	Equal	Varies
1	"The certified individual knows the 'language' better than the experienced individual. Unfortunately, she/he also tends to get too far into the technology instead of focussing on solving the problem."				Yes
2	"The folks with certifications are capable of bringing 'tools' to the discussion, but the knowledge comes from experience."		Yes		
3	"Individuals with on the job experience are often the equivalent of certified individuals."			Yes	
4	"Individuals with experience only tend to create 'black box' approximate solutions. Certified individuals tend to create more analytical solutions closer to optimality."	Yes			
5	"Certified individuals' are looking for standards and recognition from bosses and/or new employers."				Yes
6	"Certifications help people gain knowledge quickly but if it is not applied it is useless. People with knowledge through doing are usually better at affecting change."				Yes
7	"Certifications carry more weight in some circumstances, but would be on case-by-case basis."				Yes
8					
9	"Experience is preferred over certification."		Yes		
10	"Certified means they took a test or exam. Experienced means they spent time applying the knowledge in the field these two items are independent in my mind."				Yes
11	"Highly corresponds to knowledge."				Yes
12	"In specific applications consistent with the area of certification, individuals with certifications fare moderately better than those with experience. Areas where certifications are demonstrably superior are in the aspects of the depth of understanding in relation to applying specific skill sets to the area of expertise as a whole. A better understanding of not only the mechanics of the process or application, but the theory of application provide a better context for applying the abstract potentials of the area of certification not just the mechanical completion of the process."	Yes			
13	"Experienced individuals are those that are able to actually get a job, certified individuals are those that are still not employed in the field of their choice."		Yes		
14	"Certified individuals may not have the experience. If they understand facilitation, they will learn to use the knowledge of those experienced."				Yes
15	"No certification can replace solid experience. Experience coupled with certification is highly regarded. Certification reinforces technical ability."		Yes		
16	"Certifications are written verification of qualification - which includes education and experience followed by demonstrated proficiency through written and practical examinations. Therefore an individual can be fully qualified without certification. However, if given a choice between two equally qualified applicants, greater weight would be given to one with relevant certification(s)."	Yes			
17	"I would not make this comparison in such a simplified manner."				Yes
18	"Certifications help."	Yes			
19	"Experience first. Certification next."		Yes		
20	"It depends. certification without experience is the least valuable. Experience with appropriate certifications is most valuable. Certification is a way for an experienced person to quantify their knowledge."				Yes
21	"Depends on how much experience they both have."				Yes

Appendix B

Figures.

