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The ATMAE Lean Six Sigma Certification Exam: Why it Matters to You?

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The ATMAE Lean Six Sigma Certification Exam: Why it Matters to You?

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ABSTRACT

As Lean Six Sigma grows in popularity among a wide variety of companies and organizations, the demand for employees possessing these skills intensifies. Furthermore, this demand has caused the average starting salaries of certified Lean Six Sigma Black Belt professionals to exceed $100,000. This article focuses on the development process of an affordable Lean Six Sigma certification alternative that follows the guidelines of the strictest personal certification accrediting body. A thorough review of the leading Lean Six Sigma Black Belt certification programs is discussed as well as why it was conducted to justify the rational for the development of the ATMAE Lean Six Sigma certification program. In addition, this article discusses the significance of the ATMAE Lean Six Sigma certification to higher education program faculty, students, and industry professionals. The content for the newly developed certification exam is reviewed as well as the format and duration of the exam. Moreover, belt status is also explained as is the question format and scoring procedure for the exam.

Introduction

Significance of Lean Six Sigma

The term Lean has now been used to depict a management philosophy for over 25 years when John Krafcik (1988) coined the term to describe the Toyota Production System while he was an MIT graduate student working on a research project focused on the productivity performance of the automotive industry. Although most people associate the term Lean with manufacturing, a wide variety of businesses and industries have embraced Lean as well. For instance, in healthcare Lean is becoming a popular method for process improvement such as improving the quality of care for patients and by increasing the efficiencies and patient flow through healthcare facilities (Anderson-Dean, 2012). Chris Crouch (2012) noted that even the concrete industry can benefit from Lean by creating standardized operating procedures so every employee can make a batch of concrete meet the specified standards as well as your best employee can. An even more obscure use for Lean was using it to assist with the United States Army's base closure process and troop transfer efforts in Afghanistan (Lopez, 2013).

Six Sigma is another term that has been used to define quality since 1986 when Bill Smith decided to use it as a measure for improving quality at Motorola (Motorola Solutions, 2014). As Lean primarily focuses on reducing waste in an organization, Six Sigma quality concentrates on reducing the variation among processes and tasks which equates to only 3.4 defects per million opportunities. The Six Sigma process for quality improvement used by itself was only effective enough to reach four sigma at Motorola (Ramberg, 2000). Therefore, Lean practices were integrated with the Six Sigma quality initiative at Motorola to eventually achieve Six Sigma quality in their processes (Motorola Solutions, 2012). During this process, Motorola started its own training center which eventually became Motorola University. The university was established to train the thousands of Motorola employees that worked at their 50 plus plants that spanned the globe (Harry, 2014). Over the years, Motorola opened the training to their suppliers to ensure the viability of quality parts and later to any organization interested in training their personnel.

Because of this easy accessibility to training and the success of Motorola, Lean Six Sigma popularity grew from not just large corporations but also to any organization looking to stay profitable or seek improvement. For example, even public entities such as the city of Irving, Texas have implemented Lean Six Sigma to reduce the cycle time for an average street repair from 14 weeks to less than six weeks (Brandt, 2011).

The financial gains from using the Lean Six Sigma process for reducing waste and variation are significant. In fact, after Motorola introduced its Six Sigma quality program it noted cost savings of 16 billion from the years 1986-2001, General Electric saved 4.4 billion from 1996-1998, Honeywell saved 1.8 billion from 1998-2000, and Ford saved over a billion from 2000-2002 (iSixSigma, n.d.). Pulakanam (2012) conducted a study of 28 organizations that implemented a six sigma quality program and found that the average return for every dollar spent on Six Sigma was over $2 in direct savings. On the whole, most of the tools associated with Lean Six Sigma can be applied to any type of organization to continually improve its quality and competitiveness and that is why it is so important to you.

Salaries of Certified Lean Six Sigma Professionals

As Six Sigma quality programs showed significant savings at Motorola, General Electric, Honeywell, Allied Signal, etc. and how the Lean Production System of Toyota cut into the Big Three automobile manufacturers market share in the late 1980's, the search for Lean Six Sigma certified professionals accelerated. Most of the larger corporations hired consultants to establish Lean Six Sigma training programs at their organizations, however, small to medium size organizations relied on hiring Lean Six Sigma certified professionals already out in the workforce or encouraged their employees to seek this certification.

