ESTABLISHING GRADUATE CERTIFICATES
ARIZONA STATE UNIVERSITY
GRADUATE COLLEGE

This form should be used by programs seeking to establish a new graduate certificate. All sections should be completed. Current graduate certificate guidelines may be found at
http://graduate.asu.edu/faculty_staff/policies/other_opportunities.

The graduate certificate is a programmatic or linked series of courses in a single field or one that crosses disciplinary boundaries. The graduate certificate facilitates professional growth for people who already hold the baccalaureate degree and may be freestanding or linked to a degree program. The virtue of the graduate certificate is that it enables the university to respond to societal needs and promotes university interaction with corporate, industrial, and professional communities.

Submit the completed and signed (chairs, unit deans) proposal to the **Office of Graduate Academic Programs** in the Graduate College. Mail code: 1003 and electronic copies to eric.wertheimer@asu.edu or Denise.Campbell@asu.edu

Please type.

Contact Name(s):	Contact Phone(s):
Esma S. Gel, Program Chair, IE, CIDSE	480.965.2906
Ronald Askin, Director, CIDSE	480.965.2567

College: Ira A. Fulton Schools of Engineering

Department/School:
Industrial Engineering Program, School of Computing, Informatics, and Decision Systems Engineering

Name of proposed Certificate: Lean Six Sigma Black Belt (LSSBB)

Requested Effective Term and Year: Fall 2013

Do Not Fill in this information: Office Use Only
CIP Code:

1. OVERVIEW. Below, please provide a brief overview of the certificate, including the rationale and need for the program, potential size and nature of the target audience, information on comparable programs (at ASU and/or peer institutions), how this program would relate to existing programs at ASU, and any additional appropriate information.

The Lean Six Sigma Black Belt Certificate is aimed at engineers and managers who oversee tactical and strategic projects as well as various operational functions in their organizations. The LSSBB certificate at ASU is intended to replace the Six Sigma Black Belt area of the Graduate Certificate in Statistics as a standalone certificate with a distinct application process. The Six Sigma Black Belt area of the Statistics Certificate has been very popular among the students (primarily MS in Industrial Engineering students), and has generated significant demand for the area courses through the various programs that the Office of Global Outreach & Extended Education (GOEE) run. In particular, GOEE has been able to market the Statistics-Six Sigma Black Belt to various non-degree student populations. Hence, we expect that the proposed certificate will generate significant interest and demand by MS in IE students as well as working professionals looking to further their leadership skills and expertise in statistical modeling and analysis of industrial processes.

Six Sigma is a proven systematic approach to continuous improvement of critical processes in a wide range of industrial environments such as banks, manufacturing facilities, and hospitals. The Six Sigma approach has grown into a field of its own, with several entities offering certification of individuals as "Six Sigma Black Belt". The American Society of Quality (ASQ) defines the Certified Six Sigma Black Belt as "a professional who can explain Six Sigma philosophies and principles, including supporting systems and tools." The typical certification process also has a capstone experience, which is conducted under the guidance and supervision of a Six Sigma Master Black Belt. Other characteristics of a Six Sigma Black Belt individual are (i) demonstration of team leadership, (ii) understanding of all aspects of the so called Define-Measure-Analyze-Improve-Control (DMAIC) improvement process, (iii) basic knowledge of lean enterprise concepts that allows identification of the non-value-added elements and activities.

Increased global pressures on cost-effectiveness has increased the importance of elimination of waste in industrial systems, and shifted the focus from a single objective of improving quality to the joint objective of improving quality and cost-effectiveness through the elimination of wasteful practices. Hence, recent years have seen an increase in entities offering Six Sigma-Lean types of certificates that try to provide the students more depth in the third aspect listed above.

The proposal for the LSSBB graduate certificate aims to provide the students with a set of contemporary tools to produce measurable improvements in industrial processes. The success demonstrated by the Six Sigma Black Belt area of the Statistics certificate is a clear indication for the demand for the certificate; the addition of emphasis to lean will make the certificate more marketable, as evidenced by the general trend in similar certification programs nationwide.

2. ADMINISTRATION AND RESOURCES

A. How will the proposed certificate be administered (including recommendations for admissions, student advisement, retention etc.)? Describe the administering body in detail, especially if the proposed certificate is part of a larger interdisciplinary agenda. How will the graduate support staff for this proposed certificate program be met?

The proposed LSSBB certificate will have a distinct application and admissions process, governed by the rules of the Graduate College. The Graduate Programs Committee (GPC) of the Industrial Engineering (IE) program will administer the certificate program, and will provide recommendations on admission and granting of the certificate to the Graduate College. The graduate advising staff of CIDSE will provide support to students considering or pursuing the certificate. Similar to the Statistics Certificate, students will be required to apply for admission in a timely manner, before the completion of a significant portion of the required courses.

B. What are the resource implications for the proposed certificate, including any projected budget needs?

Will new books, library holdings, equipment, laboratory space and/or personnel be required now or in the future? If multiple units/programs will collaborate in offering this certificate, please discuss the resource contribution of each participating program. Letters of support must be included from all academic units that will commit resources to this certificate program.