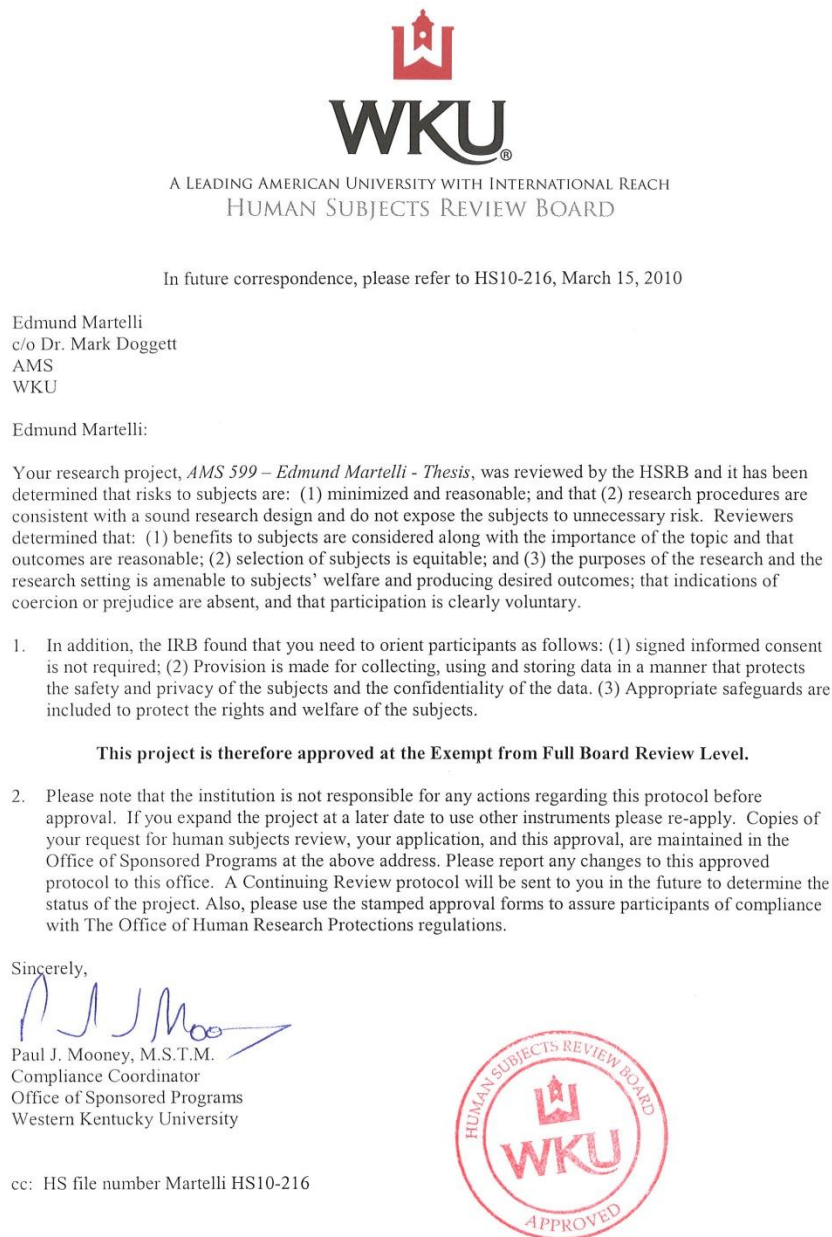


Figure 16. Approval from Human Subjects Review Board.

Survey materials.

Western Kentucky University
Architectural & Manufacturing Science Department
1906 College Heights Boulevard Office 137
Bowling Green, Kentucky 42101
April 19, 2010

Dear Sir or Madam:

This message is to request participation in an online survey. The survey will be used to research various aspects of professional certifications for Quality Management (QM).

The intent of the research is to provide current and valid information regarding both industrial professional perceptions and certification organization opportunities.

All individual participants will remain anonymous. Individual identifiers are not included in the survey. Published results may contain organization information. Dependent on familiarity maximum completion time should be approximately one half hour or less.

The survey was reviewed and approved by Western Kentucky University's (WKU) Institutional Review Board (IRB).

If you, or someone you know, are employed in Quality Management (QM) or an associated profession please feel free to participate.

The survey can be completed online following the hyperlink listed below.

[https://www.wku.edu/Dept/Support/Tech/itdiv/infotech/atech/apps/phpESP/public/survey.php?name=Industrial Professionals Condensed](https://www.wku.edu/Dept/Support/Tech/itdiv/infotech/atech/apps/phpESP/public/survey.php?name=Industrial_Professionals_Condensed)

Any published results will be available at the WKU TopScholar website.

Note: This survey is not a solicitation and not intended to discredit any organization. The intention of the survey is to test hypotheses in the thesis titled, *Intricacies of Professional Certifications for Quality Management (QM)*. The thesis purpose is only for the sake of knowledge and any publicity generated is limited to scientific inquiry.

Sincerely,

Edmund Martelli
Principle Investigator
Graduate Student

Figure 17. Industrial professionals' revised participation letter and hyperlink.

Western Kentucky University
 Architectural & Manufacturing Science Department
 1906 College Heights Boulevard Office 137
 Bowling Green, Kentucky 42101
 April 19, 2010

Dear Sir or Madam:

This message is to request participation in an online survey. The survey will be used to research various aspects of professional certifications for Quality Management (QM).

The intent of the research is to provide current and valid information regarding both industrial professional perceptions and certification organization opportunities.

All individual participants will remain anonymous. Individual identifiers are not included in the survey. Published results may contain organization information. Dependent on familiarity maximum completion time should be approximately one half hour or less.

The survey was reviewed and approved by Western Kentucky University's (WKU) Institutional Review Board (IRB).

If you, or someone you know, are employed in Quality Management (QM) or an associated profession please feel free to participate.

The survey can be completed online following the hyperlink listed below.

<http://www.wku.edu/phpESP/public/survey.php?name=ASQ>

Any published results will be available at the WKU TopScholar website.

Note: This survey is not a solicitation and not intended to discredit any organization. The intention of the survey is to test hypotheses in the thesis titled, *Intricacies of Professional Certifications for Quality Management (QM)*. The thesis purpose is only for the sake of knowledge and any publicity generated is limited to scientific inquiry.

