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**Cover Sheet**  
SACS-COC Substantive Change Prospectus  
University of Louisiana at Lafayette  
Ph.D. in Systems Engineering  
Proposed implementation: January 11, 2012  
Submitted October 10, 2011

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**Degrees the institution is authorized to grant :** See attached pages from UL Lafayette's Institutional Summary.

**Degrees which are related to the proposed programs:**

- Ph.D. in Computer Engineering
- Master of Science in Engineering with options in Chemical, Civil, Mechanical and Petroleum Engineering, and Master of Science in Computer Engineering
- Bachelor's degrees in Chemical, Civil, Electrical, Mechanical and Petroleum Engineering and Industrial Technology.

**Institutional Strengths that facilitate the offering of the proposed program:**

- This program is very closely aligned with State economic development projections and job demand
- The University already has a strong College of Engineering with faculty members who have very high research productivity and are highly qualified to offer instruction and placement at the doctoral level.
- Engineering-related research and development funding averages approximately 10 million dollars annually, which demonstrates the research activity and will support the Ph.D. program and its students without additional funding.
- This program complements other degree programs in the state, which recently lost an important Ph.D. program in engineering at Tulane.
- The University has a significant and growing number of doctoral programs (9 currently) and a new graduate dean, and is well equipped to expand its doctoral offerings
- Increased research activity is among the University's most important strategic goals, and the development of this program will increase its research activity in an important area

## University of Louisiana at Lafayette SACS Institutional Summary Form

1. The University of Louisiana at Lafayette, founded in 1900 as Southwest Louisiana Industrial Institute, offered its first baccalaureate degrees in 1921. By the 1950s, the institution awarded master's degrees and became the first all-white, state-supported public college in the South to enroll a black student. The University of Southwestern Louisiana, as the institution became known in 1960, began offering doctoral degrees in the Sixties. Selective admissions were implemented in 1999, and since that time the average composite ACT of entering freshmen has risen from 19.5 to 22.3. The University is now classed as a Carnegie Research University with high research activity. UL Lafayette enrolls over 16,300 students (58% women) and offers 75 bachelor's degrees, 26 master's degrees, and nine doctorates through eight academic colleges and the Graduate School. The University's students are predominantly from Louisiana (91%), though non-resident enrollment is increasing (currently representing 48 states and 95 countries). The largest racial minority is African American (18%). Externally-funded research now tops \$50 million. Much of the University's identity is derived from the cultural heritage of the Cajun and Creole populations who settled in Lafayette and surrounding parishes, known collectively as "Acadiana." UL Lafayette is integrally involved in the region's economic development, particularly its push to become a leading hub for technology. University faculty and students are meaningfully involved in area communities through service learning projects, internships, and cooperative education programs. SREB peers identified jointly by the Louisiana's governing board for higher education, the Board of Regents, and UL Lafayette include Old Dominion, Virginia Commonwealth, Louisiana Tech, University of Alabama Birmingham, Mississippi State, Florida Atlantic, University of Texas at Arlington, University of Memphis, Georgia Southern, and UNC Greensboro.
  
2. The following tables indicate the degrees offered by the University.

### College of Nursing and Allied Health Professions

Department/Unit	Major	Concentration within Major	Degree Awarded
<i>Nursing</i>	Nursing		B.S.N.
<i>Allied Health</i>	Dental Hygiene*		B.S.D.H.
	Dietetics	Nutrition	B.S.

## College of General Studies

Department/Unit	Major	Concentration within Major	Degree Awarded
	General Studies	Arts and Humanities	B.G.S.
		Natural Sciences	
		Behavioral Sciences	
		Applied Sciences A	
		Applied Sciences B	

## College of the Arts

Department/Unit	Major	Concentration within Major	Degree Awarded
<i>Architecture and Design</i>	Architectural Studies		B.S.
	Interior Design		B.I.D.
	Industrial Design		B O.I.D.
	Fashion Design and Merchandising	Design	B.S.
	Merchandising		
<i>Music</i>	Music	Jazz Studies	B.M.
		Music Media	
		Piano Pedagogy	
		Performance	
		Theory/Composition	
<i>Performing Arts</i>	Performing Arts	Theater	B.F.A.
		Dance	
<i>Visual Arts</i>	Visual Arts	Art History	B.F.A.
		Ceramics	
		Computer Art and Animation	
		Drawing	
		Graphic Design	
		Media Art	
		Metalwork and Jewelry	
		Painting	
		Photography	
		Printmaking	
		Sculpture	

## B. I. Moody III College of Business Administration

Department/Unit	Major	Concentration Within Major	Degree Awarded
<i>Accounting</i>	Accounting		B.S.B.A.
<i>Business Systems, Analysis and Technology</i>	Management Information Systems		B.S.B.A.
<i>Economics and Finance</i>	Economics		B.S.B.A.
	Finance		
	Insurance and Risk Management		
<i>Management</i>	Management		B.S.B.A.
	Professional Land and Resource Management		
<i>Marketing and Hospitality</i>	Marketing		B.S.B.A.
	Hospitality Management		B.S.B.A.