Because of the proven savings benefits of Lean Six Sigma quality programs, individuals certified in this area are in great demand and therefore command higher salaries. According to Salary.com (2015), the median salary for a certified Six Sigma Black Belt is $97,477. The online job search company Indeed (2015) noted that the average salaries of Black Belt certified professional positions listed on their website was $94,000. The website iSixSigma (2015) noted that the average annual salary of Lean Six Sigma Black Belts was $92,157. In addition, Lean Six Sigma Black Belts are noted to receive bonuses averaging over 10% of their salaries. Therefore, according to all of these sources, Lean Six Sigma Black Belt certified professionals' average over $100,000 a year. Consequently, becoming Lean Six Sigma Black Belt certified can be quite an incentive for college graduates seeking future employment.

Lean Six Sigma Black Belt Certification Providers

As the importance of Lean and Six Sigma spreads to all types of organizations besides manufacturing, so has the demand for certified professionals. In order to meet this demand, the number of organizations offering Lean Six Sigma Black Belt programs has escalated over the years. A Google.com search will uncover hundreds of entities providing Lean, Six Sigma or a combination of both certifications. These programs are provided by a multitude of industries, universities, community colleges, consultants, professional quality organizations and more. Appendix A illustrates the various costs, time, and other pertinent information regarding the top listed certification programs found on the web for Lean and Six Sigma. The issues found with these programs were that they were either very expensive or had no real credibility. Moreover, it was hard to directly compare them since some certification providers only offered testing services while others included the training and testing. In addition, most of them noted that they followed a standardized body of knowledge; however, there currently is no standardized body of knowledge for Lean, Six Sigma or Lean Six Sigma. Further, some certification providers required a project of a certain monetary value that needed to be successfully completed; some required a passing score on an exam; while others required both.

Several leading Six Sigma trainers noted that the inconsistency in training/certification requirements has produced discourse among quality professionals (Hamel, 2011; Munro, 2013 & Ramberg, 2000). DeRuntz and Meier (2009) noted during their research on the importance of ten topics included in the ASQ Six Sigma Black Belt certification that, "While no organization should have its Black Belt training methodologies mandated, there are at least two reasons why a consistent level of rigor to its content is virtually important to the quality of the profession. First, this level of rigor will protect and ensure the credibility of the Black Belt certification, and secondly, will promote the acceptance of Black Belts as a recognized profession" (p.3). Although there are still numerous bodies of knowledge (BOK) pertaining to Lean, Six Sigma,

and Lean Six Sigma, over the past few years many certification programs mention on their websites that their curriculum is derived from one of the following three organizations BOK: ASQ, IASSC, or the Council for Six Sigma Certification.

Need for ATMAE Lean Six Sigma Certification

With the flood of credentialing providers offering Lean Six Sigma certifications, it was thought by these authors that a suitable certification exam would be available for students to take in order to improve their chances of obtaining employment. After a thorough review of over 50 certifications offered on the web, it was found that most of these programs were either too expensive for college students, required a project of a certain monetary value that most students could not secure, and/or there was no feedback used for assessment provided by the certification body to the university programs referring the students. Because of these factors, a Lean Six Sigma Certification Commission (LSSCC) was established by the ATMAE Certification Board to explore the concept of developing such a certification in November of 2010. The major premise for the ATMAE LSSCC was to provide an affordable certification that would provide assessment feedback of examinees to sponsoring college/university programs while also following the guidelines of accrediting organizations to maintain credibility with employers.