Sincerely,

Edmund Martelli
 Principle Investigator
 Graduate Student

Figure 18. ASQ's participation letter and hyperlink.

Western Kentucky University
 Architectural & Manufacturing Science Department
 1906 College Heights Boulevard Office 137
 Bowling Green, Kentucky 42101
 April 19, 2010

Dear Sir or Madam:

This message is to request participation in an online survey. The survey will be used to research various aspects of professional certifications for Quality Management (QM).

The intent of the research is to provide current and valid information regarding both industrial professional perceptions and certification organization opportunities.

All individual participants will remain anonymous. Individual identifiers are not included in the survey. Published results may contain organization information. Dependent on familiarity maximum completion time should be approximately one half hour or less.

The survey was reviewed and approved by Western Kentucky University's (WKU) Institutional Review Board (IRB).

If you, or someone you know, are employed in Quality Management (QM) or an associated profession please feel free to participate.

The survey can be completed online following the hyperlink listed below.

<http://www.wku.edu/phpESP/public/survey.php?name=IIE>

Any published results will be available at the WKU TopScholar website.

Note: This survey is not a solicitation and not intended to discredit any organization. The intention of the survey is to test hypotheses in the thesis titled, *Intricacies of Professional Certifications for Quality Management (QM)*. The thesis purpose is only for the sake of knowledge and any publicity generated is limited to scientific inquiry.

Sincerely,

Edmund Martelli
 Principle Investigator
 Graduate Student

Figure 19. IIE's participation letter and hyperlink.

Western Kentucky University
 Architectural & Manufacturing Science Department
 1906 College Heights Boulevard Office 137
 Bowling Green, Kentucky 42101
 April 19, 2010

Dear Sir or Madam:

This message is to request participation in an online survey. The survey will be used to research various aspects of professional certifications for Quality Management (QM).

The intent of the research is to provide current and valid information regarding both industrial professional perceptions and certification organization opportunities.

All individual participants will remain anonymous. Individual identifiers are not included in the survey. Published results may contain organization information. Dependent on familiarity maximum completion time should be approximately one half hour or less.

The survey was reviewed and approved by Western Kentucky University's (WKU) Institutional Review Board (IRB).

If you, or someone you know, are employed in Quality Management (QM) or an associated profession please feel free to participate.

The survey can be completed online following the hyperlink listed below.

http://www.wku.edu/phpESP/public/survey.php?name=Juran_Institute

Any published results will be available at the WKU TopScholar website.

Note: This survey is not a solicitation and not intended to discredit any organization. The intention of the survey is to test hypotheses in the thesis titled, *Intricacies of Professional Certifications for Quality Management (QM)*. The thesis purpose is only for the sake of knowledge and any publicity generated is limited to scientific inquiry.

Sincerely,

Edmund Martelli
 Principle Investigator
 Graduate Student

Figure 20. Juran Institute's participation letter and hyperlink.

Professional Certification Survey for Industrial Professionals

INSTRUCTIONS. Information obtained is only for research. Any information provided is voluntary. Respond to the questionnaire and follow instructions for each question. Please ensure that applicable responses are genuinely informed. If the question does not apply to your organization simply disregard that question or respond as non-applicable. There is not a time limit on the survey. Ranked order responses in this survey are scaled numerically from one (1) through five (5), whereas a response of one is least effective and a response of five is most effective. Compensation in this survey is expressed in approximate USD (United States Dollar). Subsequent to survey completion submit the survey.

Questions marked with an * are required.

1. **INFORMED CONSENT- AUTHORIZATION TO USE AND DISCLOSE INFORMATION.** Description. This survey will attempt to identify differences in current certification organizations for manufacturing sectors. This survey is completed using the Internet and a web server protocol. Duration of this survey will vary accordingly to the individual. All personal information disclosed remains in confidentiality. Any published results are intended for general knowledge purposes only. I agree to permit the Principal Investigator and collaborators to obtain, use, and disclose the anonymous information provided as subsequently described. Conditions. 1. I understand that all information is confidential. I will not be personally identified in any information. I agree to complete this online survey for research purposes. I understand that data derived from this survey may be made publically available in the form of presentations and literature. 2. I understand the online survey involves questions regarding professional certifications and their viability. All individual information will not be revealed or recorded. 3. I understand that declining to participate will involve no adverse consequences, I may withdraw at any time, and I may decline to answer any question in that I am not comfortable. 4. I understand that I can contact the Principle Investigator with any concerns. I am aware that participation offers no direct benefit other than a general pursuit of knowledge. 5. By answering yes to the question below I voluntarily provide consent, acknowledge my rights as a participant as described above, and provide consent to the Principle Investigator to use my information to collect, interpret, analyze, conclude results in a publish form. *Do you understand the above instructions, description, and conditions, and will you voluntarily participate?