## College of Engineering

Department/Unit	Major	Concentration Within Major	Degree Awarded
<i>Chemical Engineering</i>	Chemical Engineering		B.S.Ch.E.
<i>Civil Engineering</i>	Civil Engineering		B.S.Ci.E.
<i>Electrical and Computer Engineering</i>	Electrical Engineering		B.S.E.E.
<i>Industrial Technology</i>	Industrial Technology		B.S.I.T.
<i>Mechanical Engineering</i>	Mechanical Engineering		B.S.M.E.
<i>Petroleum Engineering</i>	Petroleum Engineering		B.S.P.E.

## College of Education

Department/Unit	Major	Certification within major	Degree Awarded	
<i>Curriculum and Instruction</i>	Early Childhood		B.S.	
	Elementary Education		B.S.	
	Middle School Education (4-8)		B.S.	
	Secondary Education (6-12)	Agriculture		B.S.
		Biology		B.S.
		Business		B.S.
		Chemistry		B.S.
		Earth Science		B.S.
		English		B.A.
		Family and Consumer Science		B.S.
		General Science		B.S.
		Technology and Industrial Arts		B.S.
		Mathematics		B.S.
		French		B.A.
		Spanish		B.A.
		German		B.A.
		Physics		B.S.
	Social Studies		B.A.	
	Speech		B.S.	
	K-12	Art		B.A.
Kinesiology			B.S.	
Instrumental Music			B.M.E.	
Vocal Music			B.M.E.	
Special Education	Mild/Moderate		B.S.	
<i>Kinesiology</i>	Kinesiology	Teacher Certification	B.S.	
		Exercise Science	B.S.	
		Health Promotion and Wellness		
		Sports Management		
	Athletic Training		B.S.	

## College of Liberal Arts

Department/Unit	Major	Concentration Within Major	Degree Awarded
<i>Communication</i>	Interpersonal and Organizational Communication		B.A.
	Mass Communication	Broadcasting	B.A.
		Journalism	
		Media Advertising	
Public Relations		B.A.	
<i>Communicative Disorders</i>	Speech Pathology and Audiology		B.A.
<i>Criminal Justice</i>	Criminal Justice		B.S.
<i>English</i>	English		B.A.
<i>History and Geography</i>	History		B.A.
<i>Modern Languages</i>	Modern Languages	French	B.A.
		Francophone Studies	
		Spanish	
<i>Political Science</i>	Political Science	Pre-Law	B.A.
<i>Psychology</i>	Psychology		B.S.
<i>Sociology and Anthropology</i>	Anthropology		B.A.
	Sociology		B.A.
	Child and Family Studies		B.S.

## Ray P. Authement College of Sciences

Department/Unit	Major	Concentration Within Major	Degree Awarded
<i>Biology</i>	Biology		B.S.
	Microbiology		
	Resource Biology & Biodiversity		
<i>Chemistry</i>	Chemistry		B.S.
<i>Computer Science</i>	Computer Science	Cognitive Science	B.S.
		Information Technology	
		Scientific Computing	
		Computer Engineering	
		Video Game Design	
<i>Geology</i>	Geology	Environmental Geology	B.S.
		Petroleum Geology	
<i>Health Information</i>	Health Information Management		B.S.
<i>Mathematics</i>	Mathematics		B.S.
<i>Physics</i>	Physics		B.S.
<i>Renewable Resources</i>	Environmental and Sustainable Resources	Natural Resources and Environmental Quality	B.S.
		Resource Conservation and Community Sustainability	B.S.
	Sustainable Agriculture	Agribusiness	B.S.
		Animal Science	B.S.
		Plant and Soil Science	B.S.
		Horticulture/Landscape Management	B.S.
		Pre-Veterinary	

## Graduate School

Degree Awarded	Major
M. Arch.	Architecture
M. A.	English
	French
	History
M.B.A.	Business Administration
	Business Administration/Health Care Administration option
CHA (Certificate)	Health Administration
M.ED.	Curriculum and Instruction
	Education of the Gifted
	Education Leadership
M.M.	Music
M.S.	Biology
	Communication
	Computer Engineering
	Computer Science
	Counselor Education (M.S.C.E.)
	Geology
	Mathematics
	Nursing (M.S.N.)
	Physics
	Psychology
	Speech Pathology and Audiology
	Telecommunications (M.S.T.C.)
M.S. in Engineering.	Chemical Engineering option
	Civil Engineering option
	Mechanical Engineering option
	Petroleum Engineering option
Ed.D.	Educational Leadership
Ph.D.	Applied Language and Speech Sciences
	Environmental and Evolutionary Biology
	Computer Engineering
	Computer Science
	English
	Francophone Studies
	Mathematics



## 1. ABSTRACT

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The University of Louisiana at Lafayette (UL Lafayette) has received approval from the Louisiana Board of Regents for the initiation of a Ph.D. in **Systems Engineering**. UL Lafayette has been laying the foundation for this program for some time and strongly believes that the establishment of this unique program for Louisiana is timely given the strong potential of this degree program to stimulate economic development, meet the state's job demands, and increase dramatically the UL Lafayette College of Engineering's already strong enrollment and productive research output.