Method

Review of Accrediting Bodies for Certification

After the ATMAE LSSCC identified the existing lean six sigma certification providers and categorized them by cost, project completion, and distribution of assessment results, the BOK for each provider was then listed on a spreadsheet to review for commonalities. During this time, the ATMAE Certification Board was in the midst of validating the credibility of their existing certifications so they could appeal to a wider market. Certification consultants had mentioned that the American National Standards Institute (ANSI) accredited personal certification programs which would be appropriate for the ATMAE LSS certification (Georgia Patrick, personal communication, March 9, 2013). The ATMAE LSSCC determined that the ANSI Guide Template ANSI/ISO/IEC 17024 for personnel certification bodies would be followed to develop the exam because of its prevalent use with technical certifications (ANSI, 2011). In addition, the ATMAE LSSCC specifically followed the Guidance on Psychometric Requirements for ANSI Accreditation bulletin which explains in detail the method for developing a valid assessment instrument ranging from determining the content to how to attain high levels of reliability (ANSI, 2009). Moreover, the ATMAE LSSCC referenced the National Commission for Certifying Agencies: Standards for the Accreditation of Certification Programs handbook that is available through the Institute for Credentialing Excellence (NCCA, 2005). This handbook of standards goes into even far greater detail on the expectations of an accredited personal certification program and was invaluable when developing the ATMAE Lean Six Sigma certification exam.

Job Analysis

According to ANSI and NCCA standards, the first step in creating a certification is to conduct a job analysis of all the duties (skills, tasks, knowledge, etc.) that are involved with a job. In the case of the ATMAE Lean Six Sigma certification, instead of reinventing the wheel and starting from scratch, existing bodies of knowledge were compiled from top certifying providers whom had already listed the tasks and knowledge that LSSBB's must know to perform their job. The body of knowledge (BOK) from each of these certifying providers was then reviewed by the ATMAE LSSCC and a list was compiled of all the tasks and knowledge that were deemed important for LSSBB's to perform their duties. The decision was made to compile these tasks from the top certifying bodies by the LSSCC after reading How is the Body of Knowledge Created?, which is listed on the ASQ.org website under Frequently Asked Questions in the Certification section. Under that section of the website it notes that, "The starting point for the exam development process is a job analysis survey that is conducted every five years to identify the skills and knowledge areas currently being used in the field" (ASQ, 2013). It goes on to say that an advisory board is appointed as was the case for the LSSCC for ATMAE. The ASQ advisory board was composed of members who worked in the area of Lean Six Sigma as was the LSSCC for ATMAE. Furthermore, the ATMAE LSSCC reviewed bestselling textbooks on the topic of Lean Six Sigma as did the advisory board for ASQ. The steps used by ASQ to develop their exam follow the guidelines established by ANSI (2009) and NCCA (2005). In addition, IASSC followed the ANSI/ISO/IEC 17024 guidelines as did the other organizations who's BOK were used for developing the lists of tasks performed by a Lean Six Sigma Black Belt. After omitting similar tasks/skills, 125 were identified between all of the certifying bodies as being essential to performing the job of a LSSBB.

Survey

These common tasks/skills were then compiled into a list in no particular order. The list was then used to create a survey that asked 56 existing black belts from a wide range of organizations from across the country to rate a particular Lean Six Sigma concept using a Likert-type scale on how often they used it in their everyday jobs (with a 5 noting that it was used often and a 1 noting that they had never used it on the job). This method for acquiring content for the certification was done similarly to the other organizations so only pertinent job related skills/knowledge would be assessed by the certification. The history of Lean and Six Sigma are not covered in this certification like most other certification bodies because it was not deemed relevant to completing a black belt project by those surveyed. This list or BOK is presented in Appendix B.

Ranking Tasks and Skills

After the survey results were collected, the order of the BOK was changed to reflect the number of points that each task/skill received. The task/skill that received the most points was

ranked number one while the task/skill that received the lowest number of points was ranked at 125. Total points for each of the 125 tasks/skills comprising the BOK were a compilation of the values from the 56 certified black belts who responded to the survey. Only surveys that ranked each of the 125 tasks/skills were used to create the final ranking.

Once the final ranking of tasks/skills was completed, test questions had to be developed to address the BOK. Tasks/skills that were ranked highly had several questions developed to address an examinee's knowledge while tasks/skills that were ranked on the bottom (approximately 25) had only one or no questions developed for the exam as was the norm for the other certification providers.