- ☐ Yes
- ☐ No

2. *What is your title within the organization and how many years have you occupied the position?

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3. Of the professional certifications listed below which are required by the organization?

- ☐ Green Belt, Black Belt, Master Black Belt, and Silver Belt
- ☐ Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt
- ☐ Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt
- ☐ Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management
- ☐ Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology
- ☐ Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence
- ☐ Advanced Master Lean Six Sigma
- ☐ Engineering Management
- ☐ Industrial Engineering Professional Skills
- ☐ Calibration Technician
- ☐ Reliability Engineer
- ☐ Juran Institute
- ☐ none applicable
- ☐ Other:

4. Which of the listed certifications are acceptably issued internally by the organization?

- ☐ Green Belt, Black Belt, Master Black Belt, and Silver Belt
- ☐ Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt
- ☐ Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt
- ☐ Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management
- ☐ Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology
- ☐ Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence
- ☐ Advanced Master Lean Six Sigma

- ☐ Engineering Management
- ☐ Industrial Engineering Professional Skills
- ☐ Calibration Technician
- ☐ Reliability Engineer
- ☐ Juran Institute
- ☐ none applicable
- ☐ Other:

5. Which of the listed certifications are acceptably issued through an affiliate? (i.e., ASQ, IIE, BMGU, SSA, Juran, Motorola, etc.)

- ☐ Green Belt, Black Belt, Master Black Belt, and Silver Belt
- ☐ Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt
- ☐ Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt
- ☐ Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management
- ☐ Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology
- ☐ Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence
- ☐ Advanced Master Lean Six Sigma
- ☐ Engineering Management
- ☐ Industrial Engineering Professional Skills
- ☐ Calibration Technician
- ☐ Reliability Engineer
- ☐ Juran Institute
- ☐ none applicable
- ☐ Other:

6. Of the professional certifications listed, how would you rate their effectiveness in the organization? (1 least effective, 5 most effective)

- Green Belt, Black Belt, Master Black Belt, and Silver Belt
- Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt
- Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt
- Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six

- Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management
- Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology
 - Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence
 - Advanced Master Lean Six Sigma
 - Engineering Management
 - Industrial Engineering Professional Skills
 - Calibration Technician
 - Reliability Engineer
 - Juran Institute
 - none applicable
 - Other:

7. How would you describe the comparison between individuals with certification and the experienced individual?

8. Does your organization utilize the Green Belt, Black Belt, Master Black Belt, and Silver Belt certifications? (if not, please skip)

- ☐ Yes
- ☐ No

9. Which of the attributes listed are exceedingly associated with Green Belt, Black Belt, Master Black Belt, and Silver Belt certifications?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

10. What approximate annual salary (compensation) do Green Belt, Black Belt, Master Black Belt, and Silver Belt certified professionals receive within your organization?

11. Does your organization utilize the Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt professional certifications? (if not, please skip)

- ☐ Yes
- ☐ No

12. Which of the attributes listed are exceedingly associated with Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt certifications?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

13. What approximate annual salary (compensation) do Six Sigma, Six Sigma Facilitator, Six Sigma Green Belt, Six Sigma Black Belt, Six Sigma Gold Belt, and Six Sigma Master Black Belt certified professionals receive within your organization?

14. Does your organization utilize the Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt professional certifications? (if not, please skip)

- ☐ Yes
- ☐ No

15. Which of the attributes listed are exceedingly associated with Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt certifications?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)

- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

16. What approximate annual salary (compensation) do Design for Six Sigma Green Belt, Design for Six Sigma Black Belt, and Design for Six Sigma Master Black Belt certified professionals receive within your organization?

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17. Does your organization utilize the Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management professional certifications? (if not, please skip)

- ☐ Yes
- ☐ No

18. Which of the attributes listed are exceedingly associated with a Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management certifications?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

19. What approximate annual salary (compensation) do Lean Facilitator, Lean Black Belt, Lean Enterprise, Lean Enterprise Master Practitioner, Lean Master, Lean Six Sigma, Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master, Lean Six Sigma Master Black Belt, and Lean Supply Chain Management certified professionals receive within your organization?