The anticipated date of implementation of this program is January 11, 2012. The UL Lafayette College of Engineering estimates that over an expected six-year initiation period, the number of students will grow from a starting population of at least 8 in Year 1 to an estimated steady-state population in excess of 40 students by Year 7. The first graduates are expected to finish their degree requirements by Year 5 with an estimated number of graduates in that year of five graduates. The steady-state annual program graduation rate is expected to be approximately eight or more graduates per year. This estimate was projected based on a very nominal per department Systems Engineering Ph.D. student population of six. This estimate is consistent with student to faculty ratios at peer colleges of engineering (the ratio used for this estimate is 0.5 to 1 [student to faculty] - again this represents a conservative estimate). Additionally, Engineering-related R&D at UL Lafayette hovers at around \$10 M per year over the past three years - this represents a tremendous pool of funding that will more than support the proposed program without the need for additional funding.

Each year, UL Lafayette receives more than 200 applications for entry into its current MS programs in engineering. Only a fraction of these applicants are accepted and enrolled into these programs because of the limited funded positions available and the College of Engineering avoiding admitting large numbers of graduate students without either university or project related funding. It is believed that given the popularity of Systems Engineering and the demand for this field within both industry and academia, there will be a surplus of applicants pursuing entry into this program. Discussions with current engineering students at UL Lafayette indicate a very high interest in this program. Domestic engineering students, in particular, are very interested in commercialization-based job tracks as evidenced by the dramatic increase in development, entrepreneurial, and six sigma programs within the engineering education arena. It is believed that a healthy mix of domestic and foreign national applicants will support the proposed program to the extent that significant growth of the program over the years is envisioned.

A minimum of 72 hours above the bachelor's degree is required for the Ph.D. degree. At least 48 of these hours must be in course work including 24 hours from a General SE Program Core and 24 hours from a Specialty Core from their selected concentration (either Chemical, Civil, Electrical, Mechanical, or Petroleum Engineering). The Specialization Core content will be designed by the student and major professor as part of the student's program of study (see more details below on program development). A comprehensive, written dissertation that summarizes all aspects of the original research performed by the candidate is required. To accomplish this, a minimum of 24 dissertation hours must be completed.

This prospectus will provide background information for the proposed degree program in Systems Engineering, an assessment of the need for the proposed program, and a description of the planning and approval process for the proposed program that has taken place over the last several years. The

prospectus will also provide a description of the proposed change in the current degree offerings, and describe the proposed Ph.D. program in Systems Engineering in detail, including the program objectives, the desired learning outcomes, the admissions and leveling procedures and oversight mechanisms. The capabilities of the faculty that will support the program are described, as well as the support services provided by the university in terms of the library, physical space, and financial support. The evaluation and assessment plan for continuous improvement of the program is also provided.

The full proposal submitted for approval by the University of Louisiana System and the Louisiana Board of Regents is included in Appendix C. At various places in this prospectus reference is made to items covered in more detail in the full proposal.

## 2. BACKGROUND INFORMATION

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### MISSION AND GOALS

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The goal of this initiative is to educate Systems Engineers within Louisiana that are specially trained to address the complexities of large engineering systems, such as deep-water drilling, power grids, automotive design and manufacturing, hospital intensive care systems, coastal engineering, algae to fuels/chemical production facilities, supercomputing interconnected grids, missile defense weapons, internet protection systems, and spacecraft design. All of these are excellent examples of engineering systems and, as a matter of fact, all fall into the categories currently targeted by the Louisiana's Department of Economic Development's Blue Ocean Strategy (which is an economic development blueprint being lead by the Governor's Economic Development Initiative). Each Blue Ocean sector – digital media, renewable energy, specialty healthcare, advanced transportation, pharmaceuticals, water management, next-generation oil and gas – will require a competitive, knowledge-based, and technical professional workforce that the proposed System Engineering Ph.D. program represents. Hence, the proposed Ph.D. program has a very strong economic development aspect to its inception and implementation.

This program clearly dovetails with important aspects of the University's Strategic Plan ([Tradition, Transition, and Transformation](#), 2009-2014), which emphasizes the development of research activity (Strategic Imperative 4: Supporting the research portfolio of our community of scholars, and in particular the development of research with links to the local economy (Strategic Imperative 8: Fostering economic and community development)).

### AUTHORIZATION

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The University of Louisiana System Board of Supervisors unanimously approved the Letter of Intent (LOI) for this program at its December 4, 2009 meeting (Appendix A, page 3; also at [http://www.ulsystem.net/assets/docs/searchable/meetings/2009/minutes\\_12-04-09.pdf](http://www.ulsystem.net/assets/docs/searchable/meetings/2009/minutes_12-04-09.pdf)), while the Louisiana Board of Regents also unanimously approved the LOI for this program during its June 24, 2010 meeting (Appendix B; also at <http://laregentsarchive.com/pdfs/2010/mi06-24-10.pdf>). The final proposal was approved by the Louisiana Board of Regents on September 22, 2011 (documentation forthcoming upon receipt).

## SIMILAR PROGRAMS

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Five Louisiana universities – UL Lafayette, LSU, Louisiana Tech, UNO, and Tulane -- currently offer Ph.D.'s within the engineering field. None of the programs, however, target the same occupational sector or utilize the same CIP Code. A brief overview of the existing programs in Louisiana is provided below:

- UL Lafayette offers a highly specialized Ph.D. in Computer Engineering through its Center for Advanced Computer Systems (CACCS), which is a center jointly managed the College of Engineering and the College of Science.
- In the case of Louisiana State University at Baton Rouge (LSU-BR), the offerings are strong, traditional programs which offer specific discipline degrees (for example, a Ph.D. in Chemical Engineering as opposed to a Ph.D. in Engineering).
- Louisiana Tech University (La Tech) and University of New Orleans (UNO) both offer programs that are very closely aligned with the sciences, yielding strong degrees that provide the graduate with robust engineering and science skills. Both of these Ph.D. programs are “umbrella” programs in which multiple departments may participate but which award a single formal degree in a specific discipline of engineering.
- Tulane has eliminated most of their engineering programs and only offers specialized Ph.D. degrees in the chemical and biochemical disciplines.