Psychometrics

Questions were developed based upon the 6 levels of Bloom's Taxonomy as detailed by ANSI (2009) and NCCA (2005) accreditation standards of certification programs. In this way, simple rote memory questions that could easily be Googled or found in the back of a textbook's glossary of terms would be limited. Since the major part of a Lean Six Sigma Black Belt's job is to correct issues (defects and variation) through the use of statistics and other problem solving techniques, analysis, synthesis, and evaluation level questions were developed for the exam as well.

The final exam is comprised of 125 questions of which 100 questions were developed following the lower levels of Bloom's Taxonomy (knowledge, comprehension, and application) and are assigned a one point value while the other 25 questions which are at the higher levels (analysis, synthesis, and evaluation) of Bloom's Taxonomy are each assigned a point value of 4. The higher level questions require an examinee to perform calculations and other time consuming tasks, thereby justifying the higher point value. The exam was designed in a two part format so no one could pass the exam unless they understood and could perform statistical calculations as well as understand and practice lean concepts.

Validity

After the LSS certification exam was completed and reviewed by the ATMAE LSSCC for psychometric and spelling errors, it was made available online. Members of the LSSCC then tested it to make sure all the answers were accurate and that the scores tallied correctly, especially when having one and four point questions. The exam was then sent to each of the certified LSSBB who completed the BOK survey. Thirteen of these individuals made suggestions to improve upon the exam in which all were addressed. The exam was sent to them again and several actually took the exam to see how they would do after passing their LSSBB exam several years earlier. One individual earned a black belt while the remaining individuals scored at the green belt level. These individuals noted that they had not studied

or prepared in any fashion so they didn't expect to achieve black belt level status. The exam is now available on the ATMAE website for individuals to take and its reliability and validity will be checked periodically as a larger number of examinees take the exam. The content for the exam can be found in Appendix C.

Limitations

This study was limited by the fact that only 56 black belt participants voluntarily provided their feedback and that all these participants resided in the United States. In addition, the thoroughness and sincerity of the participants completing the questionnaire could also be a limitation. Furthermore, the development of a new body of knowledge that is based upon the compilation of existing bodies of knowledge from widely known certification bodies could be flawed by how well these certification bodies initially developed their bodies of knowledge. Another limitation to this study was that only a dozen or so of the original black belt participants who completed the survey later provided feedback on the initial draft version of the certification exam that was developed. Lastly, the five year time frame taken to develop the exam may have been too long of a span for the relevancy of some of the content appearing on the exam.

Results

The ATMAE LSS certification exam is comprised of 125 multiple choice questions of which 25 require performing some type of calculation to answer the question. The questions that require time consuming calculations are worth 4 points each while the other 100 questions are worth one point a piece. The total possible score for the exam is 200 points. The exam is unique in that examinees who earn a 40-59% will obtain Lean Six Sigma Yellow Belt status, examinees earning a 60-79% will obtain Lean Six Sigma Green Belt status, and examinees earning an 80% or higher on the exam will obtain Lean Six Sigma Black Belt status (ATMAE, 2015a). Examinees are given two hours to take the open book exam. The exam is one of the least expensive exams on the market and also provides feedback to schools using it for an assessment tool. In all, a breakdown of the 12 major content areas and 88 subsections are provided to proctors of the exam so they can see how well their students fared in that exam session. Moreover, feedback is provided on how well each of the students fared against everyone else who has taken the exam for that year and for the lifespan of the exam. This makes it fairly simple to pin point areas of a program's curriculum that would need to be revised to improve the pass rate as well as better prepare the graduates for future employment opportunities. The free study guide for the exam can be downloaded from the ATMAE.org website as well as additional information on the exam such as pricing, scheduling, requirements, and more (ATMAE, 2015b).

Conclusions

After five years of developing an affordable Lean Six Sigma certification exam, it was concluded that all of the leading Lean Six Sigma Black Belt certification programs reviewed by these authors shared a vast majority of their content even though there is not presently a universally accepted body of knowledge. Furthermore, none of the certification programs were accredited, but several followed the procedures listed by accrediting bodies such as ANSI and NCCA. As a larger number of examinees take the ATMAE Lean Six Sigma exam, true validity and reliability studies can be conducted to guide the ATMAE LSSBB Commission to strengthen and improve the exam so it can be a formidable contender amidst the vast array of Lean Six Sigma certifications currently flooding the market. Although the certification program is still in its infancy, the ATMAE LSS certification program already offers an affordable alternative to individuals seeking some type of Lean Six Sigma belt certification that distinguishes them from others. Moreover, educators have a means of identifying strengths and weaknesses of programs emphasizing Lean Six Sigma as well as a means of assessing students. Lastly, certified graduates improve program placement rates and assist industry with obtaining qualified employees who can hit the ground running.