The proposed graduate certificate carries no expected resource implications. The required courses are regularly offered by existing IE program faculty.

3. ADMISSIONS PROCEDURES AND CRITERIA

A. Admission criteria – Applicants must meet the admissions criteria for the Graduate College. Please also include any other additional admission requirements, e.g. type of undergraduate degree, minimum GPA, tests and/or entry-level skills that are required for this certificate program. (http://graduate.asu.edu/faculty_staff/policies/admissions)

Students should have completed a course in basic statistics, have math through vector calculus, and demonstrated computer skills with modern programming languages and software. The basic statistics course should cover descriptive statistics, modeling uncertainty though the use of probability distributions, the concept of hypothesis testing, analysis of variance, and confidence intervals, and simple linear regression. Students will be communicated any further deficiencies that need to be remedied prior to taking the required courses.

B. Application Review Terms

Indicate all terms for which applications for admissions are accepted and the corresponding application deadline dates, if any:

<u>**To select desired box**</u>, place cursor on the left side of the box, right click mouse, select *Properties*, under *Default Value* select *Checked*, press *OK* and the desired box will be checked

        ☒ Fall   Deadline (month/year): **July 1**

        ☒ Spring   Deadline (month/year): **October 1**

        ☒ Summer   Deadline (month/year): **April 1**

C. Projected annual admission/enrollment

How many students will be admitted immediately following final approval of the certificate? What are enrollment projections for the next three years?

We expect that the annual enrollment to the graduate certificate will be in the order of 50 students. The SSBB area of the Statistics certificate has been very popular among the IE students as well as working professionals and students from US and other countries.

---

4. ACADEMIC REQUIREMENTS

A. Minimum credit hours required for certificate (15 credit hour minimum)

15 credit hours

B. Please describe the primary course delivery mode, (e.g., online, face-to-face, off-site etc.). Please note: If this proposed initiative will be offered underline completely online, clearly state that in this section.

Courses will be available face-to-face for on-campus students and available Online through the Office of Global Outreach & Extended Education (GOEE). To support the professional engineering workforce, students will be able to complete the graduate certificate entirely online. All of the required courses have been offered online several times previously.

C. As applicable, please describe culminating experience required (e.g., internship, project, research paper, capstone course, etc.)

The culminating experience is the applied project that the students are required to complete as part of the capstone course indicated in the course list below. This requirement is in line with the Black Belt certification requirements used nationwide in similar commercially available certification programs.

D. What knowledge, competencies, and skills (learning outcomes) should students have when they graduate from this proposed certificate program? Examples of program learning outcomes can be found at (http://www.asu.edu/oue/assessment.html).

Graduates of the certificate program will:

- **Gain an in-depth understanding of the DMAIC process and the tools used to achieve effective process and product improvement,**

- **Develop leadership and team-building skills necessary to oversee continuous improvement projects with many stakeholders, and**

- **Understand how lean principles and design for Six Sigma fit into the overall task of product and process improvement.**

Among the above stated outcomes, it is worthwhile to explain further how the leadership and team building skills will be developed.

The required IEE 585 Six Sigma Capstone course involves a real-life six sigma project, conducted under the supervision of a Six Sigma Master Black Belt in addition of the course instructor. The project involves all of the usual and necessary components of the DMAIC (Define, Measure, Analyze, Improve, Control) process of the Six Sigma approach, in addition to the demonstration of a deep understanding of the problem and solution approach by the student. In particular, the student is expected to take leadership in the definition of the problem and the determination of the appropriate methods to address it, in the context of the define, measure, analyze, improve and control steps. The project is conducted by the students throughout the semester, and are generally set up by students themselves, through the instructors' contacts in local industrial companies.

The project and results have to be considered and evaluated by the Six Sigma master Black Belt overseeing or supervising the project at the company, and in general companies require that the students communicate the results to several different parties. Hence, students generally get ample opportunities to present their work, communicate their contributions to other relevant members of the company team, and take ownership of their chosen problem of study. We have had excellent comments about the work that the students have conducted in these settings.

E. How will students be assessed and evaluated in achieving the knowledge, competencies, and skills outlined in 4.D. above? Examples of assessment methods can be found at (http://www.asu.edu/oue/assessment.html).

Students will be assessed based on designated, relevant questions from course final exams and successful presentation of capstone project report or portfolio.

F. Satisfactory student academic progress standards and guidelines (including any time limits for completion).

Students must maintain continuous enrollment and complete the program within three years. Students with a graduate GPA below 3.0 will be placed on probation and must receive at least a 3.0 in each subsequent semester as well as achieving an overall GPA of at least 3.0 within two semesters of being placed on probation. Failure to do so will lead to a recommendation of removal from the program.

G. Will this proposed certificate program allow sharing of credit hours from another ASU degree program to be used as part of this certificate program? (Please note that a maximum of 9 hours taken as a non-degree student at ASU, including as a part of a certificate program, may be used towards a future graduate degree at ASU).