It is interesting to note that the former Tulane programs were productive; hence, the State of Louisiana has actually lost a key asset in terms of the production of engineering Ph.D.'s. Unfortunately for Louisiana, it is the Engineering Ph.D. that provides a critical developmental foundation for stimulating regional economic development. None of the Ph.D. programs discussed above is a Systems Engineering Program. The problem-solving approach embraced by the Systems Engineering field is unique and strongly oriented toward design/development rather than basic research, providing an important new capability for Louisiana.

It is envisioned that a collaborative synergy will develop between the proposed Systems Engineering Ph.D. and the current engineering Ph.D. programs within the state that can be used to jointly compete for additional external federal R&D dollars while increasing economic development. The collaboration expected to develop between the proposed program and existing programs is viewed as a great benefit to the state and a scenario of high potential, particularly given the process developmental transition that the two types of engineering Ph.D. degrees will then offer the state in terms of tracking technology development from basic highly focused research through to a systems oriented development path and later commercialization.

## 3. ASSESSMENT OF NEED AND PROGRAM PLANNING/APPROVAL

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### ASSESSMENT OF NEED

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The majority of current engineering Ph.D. programs within the US are oriented toward basic research, which is often supported by the infusion of science into the research paradigm. Most of these programs are oriented toward specializations related to the various research groups housed within departments.

As strong as these programs are with regard to advancing science and engineering theory, they do not foster the concept of approaching more applied problems via a holistic, design-based solutions oriented approach, similar to the Six Sigma problem solving paradigm. As a result, Systems Engineering has evolved as an exciting new engineering field within the United States and the world that is much more oriented toward product development and design.

The proposed Ph.D. in Systems Engineering at UL Lafayette will orient Ph.D.-level research toward design-based problem solving. It is envisioned that this new degree program will greatly increase the level of multi-disciplinary learning and research interaction among the faculty and graduate students. By design, the proposed Systems Engineering Program will include a greater level of industry-interaction than is found in most engineering Ph.D. programs. The infusion of management principles, coupled with significant industry input and the solutions-oriented research of the proposed Ph.D. degree, will provide the framework for an exciting new educational program for the State of Louisiana. With the NSF reporting that ~70% of today's graduating Engineering Ph.D.'s are employed by industry or the government, it is believed that the proposed Systems Engineering Ph.D. program will produce graduates who will have a much stronger appeal to industries hiring engineering Ph.D. graduates than graduates with Ph.D.s from a more traditional engineering program. This new resource will provide a much-needed addition to the developing technology-based professional labor pool found within Louisiana. It is believed that this type of program would be much more appealing to domestic students (particularly, Louisiana students) who have shunned entry into Engineering Ph.D. programs due to their interest in pursuing industry jobs rather than academic positions.

## PROGRAM PLANNING AND EVALUATION

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UL Lafayette has never had a Systems Engineering Ph.D. program. Until the mid-1980's, a MS in Engineering Systems was offered at UL Lafayette with specialties within each of its five engineering departments. This program focused on how each discipline contributed toward an engineering component of a system using a very traditional MS approach to both the research and academic aspects of the program. Later, UL Lafayette changed from this approach to a more traditional department-associated specialty MS format. In April 2011, the Board of Supervisors for the University of Louisiana System and the Louisiana Board of Regents approved the consolidation of the five engineering masters programs into one M.S. in Engineering (See <http://bulletin.louisiana.edu/GR/13/Graduate2010-12.pdf>, pp. 78-82). Until recently, the UL Lafayette College of Engineering did have an Engineering and Technology Management MS Program that featured some of the educational and developmental aspects of a Systems Engineering Program. This highly productive program was voluntarily phased out as UL Lafayette's College of Engineering optimized and reorganized the curriculum content of each of its MS programs to feature characteristics of the Systems Engineering field in preparation for the formal request to initiate this proposed Ph.D. program. In contrast to the philosophy of having some engineering graduate students pursuing project management skills via a stand-alone Engineering and Technology MS program, the new Ph.D. program will not only embed project management skills development into all of the college's graduate programs, it will integrate the other aspects of the Systems Engineering field into the total educational experience (research approach, graduate committees, etc.).

## PROGRAM REVIEW AND APPROVAL

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An advisory board composed of six industry and university experts with direct knowledge of Systems Engineers will be created. It is targeted that four members will be from industry and two from other colleges of engineering offering a similar degree program. This board will provide guidance to the college to ensure the program remains current and optimized to maximize industry interest. This board will meet at least once a year to review all aspects of the program as a means of ensuring the program is current and germane to meeting the needs of the targeted employment sectors.