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Appendix A: Top Five Lean Six Sigma Black Belt Certification Providers Found on the Internet

Certification Body	Type of Organization	Required # of Hours	Certification/Training Cost
Villanovau.com	University – for profit	90	$4,095 online
Trainingcamp.com	Private – for profit	40	$2,995 classroom
Sixsigmatraining.org	Private – for profit	180	$2,420 online
Msicertified.com	Private – for profit	30	$299.95 online
ASQ.org	Professional Org. (Cert.) Consultants (training) – for profit	140	$459 Certification only $10,995 classroom & $3,100 online training

Appendix B: Ranking of the Collective BOK by Certified Lean Six Sigma Black Belts

No.	Ranking	Task/skill/knowledge
1	6	Understand the voice of the customer
2	4	Define the deliverables of a LSS project
3	17	Develop project metrics
4	24	Create a cause & effect / fishbone diagram
5	1	Define DMAIC
6	16	Build a business case & project charter
7	25	Define and create process maps
8	111	Identify and use team communication methods to report progress conduct milestone reviews and support the overall success of the project
9	101	Know the elements of a control plan
10	114	Measure team progress in relation to goals, objectives and other metrics
11	100	Create a cost benefit analysis
12	8	Define a process
13	2	Apply the appropriate methods and procedures for each of the DMAIC steps
14	84	Understand Kanban systems
15	85	Understand poka-yoke (mistake proofing)
16	29	Conduct a Failure Modes & Effects Analysis (FMEA)
17	9	Understand critical to quality characteristics (CTQ's)
18	112	Use team decision-making tools
19	15	Identify and properly select Lean Six Sigma projects
20	103	Determine when to perform a Kaizen Blitz
21	5	Define the problem solving strategy Y = f(x)
22	36	Conduct a capability analysis
23	31	Differentiate between precision & accuracy
24	86	Create Statistical Process Control (SPC) charts
25	113	Define and describe factors that influence the selection of team members
26	107	Define and describe various types of teams
27	98	Calculate center lines & control limits
28	109	Identify and describe the elements required for launching a team
29	39	Identify patterns of variation
30	3	Define the term six sigma
31	18	Prepare financial evaluations & benefits capture
32	115	Develop and use a Gantt chart
33	30	Understand normal distributions & normality
34	11	Know and use the Pareto Analysis (80:20 rule)

35	10	Comprehend the cost of poor quality (COPQ)
36	74	Identify and list experimental methods
37	96	Utilize Control Methods
38	14	Define Cycle Time
39	35	Determine process capability
40	37	Understand the concept of stability
41	26	Create a SIPOC for process improvement
42	108	Define and describe various team roles and responsibilities
43	19	Conduct effective tollgate reviews
44	97	Understand subgroups, impact of variation, frequency of sampling
45	61	Identify the seven wastes
46	27	Draw a current and future state value stream map
47	102	Know the elements of a response plan
48	75	Understand experiment design considerations
49	110	Facilitate team through the classic stages of development: forming, storming, etc.
50	43	Identify sampling techniques & understand uses
51	73	Identify experiment objectives
52	64	Understand correlation
53	87	Collect data for SPC
54	7	Know the six sigma roles & responsibilities
55	90	Read and create a U Chart
56	33	Conduct gage repeatability & reproducibility tests
57	89	Read and create a Xbar-R Chart
58	72	Set up a design of experiments
59	123	Describe the importance of six sigma
60	38	Differentiate between attribute & discrete Capability
61	125	Define DMADV and understand when to use it
62	99	Develop Six Sigma Control Plans
63	124	Know the general history of six sigma & continuous improvement
64	45	Hypothesis Testing
65	46	Understand the general concepts & goals of hypothesis testing
66	44	Understand the Central Limit Theorem
67	41	Understand the classes of distributions
68	28	Create an X-Y Diagram
69	88	Read and create a I-MR Chart
70	22	List and define the seven elements of waste
71	34	Conduct a variable & attribute MSA
72	23	Define and apply 5S