Students in a degree program may be permitted to use 15 credit hours for the certificate, which have already counted or will be counted towards the minimum requirements for another degree program(s) with prior approval from that School.

Specifically, students in the Master of Engineering and Master of Science degree programs will be able to earn this certificate and the master's degree simultaneously with the sharing of 15 credit hours.

H. Below, please list all required and elective courses in the appropriate boxes (you may attach additional pages if necessary).

Please ensure that all *new core* course proposals have been submitted to the Provost's office through ChangeMaker online course proposal submission system. Please note: a minimum of 2/3 of the courses required for a graduate certificate must be at the 500-level or above.

Required Courses			Credit Hours
(Prefix & Number)	*(Course Title)*	*(New Course?) Yes or No?*	**(Insert Section Sub-total)** **6**
IEE 570	**Advanced Quality Control**	**No**	**3**
IEE 581	**Six Sigma Methodology**	**No**	**3**
Electives			Credit Hours
(Prefix & Number)	*(Course Title)* *(students will select two courses)*	*(New Course?) Yes or No?*	**(Insert Section Sub-total)** **6**
IEE 572	**Design Engineering Experiments**	**No**	**3**
IEE 578	**Regression Analysis**	**No**	**3**
IEE 561	**Production Systems**	**No**	**3**
Culminating Experience (if applicable)			Credit Hours **(Insert Section Sub-total)** **3**
IEE585	**Six Sigma Capstone**	**No**	**3**
Total required credit hours			**15**

5. PRIMARY FACULTY PARTICIPANTS - Please list all primary faculty participants for the proposed certificate, including home unit and title. You may attach additional pages if necessary.

Name	Home Unit	Title
George Runger	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Professor
Douglas Montgomery	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Regents Professor
Jing Li	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Assistant Professor
Ronald Askin	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Professor & School Director

6. REQUIRED SUPPORTING DOCUMENTS
   (Please label accordingly, i.e., Appendix or Attachment A, B, etc.)

   Please include the following with your proposal:

   A. Sample plans of study for students in the proposed program

   B. Statements of support from all deans and heads of impacted academic units

7. APPROVALS - If the proposal submission involves multiple units, please include letters of support from those units.

DEPARTMENT CHAIR or SCHOOL DIRECTOR (PRINT/TYPE)

Ronald Askin

SIGNATURE	DATE
Ronald Askin	**11/7/2012**

DEAN (PRINT/TYPE)

Paul Johnson (see attached signature page)

SIGNATURE	DATE
(see attached sheet)	

The following section will be completed by GC following the recommendations of faculty governance bodies.

EXECUTIVE VICE PROVOST FOR ACADEMIC AFFAIRS AND DEAN OF THE GRADUATE COLLEGE	
SIGNATURE	DATE

Please note: Proposals for new certificates also require the review and recommendation of approval from the University Graduate Council, Curriculum and Academic Programs Committee (CAPC), the Academic Senate, and the Office of the Provost before they can be put into operation.

The final approval notification will come from the Office of the Provost.

GF0311G-89

APPENDIX

SAMPLE PLANS OF STUDY FOR STUDENTS IN THE PROPOSED PROGRAM

Sample PoS - 1

Required Courses
IEE 572 Design of Engineering Experiments
IEE 561 Production Systems
IEE 570 Advanced Quality Control
IEE 581 Six Sigma Methodology
IEE 585 Six Sigma Capstone

Sample PoS - 2

Required Courses
IEE 578 Regression Analysis
IEE 561 Production Systems
IEE 570 Advanced Quality Control
IEE 581 Six Sigma Methodology
IEE 585 Six Sigma Capstone

Sample PoS - 3

Required Courses
IEE 572 Design of Engineering Experiments
IEE 578 Regression Analysis
IEE 570 Advanced Quality Control
IEE 581 Six Sigma Methodology
IEE 585 Six Sigma Capstone

Name	Home Unit	Title
George Runger	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Professor
Douglas Montgomery	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Regents Professor
Jing Li	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Assistant Professor
Ronald Askin	School of Computing, Informatics, and Decision Systems Engineering, Ira A. Fulton Schools of Engineering	Professor & School Director

6. REQUIRED SUPPORTING DOCUMENTS
(Please label accordingly. i.e., Appendix or Attachment A, B, etc.)

Please include the following with your proposal:

A. Sample plans of study for students in the proposed program

B. Statements of support from all deans and heads of impacted academic units

7. APPROVALS - If the proposal submission involves multiple units, please include letters of support from those units.

DEPARTMENT CHAIR or SCHOOL DIRECTOR (PRINT/TYPE)

Ronald Askin

SIGNATURE

DATE

11/7/2012

DEAN (PRINT/TYPE)

Paul Johnson   James Collofello

SIGNATURE

DATE

11/9/12

The following section will be completed by GC following the recommendations of faculty governance bodies.

EXECUTIVE VICE PROVOST FOR ACADEMIC AFFAIRS AND DEAN OF THE GRADUATE COLLEGE

SIGNATURE

DATE

Establishing Graduate Certificates