## 4. DESCRIPTION OF THE CHANGE

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### SPECIFIC OUTCOMES

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The College of Engineering at the University of Louisiana at Lafayette has designed a program that is directly targeted toward placing the graduates in current and future Louisiana industries. However, from the perspective of a graduate from this proposed program, the designed program will have tremendous appeal to other regions in the US and across the globe. The degree will also have a strong appeal to other colleges of engineering for these graduates as future faculty members given the fast growing popularity of this degree. Numerous current and recently graduated domestic students (mainly from Louisiana) from the UL Lafayette Engineering program have come forward and expressed interest in the proposed program indicating that an extraordinary high level of interest for this type of degree program will exist with domestic students (which is a great need for not only Louisiana, but the entire US as well).

A supporting critical activity that is considered key to the successful maturation of any degree program is the continued provision of a very strong jobs market for the graduates of that program and student recruiting. Therefore, an aggressive marketing effort will be initiated to entrench UL Lafayette as a “go-to” source for solid Systems Engineers for both industry and government agencies. Envisioned activities include 1) strong participation in professional society meetings to highlight UL Lafayette’s program to potential employers and students, 2) periodic meeting with numerous regional industries to ensure that their needs are being addressed by the program and to verify that their current staffing is aware of the program offering, 3) setting up collaborations with other US colleges of engineering granting similar degrees (target M.S. and Ph.D. granting institutions), 4) a strong presence in INCOSE, 5) the formation of a program advisory board as mentioned above, 6) publishing of scholastic products in journals and industry trade magazines, 7) seek collaboration with international colleges of engineering with similar interests in Systems Engineering, 8) meet with government agencies, such as DoD, and NASA, to set-up potential training opportunities for their staff, 9) set-up recruiting booths for potential students at regional jobs placement events at regional universities, and 10) offer a series of short courses within the region. Most of these activities are actually on-going for the current engineering programs at UL Lafayette. The results of these efforts have been dramatic with the college experiencing a more than 30% increase in undergraduate student populations along with an increase in the number of companies recruiting UL Lafayette engineering and industrial technology graduates. Hence, this marketing initiative is viewed as having great potential to facilitate the program meeting its full potential.

The University of Louisiana at Lafayette and the College of Engineering are well prepared by prior experience to implement the Ph.D. program in Systems Engineering. UL Lafayette already offers Ph.D.

degrees in several other disciplines, and the College of Engineering already offers a Ph.D. in Computer Engineering in partnership with the College of Science (see <http://bulletin.louisiana.edu/GR/13/Graduate2010-12.pdf>, pp. 68-69). It is also noteworthy to mention that a review of the American Society of Engineering Educators (ASEE) colleges database (ASEE 2011) indicates that the UL Lafayette College of Engineering is in line with other colleges of engineering granting a Ph.D. from every metric including R&D funding, faculty numbers, student numbers, Carnegie classification, and degree production. The college badly needs the Systems Engineering Ph.D. program to make that final critical step toward realizing its full potential to greatly contribute to the economic development of the State of Louisiana. Appendix D of the attached proposal presents letters of support for both the Systems Engineering Ph.D. and the value of an engineering Ph.D. degree and associated research to both universities and regions from two noted university presidents: Dr. Kirk Schulz, President of Kansas State University, who holds a Ph.D. in Chemical Engineering and Dr. Bowen Loftin, President of Texas A&M, who holds a degree in Industrial and Systems Engineering. These two presidents offer a unique perspective in that they are national education leaders and experts on the field of engineering. Both Drs. Schulz and Loftin have reviewed an overview of the Systems Engineering Program design as drafted by UL Lafayette and have written the attached letters as an opinion on the value of a Ph.D. program to an engineering college along with their thoughts on UL Lafayette's ability to implement the proposed program.

## LEARNING OBJECTIVES

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Systems Engineering is geared toward the rapid design and development of large and complex systems. Systems Engineering integrates all the specialty and sub-specialty groups of engineering disciplines into a team whose efforts result in a structured development process that proceeds from concept to production to operation. Example systems include coastal ecosystems, water treatment facilities, computer networks, visualization platforms, deep-water drilling operations, highway safety systems, biofuels production facilities, robotic units, refineries, fiber optic networks, aircraft, vehicle control systems, biomass gasification units, management of utilities during disaster events, and power grids.

Each of the five engineering departments at UL Lafayette participates in the offering of Systems Engineering Ph.D. degree with a discipline concentration within each department. This innovative program builds upon the research-based learning experience associated with most Engineering Ph.D. programs by adding the additional learned skill set of Systems Engineering principals. The graduate of this program is expected to be highly appealing to both industry and academic positions. The applicant is required to select a concentration (specialization) department from within the college – chemical engineering, civil engineering, electrical engineering, mechanical engineering, and petroleum engineering. Hence, the graduate exits the program with a strong specialized knowledge appropriate of a traditional engineering Ph.D. coupled with expertise in the application of systems theory toward solving complex problems within their specialty. The program does accept direct Ph.D. (student has a BS in an acknowledged engineering field) and Post-MS students (previously obtained a MS).

## PROPOSED COURSE OFFERINGS

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A minimum of 72 hours above the bachelor's degree is required. At least 48 of these hours must be in course work including 24 hours from a General SE Program Core and 24 hours from a Specialty Core from their selected concentration (either Chemical, Civil, Electrical, Mechanical, or Petroleum

Engineering). The Specialization Core content will be designed by the student and major professor as part of the student's program of study (see more details below on program development).