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20. Does your organization utilize the Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology professional certifications? (if not, please skip)

- ☐ Yes
- ☐ No

21. Which of the attributes listed are exceedingly associated with a Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology certifications?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

22. What approximate annual salary (compensation) do Master Six Sigma, Master Six Sigma Financial Services, and Master Six Sigma Information Technology certified professionals receive within your organization?

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23. Does your organization utilize the Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence professional certifications? (if not, please skip)

- ☐ Yes
- ☐ No

24. Which of the attributes listed are exceedingly associated with Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence certifications?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

25. What approximate annual salary (compensation) do Quality Auditor, Quality Engineer, Quality Improvement Associate, Quality Inspector, Quality Process Analyst, Quality Technician, Software Quality Engineer, and Manager of Quality/Organizational Excellence certified professionals receive within your organization?

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26. Does your organization utilize the Advanced Master Lean Six Sigma professional certification? (if not, please skip)

- ☐ Yes
- ☐ No

27. Which of the attributes listed are exceedingly associated with a Advanced Master Lean Six Sigma certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

28. What approximate annual salary (compensation) do Advanced Master Lean Six Sigma certified professionals receive within your organization?

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29. Does your organization utilize the Engineering Management professional certification? (if not, please skip)

- ☐ Yes
- ☐ No

30. Which of the attributes listed are exceedingly associated with a Engineering Management certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)

- ☐ Professionalism (appearance, effectiveness, mastery)

31. What approximate annual salary (compensation) do Engineering Management certified professionals receive within your organization?

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32. Does your organization utilize the Industrial Engineering Professional Skills professional certification? (if not, please skip)

- ☐ Yes
- ☐ No

33. Which of the attributes listed are exceedingly associated with an Industrial Engineering Professional Skills certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

34. What approximate annual salary (compensation) do Industrial Engineering Professional Skills certified professionals receive within your organization?

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35. Does your organization utilize the Calibration Technician professional certification? (if not, please skip)

- ☐ Yes
- ☐ No

36. Which of the attributes listed are exceedingly associated with a Calibration Technician certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)

- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

37. What approximate annual salary (compensation) do Calibration Technician certified professionals receive within your organization?

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38. Does your organization utilize the Reliability Engineer professional certification? (if not, please skip)

- ☐ Yes
- ☐ No

39. Which of the attributes listed are exceedingly associated with a Reliability Engineer certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

40. What approximate annual salary (compensation) do Reliability Engineer certified professionals receive within your organization?

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41. Does your organization utilize the Juran Institute professional certification? (if not, please skip)

- ☐ Yes
- ☐ No

42. Which of the attributes listed are exceedingly associated with a Juran Institute certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)

- Intrapersonal (creativity/ sensitivity)
- Efficiency (spatial/logical)
- Professionalism (appearance, effectiveness, mastery)

43. What approximate annual salary (compensation) do Juran Institute certified professionals receive within your organization?

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Thank you for participating.
Edmund Martelli-Western Kentucky University-Principle Investigator

Figure 21. Revised survey for industrial professionals.

Professional Certification Survey

INSTRUCTIONS. Information obtained is only for research. Any information provided is voluntary. Respond to the questionnaire and follow instructions for each question. Please ensure that applicable responses are genuinely informed. If the question does not apply to your organization simply disregard that question or respond as non-applicable. There is not a time limit on the survey. Rate responses in this survey are expressed as a percentage from zero percent (0%) to one-hundred percent (100%), whereas zero percent is no quantity and one-hundred percent is full quantity. Cost in this survey is expressed in approximate USD (United States Dollar). Subsequent to survey completion submit the survey.

Questions marked with a * are required.