73	106	Describe and apply techniques that motivate and sustain team members
74	119	Define and distinguish between various types of benchmarking
75	40	Conduct a multivariate analysis
76	121	Perform an X-tracker analysis
77	12	Define DPU and DPMO
78	83	Know the control methods for 5S
79	42	Understand inferential statistics
80	20	Know the history of lean
81	47	Understand significance; practical vs. statistical
82	93	Read and create a X-S chart
83	92	Read and create a NP Chart
84	91	Read and create a P Chart
85	52	Understand 1 sample variance
86	48	Understand risk; Alpha & Beta
87	122	Design and apply a quality function deployment (QFD)
88	53	Read and create a One Way ANOVA
89	51	Read and create 1 & 2 sample t-tests
90	32	Understand statistical bias and linearity
91	21	Describe the difference between lean & six sigma
92	71	Understand Data Transformation: Box-Cox plot
93	13	Define and calculate FTY and RTY
94	49	Understand hypothesis testing
95	50	Understand hypothesis testing with normal data
96	54	Conduct hypothesis testing with non-normal data
97	66	Compute a Multiple Regression Analysis
98	80	Be able to fit, diagnose model and center points
99	105	Create an A3 report
100	62	Read and create a One and Two Sample Proportion test
101	82	Identify confounding effects
102	55	Read and create a Mann-Whitney test
103	120	Define and describe elements of metrology, calibration systems, etc.
104	63	Perform a simple linear regression test
105	76	Perform a full factorial experiment
106	69	Understand Confidence & Prediction Intervals
107	60	Read and create a 1 Sample Wilcoxon test
108	65	Understand Residuals Analysis
109	67	Read and calculate a Non- Linear Regression
110	77	Perform a 2k full factorial design
111	95	Read an EWMA Chart
112	79	Understand balanced & orthogonal designs

113	94	Read a CumSum Chart
114	59	Read and create a 1 Sample Sign test
115	56	Read and create a Kruskal-Wallis test
116	58	Read and create a Friedman test
117	57	Read and create a Mood's Median test
118	68	Read and calculate a Multiple Linear Regression
119	78	Calculate linear & quadratic mathematical models
120	81	Understand fractional factorial experiments
121	70	Conduct a residuals analysis
122	104	Develop a Hoshin Plan
123	116	Describe and use the theory of (TRIZ)
124	117	Conduct a Pugh analysis in designing products
125	118	Use Porter's Five forces analysis and portfolio architecting in strategic design and planning

Appendix C: ATMAE Lean Six Sigma Certification Exam Content

Content	Number of Questions
1. Lean – Fundamentals	7
1.1 7 Wastes	
1.2 Gemba	
1.3 Muda, Mura, & Muri	
1.4 5 Whys	
1.5 Jidoka, Poka-yoke	
1.6 Hoshin Planning (A3, PDCA)	
2. Lean - Value Stream Mapping	14
2.1 Purpose and Types	
2.2 Major Parts	
2.3 Icons/Symbols	
2.4 Task, Subtask Diagrams, & Terminators	
2.5 Current State & Future State Maps 1.6 Hoshin Planning (A3, PDCA)	
3. Lean – Stability	14
3.1 4 Ms (man, machine, material, method)	
3.2 5S (sort, set in order, shine, standardize, sustain)	
3.3 TPM (total productive maintenance)	
3.4 OEE (overall equipment effectiveness)	
3.5 Heijunka	
3.6 Kanbans (signal, production, withdrawal)	
3.7 Kaizen, Kaizen Blitz	
3.8 Visual Management	
4. Lean - Standardized Work (Charts, Tables, etc.)	6
4.1 Production Capacity Charts	
4.2 Standardized Work Combination Tables	
4.3 Standardized Work Analysis Chart	
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