### GENERAL PROGRAM CORE (24 HOURS)

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1. Project Management (3 hours) - Principles of engineering management applicable to project development and implementation. Includes topics such as systems theory and concepts, organizational structure, project planning, scheduling, staffing, budgeting, and control of engineering projects.
2. Engineering Statistics (3 hours) - Basic concepts of random variation in engineering projects, planning experiments and analyzing the resulting data.
3. Six Sigma (3 hours) - A study of the lean six sigma philosophy, six sigma tools, and the six sigma infrastructure within the organization.
4. Linear and Non-Linear Programming (3 hours) - Techniques for optimizing linear and non-linear models of engineering systems. Deterministic and stochastic techniques; continuous and discrete variables and functions; constrained and unconstrained problems.
5. Graduate Mathematics, Statistics, or Science Elective (3 hours) – Selected in consultation with the student's Major Professor and Graduate Committee (requires Program Coordinator's approval as well).
6. Systems Engineering I (3 hours) - General analytical concepts used in the modeling and analysis of engineering systems, including system requirements, cost modeling and life cycle analysis.
7. Systems Engineering II (3 hours) - Design and integration of engineering systems, including structured and object-oriented analysis techniques. Life cycle issues and tools. Team-based preliminary system design project.
8. Non-Emphasis Graduate Engineering Elective (3 hours) - The student must take one course from another engineering department outside of his/her specialization to enhance the multi-disciplined flavor of the student's educational experience.

### SPECIALIZATION CORE (AT LEAST 24 HOURS)

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At least 24 hours must be taken from a student's concentration department and/or classes offered by the College of Engineering and/or R.P. Authement College of Science. As with the General Core component, there is not a specific sequence of courses required by each department for meeting the Specialization Core. This structure provides significant opportunity for the student to meet the requirements of System Engineering training from the humanistic factors, economics, and project management perspectives, while at the same time allowing an appreciable level of specialization and customization to meet individual learning needs within a specific engineering discipline.

## PROGRAM OF STUDY

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A program of study for the Specialization Core must be designed upon entry of a student into the program. This program of study to be drafted under the lead of the major professor and program coordinator will detail courses that the student must successfully complete. The program must obtain approval by the student's graduate committee, and hence, will require a majority acceptance by the student's graduate committee. The program of study will also require approval from the Program Coordinator.

## LEADERSHIP DEVELOPMENT

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The UL Lafayette College of Engineering offers an innovative leadership development program entitled "Designing Leaders" that is offered once a year during the Spring Semester. Leadership is often listed as a key targeted characteristic for Systems Engineers. Therefore, since the graduates of the Systems Engineering Ph.D. degree program must have strong leadership skills, it is required that all students in the Systems Engineering Ph.D. program enroll in and successfully complete Designing Leaders program prior to graduation.

## 5. FACULTY

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The successful initiation of any program, regardless of scope and area of interest, is contingent upon the quality of the people who provide the personnel foundation of that venture. Significant planning, targeted faculty hiring, and faculty resource provision have been ongoing at UL Lafayette over the past several years to properly position the university to provide the faculty foundation to successfully implement the proposed program. Faculty searches have been particularly focused on the recruiting and hiring of new faculty capable of generating substantial external R&D funding and showing strong interest in participating and growing a Ph.D. offering in Systems Engineering. Based on the rapid growth of engineering-related R&D funds at UL Lafayette, this goal is partially met - still, the initiation of the Systems Engineering Ph.D. program remains. However, the approval and implementation of this program is by far the most important issue voiced by faculty members in the college as well as by the five departments' advisory boards.

## INVOLVED ACADEMIC UNITS

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The program will involve the departments of Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Mechanical Engineering, and Petroleum Engineering. All of these units have experienced substantial growth in student numbers and research funds over the past five years. Additionally, each of these departments has a long and successful history of operation and each is well-known and well-respected within their respective industries across Louisiana. These programs all offer MS programs and Electrical and Computer Engineering has an affiliated Computer Engineering Ph.D. program. All five of these involved programs are all fully accredited and none of them are on any "Low Performer" list organized either the ULS or the Louisiana Board of Regents.



## PROPOSED PROGRAM FACULTY AND INSTITUTIONAL OVERSIGHT

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All graduate programs are officially part of the university's Graduate School which is lead by a dean (Dr. David Breaux is the current Dean of the Graduate School at UL Lafayette). Within the College of Engineering, a Program Coordinator (Dr. Jim Lee, Mechanical Engineering) will oversee the day-to-day implementation of the program. A committee will be organized and tasked with program oversight, policy development, and quality assurance via the formation of an Executive Committee. Please note that an External Advisory Committee will be formed for providing annual program reviews to continuously interject industry input on content and implementation, advice on program directions and for opening up increased hiring opportunities for future program graduates (more details provided later).

## KEY FACULTY CREDENTIALS

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Two supporting sources of evidence are provided to assist with the review of this critical program resource. The first supporting source concerning the quality and ability of the College of Engineering's faculty is the inclusion of abbreviated CVs of key faculty who will be actively involved in the implementation and management of the proposed program (see Appendix G of the attached proposal). The second source is the very concise descriptions of the pertinent background of both the Program Coordinator (Dr. Jim Lee) and the Executive Committee are presented in page 20 through page 28 of the attached proposal.