***1. INFORMED CONSENT- AUTHORIZATION TO USE AND DISCLOSE INFORMATION.** Description. This survey will attempt to identify differences in current certification organizations for manufacturing sectors. This survey is completed using the Internet and a web server protocol. Duration of this survey will vary accordingly to the individual. All personal information disclosed remains in confidentiality. Any published results are intended for general knowledge purposes only. I agree to permit the Principal Investigator and collaborators to obtain, use, and disclose the anonymous information provided as subsequently described. Conditions. 1. I understand that all information is confidential. I will not be personally identified in any information. I agree to complete this online survey for research purposes. I understand that data derived from this survey may be made publically available in the form of presentations and literature. 2. I understand the online survey involves questions regarding professional certifications and their viability. All individual information will not be revealed or recorded. 3. I understand that declining to participate will involve no adverse consequences, I may withdraw at any

time, and I may decline to answer any question in that I am not comfortable. 4. I understand that I can contact the Principle Investigator with any concerns. I am aware that participation offers no direct benefit other than a general pursuit of knowledge. 5. By answering yes to the question below I voluntarily provide consent, acknowledge my rights as a participant as described above, and provide consent to the Principle Investigator to use my information to collect, interpret, analyze, conclude results in a publish form. Do you understand the above instructions, description, and conditions, and will you voluntarily participate?

- ☐ Yes
- ☐ No

*2. What is your title within the organization and how many years have you occupied the position?

3. Of the professional certifications listed which are offered by your organization?
Calibration Technician

- ☐ Manager of Quality/Organizational Excellence
- ☐ Quality Auditor
- ☐ Quality Engineer
- ☐ Quality Improvement Associate
- ☐ Quality Inspector
- ☐ Quality Process Analyst
- ☐ Quality Technician
- ☐ Reliability Engineer
- ☐ Six Sigma Black Belt
- ☐ Six Sigma Green Belt
- ☐ Software Quality Engineer
- ☐ Other

4. What accreditations does your organization maintain to ensure competency?

5. How would you describe the comparison between individuals with certification and the experienced individual?

6. Which of the attributes listed are exceedingly invested to the Calibration Technician certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

7. Which of the attributes listed are exceedingly invested to the Manager of Quality/Organizational Excellence certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

8. Which of the attributes listed are exceedingly invested to the Quality Auditor certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

9. Which of the attributes listed are exceedingly invested to the Quality Engineer certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

10. Which of the attributes listed are exceedingly invested to the Quality Improvement Associate certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

11. Which of the attributes listed are exceedingly invested to the Quality Inspector certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

12. Which of the attributes listed are exceedingly invested to the Quality Process Analyst certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

13. Which of the attributes listed are exceedingly invested to the Quality Technician certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

14. Which of the attributes listed are exceedingly invested to the Reliability Engineer certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)

- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

15. Which of the attributes listed are exceedingly invested to the Six Sigma Black Belt certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

16. Which of the attributes listed are exceedingly invested to the Six Sigma Green Belt certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

17. Which of the attributes listed are exceedingly invested to the Software Quality Engineer certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

18. What is the most current achievement rate in percentage terms for the Calibration Technician certification?

19. What is the most current achievement rate in percentage terms for the Manager of Quality/Organizational Excellence certification?

20. What is the most current achievement rate in percentage terms for the Quality Auditor certification?

21. What is the most current achievement rate in percentage terms for the Quality Engineer certification?

22. What is the most current achievement rate in percentage terms for the Quality Improvement Associate certification?

23. What is the most current achievement rate in percentage terms for the Quality Inspector certification?

24. What is the most current achievement rate in percentage terms for the Quality Process Analyst certification?

25. What is the most current achievement rate in percentage terms for the Quality Technician certification?

26. What is the most current achievement rate in percentage terms for the Reliability Engineer certification?

27. What is the most current achievement rate in percentage terms for the Six Sigma Black Belt certification?

28. What is the most current achievement rate in percentage terms for the Six Sigma Green Belt certification?

29. What is the most current achievement rate in percentage terms for the Software Quality Engineer certification?

30. What is the average cost of tuition per individual for a Calibration Technician certification?

31. What is the average cost of tuition per individual for a Manager of Quality/Organizational Excellence certification?

32. What is the average cost of tuition per individual for a Quality Auditor certification?

33. What is the average cost of tuition per individual for a Quality Engineer certification?

34. What is the average cost of tuition per individual for a Quality Improvement Associate certification?

35. What is the average cost of tuition per individual for a Quality Inspector certification?

36. What is the average cost of tuition per individual for a Quality Process Analyst certification?

37. What is the average cost of tuition per individual for a Quality Technician certification?

38. What is the average cost of tuition per individual for a Reliability Engineer certification?

39. What is the average cost of tuition per individual for a Six Sigma Black Belt certification?

40. What is the average cost of tuition per individual for a Six Sigma Green Belt certification?

41. What is the average cost of tuition per individual for a Software Quality Engineer certification?

Thank you for participating.
Edmund Martelli-Western Kentucky University-Principle Investigator

Figure 22. Survey for ASQ.