## PARTICIPATING FACULTY

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The proposed Ph.D. program will be directly supported by over 50 tenure-track and research faculty from five departments (Chemical, Civil, Electrical/Computer, Mechanical, and Petroleum Engineering). These faculty members have published at an annualized rate of over 80 peer-reviewed publications per year over the past five years and have directly been involved in the graduation of over 100 graduate students during this same period. As stated above, engineering R&D projects at UL Lafayette are in excess of \$12M of involved standing research grants that may be used to support the proposed program. Engineering related R&D at UL Lafayette has consistently exceeded \$10M per year over the past four years. It is noteworthy to mention that these statistics describing faculty performance at UL Lafayette's College of Engineering that are related to graduate education and R&D productivity are impressive for engineering colleges having a Ph.D. programs.

## 6. LIBRARY AND LEARNING RESOURCES

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### LIBRARY RESOURCES

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The library at UL Lafayette represents a strong university-grade library highly capable of supporting the activities of a comprehensive research university; inclusive of the proposed program. The library has over 1 million bound volumes, over 2 million microform units, and over 6,000 subscription journals. The UL Lafayette library collects numerous print and non-print informational and cultural items which add to the research and educational support capacity of the library. Book collections in germane areas for

Systems Engineering include 31,837 engineering books, 54,671 biology, chemistry, physics, and computer science books, and 71,479 business development books. The facilities within the library include numerous high volume student computing stations, networked systems, and various meeting support areas.

Most of its collection and holdings are accessible on-line. Additionally, education support facilities and equipment are available within the Instructional Materials Center. A highly trained and professional staff is maintained to ensure that the needs of the institution and region are more than fully met. The UL Lafayette library is a member of Southeastern Library Network (SOLINET) which further entrenches its ability to support high-level academic endeavors. The library is a member of the regional library organization, Lyrasis, which provides nationwide networked cataloging and other professional services. Additionally, the library subscribes to several electronic databases via the internet including Web of Science, Engineering Village, and Scifinder Scholar.

Total annual library expenditures over the past two years at the UL Lafayette in support of engineering and other related areas exceed \$500K per year. This places these annual investments on par with the libraries at peer institutions offering multiple engineering Ph.D. programs. Additionally, the library already supports numerous highly related Ph.D. programs at UL Lafayette, such as computer engineering, mathematics, and biology. In summary, the current facilities of the UL Lafayette library are more than adequate to support the proposed program without the need for special expansion of resources to support the proposed program. Hence, no additional funds are necessary for supporting the library needs associated with the proposed degree program.

It is noteworthy to mention that several other Louisiana universities do have supporting capabilities to compliment the UL Lafayette library with additional, complimentary resources (such as LSU-BR, LaTech, and UNO). A formal and active exchange program has been in place for some time between the libraries at these institutions and others in Louisiana.

## OTHER INFORMATIONAL RESOURCES

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Several informational resources are already in-place at UL Lafayette to support the proposed program. The faculty has access to several RFP informational computer programs, such a monthly newsletter released by the UL Lafayette Research Office and Grants.gov, that allow UL Lafayette faculty to continue to grow their R&D programs. A wireless internet system is in-place within the College of Engineering's facilities along with numerous hard-wire access points making easy access to the internet for the proposed infusion of Ph.D. students. The departments within the college have numerous work stations to fully support the computational needs of the increased number of new graduate students. The College of Engineering has its own IT Coordinator who oversees the IT support framework for the college, while the university maintains a highly trained staff to provide this level of support to the entire university. Each department within the UL Lafayette College of Engineering has its own full-time technician who provides critical technical support with IT and other research equipment. In closing, the facilities that are in-place and will be available to support the new Ph.D. students from the proposed program are more than adequate to accomplish this goal. Hence, no new expenditures for IT-related resources are necessary for initiation of the proposed program.

## 7. PHYSICAL RESOURCES

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### LABORATORIES

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The College of Engineering at UL Lafayette has tremendous facilities for supporting the proposed program. Each of the five departments involved in the degree program has at least 10,000 square feet of laboratory space dedicated to research (many of them have significantly more). These facilities have been the beneficiary of recent and substantial university and college-level investments in terms of improving infrastructure resulting in laboratories of the highest quality.

The college serves as home to numerous high profile R&D entities that will serve as strong support entities to the new program. These entities are envisioned to provide excellent sources of graduate student support while at the same time greatly benefiting from the establishment of the proposed program. Examples include:

- Bioprocessing Research Laboratory
- Center for Analysis of Spatial and Temporal Systems
- Center for Louisiana Inland Water Studies
- Center for Telecommunications Studies
- Center for Structural and Functional Materials
- Corrosion Research Center
- Environmental Engineering Laboratory
- Cleco Alternative Energy Facility (Crowley, LA)
- Industrial Assessment Center

An additional key point with regard to available facilities is the many university-level research centers and institutes where the faculty of the UL Lafayette College of Engineering are highly active via roles as formal affiliates and/or collaborators. Examples include:

- Center for Business and Information Technology
- Center for Ecology and Environmental Technology
- Energy Institute
- Institute for Coastal Ecology and Engineering
- Louisiana Accelerator Center
- Louisiana Immersive Technologies Enterprise
- Manufacturing Extension Partnership of Louisiana
- National Incident Management System and Advanced Technologies Institute
- New Iberia Research Center
- Small Business Development Center
- University Research Park

## EQUIPMENT

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The University, working in concert with the UL Lafayette College of Engineering, has invested several million dollars over the past years toward the purchase and installation of research equipment. These investments were made to increase the competitiveness of the engineering faculty while also positioning the college to ultimately move forward with the establishment of a Systems Engineering Ph.D. program.