Professional Certification Survey

INSTRUCTIONS. Information obtained is only for research. Any information provided is voluntary. Respond to the questionnaire and follow instructions for each question. Please ensure that applicable responses are genuinely informed. If the question does not apply to your organization simply disregard that question or respond as non-applicable. There is not a time limit on the survey. Rate responses in this survey are expressed as a percentage from zero percent (0%) to one-hundred percent (100%), whereas zero percent is no quantity and one-hundred percent is full quantity. Cost in this survey is expressed in approximate USD (United States Dollar). Subsequent to survey completion submit the survey.

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provided as subsequently described. Conditions. 1. I understand that all information is confidential. I will not be personally identified in any information. I agree to complete this online survey for research purposes. I understand that data derived from this survey may be made publically available in the form of presentations and literature. 2. I understand the online survey involves questions regarding professional certifications and their viability. All individual information will not be revealed or recorded. 3. I understand that declining to participate will involve no adverse consequences, I may withdraw at any time, and I may decline to answer any question in that I am not comfortable. 4. I understand that I can contact the Principle Investigator with any concerns. I am aware that participation offers no direct benefit other than a general pursuit of knowledge. 5. By answering yes to the question below I voluntarily provide consent, acknowledge my rights as a participant as described above, and provide consent to the Principle Investigator to use my information to collect, interpret, analyze, conclude results in a publish form. Do you understand the above instructions, description, and conditions, and will you voluntarily participate?

- ☐ Yes
- ☐ No

*2. What is your title within the organization and how many years have you occupied the position?

3. Of the professional certifications listed which are offered by your organization?

- ☐ Lean Six Sigma Green Belt
- ☐ Lean and Six Sigma Facilitator
- ☐ Lean Enterprise
- ☐ Lean Supply Chain Management
- ☐ Lean Enterprise Master Practitioner
- ☐ Six Sigma
- ☐ Six Sigma Green Belt
- ☐ Six Sigma Black Belt
- ☐ Engineering Management
- ☐ Industrial Engineering Professional Skills
- ☐ Other

4. What accreditations does your organization maintain to ensure competency?

5. How would you describe the comparison between individuals with certification and the experienced individual?

6. Which of the attributes listed are exceedingly invested to the Lean Six Sigma Green Belt certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

7. Which of the attributes listed are exceedingly invested to the Lean and Six Sigma Facilitator certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

8. Which of the attributes listed are exceedingly invested to the Lean Enterprise certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

9. Which of the attributes listed are exceedingly invested to the Lean Supply Chain Management certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)

- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

10. Which of the attributes listed are exceedingly invested to the Lean Enterprise Master Practitioner certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

11. Which of the attributes listed are exceedingly invested to the Six Sigma certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

12. Which of the attributes listed are exceedingly invested to the Six Sigma Green Belt certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

13. Which of the attributes listed are exceedingly invested to the Six Sigma Black Belt certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

14. Which of the attributes listed are exceedingly invested to the Engineering Management certification?

- Motivation (punctuality, enthusiasm)
- Communication (oral/written)
- Cooperation (patients/participation/consideration)
- Intrapersonal (creativity/ sensitivity)
- Efficiency (spatial/logical)
- Professionalism (appearance, effectiveness, mastery)

15. Which of the attributes listed are exceedingly invested to the Industrial Engineering Professional Skills certification?

- Motivation (punctuality, enthusiasm)
- Communication (oral/written)
- Cooperation (patients/participation/consideration)
- Intrapersonal (creativity/ sensitivity)
- Efficiency (spatial/logical)
- Professionalism (appearance, effectiveness, mastery)

16. What is the most current achievement rate in percentage terms for the Lean Six Sigma Green Belt certification?

17. What is the most current achievement rate in percentage terms for the Lean and Six Sigma Facilitator certification?

18. What is the most current achievement rate in percentage terms for the Lean Enterprise certification?

19. What is the most current achievement rate in percentage terms for the Lean Supply Chain Management certification?

20. What is the most current achievement rate in percentage terms for the Lean Enterprise Master Practitioner certification?

21. What is the most current achievement rate in percentage terms for the Six Sigma certification?

22. What is the most current achievement rate in percentage terms for the Six Sigma Green Belt certification?

23. What is the most current achievement rate in percentage terms for the Six Sigma Black Belt certification?

24. What is the most current achievement rate in percentage terms for the Engineering Management certification?

25. What is the most current achievement rate in percentage terms for the Industrial Engineering Professional Skills certification?

26. What is the average cost of tuition per individual for a Lean Six Sigma Green Belt certification?

27. What is the average cost of tuition per individual for a Lean and Six Sigma Facilitator certification?

28. What is the average cost of tuition per individual for a Lean Enterprise certification?

29. What is the average cost of tuition per individual for a Lean Supply Chain Management certification?

30. What is the average cost of tuition per individual for a Lean Enterprise Master Practitioner certification?

31. What is the average cost of tuition per individual for a Six Sigma certification?

32. What is the average cost of tuition per individual for a Six Sigma Green Belt certification?

33. What is the average cost of tuition per individual for a Six Sigma Black Belt certification?

34. What is the average cost of tuition per individual for a Engineering Management certification?

35. What is the average cost of tuition per individual for a Industrial Engineering Professional Skills certification?

Thank you for participating.
Edmund Martelli-Western Kentucky University-Principle Investigator

Figure 23. Survey for IIE.

Professional Certification Survey

INSTRUCTIONS. Information obtained is only for research. Any information provided is voluntary. Respond to the questionnaire and follow instructions for each question. Please ensure that applicable responses are genuinely informed. If the question does not apply to your organization simply disregard that question or respond as non-applicable. There is not a time limit on the survey. Rate responses in this survey are expressed as a percentage from zero percent (0%) to one-hundred percent (100%), whereas zero percent is no quantity and one-hundred percent is full quantity. Cost in this survey is expressed in approximate USD (United States Dollar). Subsequent to survey completion submit the survey.

Questions marked with a * are required.

*1. INFORMED CONSENT- AUTHORIZATION TO USE AND DISCLOSE INFORMATION. Description. This survey will attempt to identify differences in current certification organizations for manufacturing sectors. This survey is completed using the Internet and a web server protocol. Duration of this survey will vary accordingly to the individual. All personal information disclosed remains in confidentiality. Any published results are intended for general knowledge purposes only. I agree to permit the Principal Investigator and collaborators to obtain, use, and disclose the anonymous information provided as subsequently described. Conditions. 1. I understand that all information is confidential. I will not be personally identified in any information. I agree to complete this online survey for research purposes. I understand that data derived from this survey may be made publically available in the form of presentations and literature. 2. I understand the online survey involves questions regarding professional certifications and their viability. All individual information will not be revealed or recorded. 3. I understand that declining to participate will involve no adverse consequences, I may withdraw at any time, and I may decline to answer any question in that I am not comfortable. 4. I understand that I can contact the Principle Investigator with any concerns. I am aware that participation offers no direct benefit other than a general pursuit of knowledge. 5. By answering yes to the question below I voluntarily provide consent, acknowledge my rights as a participant as described above, and provide consent to the Principle Investigator to use my information to collect, interpret, analyze, conclude results in a publish form. Do you understand the above instructions, description, and conditions, and will you voluntarily participate?

- ☐ Yes
- ☐ No

*2. What is your title within the organization and how many years have you occupied the position?

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3. Of the professional certifications listed which are offered by your organization?

- ☐ Juran certification
- ☐ Other
- ☐ Other
- ☐ Other
- ☐ Other
- ☐ Other

4. What accreditations does your organization maintain to ensure competency?

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5. How would you describe the comparison between individuals with certification and the experienced individual?

6. Which of the attributes listed are exceedingly invested to the Juran certification?

- ☐ Motivation (punctuality, enthusiasm)
- ☐ Communication (oral/written)
- ☐ Cooperation (patients/participation/consideration)
- ☐ Intrapersonal (creativity/ sensitivity)
- ☐ Efficiency (spatial/logical)
- ☐ Professionalism (appearance, effectiveness, mastery)

7. What is the most current achievement rate in percentage terms for the Juran certification?

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8. What is the average cost of tuition per individual for a Juran certification?

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Thank you for participating.
Edmund Martelli-Western Kentucky University-Principle Investigator

Figure 24. Survey for the Juran Institute