## STUDENT OFFICES AND SUPPORT

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Over the past three years, the College of Engineering has secured significant office space to support the new Systems Engineering Ph.D. program. Currently the college has capacity to house over 30 new students between the two primary buildings occupied by the UL Lafayette College of Engineering. Additional space is being secured and this new space reconfigured to support even more students. Each Engineering Department at UL Lafayette has a full-time technician and office staff to provide additional support to the students. Also, the departments have all set-up formal Graduate Advisory Committees (GACs) to facilitate the smooth operation of the current MS degree and implementation of the new Systems Engineering program. The GACs evaluate potential candidates and oversee the operation of the graduate programs in each department. The chairperson for each GAC is the departmental graduate coordinator.

## SUMMARY

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The laboratories and equipment located at the UL Lafayette College of Engineering are considered high caliber and are more than capable of supporting the proposed program of study. Additionally, classroom, laboratory, and office facilities are also in place to house the expected increase in graduate students. Hence, no additional funds are necessary to initiate the proposed program.

## 8. FINANCIAL SUPPORT

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Since 2005, the UL Lafayette College of Engineering has been positioning itself to initiate the proposed Ph.D. program through curricular redesign, workload optimization, greatly increasing R&D support through external funding sources, building strong ties to industries, alignments with courses offered by other colleges, and benchmarking visits to other colleges of engineering offering internationally recognized Ph.D. degrees in Systems Engineering including MIT and George Mason University. Since 2007, the college has been working toward the goal of initiating a strong Systems Engineering Ph.D. program through the reorganizing and consolidation of programs and associated offerings. These efforts were undertaken to provide the foundation for the initiation of the Systems Engineering Program without the requirement for additional funding.

The college currently utilizes a total funding support from the university at the \$6.8M per year level which covers administrative, faculty and staff labor, laboratory and classroom support, college advancement, and travel (has been a somewhat static figure over the past three years due to state funding shortfalls). The current funding levels are in-place to fully support the proposed program without an increase in funding. It is estimated that approximately 10% of these funds or approximately

\$700K per year will be used to support the proposed program. These funds will be used to support classes, laboratories, and travel; however, it should be noted that engineering graduate programs utilize common classes (shared classes) for supporting both MS and Ph.D. programs. A modest increase in courses offered (approximately 2 per semester across the college) is required to fully support the implementation of the proposed program. Note that the optimization and resulting reduction in graduate courses currently offered which was implemented in Spring 2010 will more than cover these new courses without the need for additional funding from the university or state. The bulk of the college-level funding goes toward department support (the college also has an Industrial Technology program - yielding a total of six departments).

As required by the Louisiana BOR, Appendix H of the attached proposal presents the Budget Form for the Systems Engineering Ph.D. program at UL Lafayette. From the form, for the first three years of implementation, no new state funds are requested nor will additional funding from the university budget be utilized. After three years into the program, a minimal ramping of additional funding from the university is shown. This addition of university funds will occur if the anticipated strong student enrollment growth is realized. The funds will be used to support the addition of new additional faculty. However, anticipated revenue growth generated from the additional students will offset this modest funding increase. Additional discussion on the business plan for this program can be found in the attached proposal, pages 34 through 37.

## 9. EVALUATION AND ASSESSMENT

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The Ph.D. program in System Engineering has been designed to support the mission of the University of Louisiana at Lafayette and the Aims and Objectives of the College of Engineering. In addition, the College of Engineering has developed a comprehensive closed loop assessment and measurement plan to measure the achievement of desired program objectives and desired student learning outcomes for the Ph.D. program in Systems Engineering.

The complete plan can be found in Appendix F of the attached proposal. In summary, the desired program educational objectives are: 1) to produce graduates who are academically qualified to practice in the field of engineering and pursue licensure as a Professional Engineer and 2) to produce graduates who assume positions of increasing responsibility in industry, government, and academia. The student learning outcomes are designed to train the student while in school to be prepared to achieve the desired program objectives over the course of their career. The curriculum for the program has been specifically designed to insure the achievement of the learning outcomes.

The desired student learning outcomes are: 1) an ability to demonstrate breadth of knowledge across the general field of engineering, 2) an ability to demonstrate depth of knowledge in an area of specialization beyond the level of an M.S. degree in engineering, and 3) an ability to demonstrate competence in solving practical problems in the field of Systems Engineering. In order to measure the achievement of the learning outcomes, three instruments have been developed. The instruments are: 1) an oral examination of the student at the time of the dissertation defense, 2) an evaluation of the dissertation document itself, and 3) an evaluation of the final exams for the courses: Systems Engineering I and II.

Rubrics have been developed for each instrument, in order to insure consistency in the evaluation process. All graduating students are assessed. At the end of each year, an Executive Committee retreat is held to evaluate the assessment data and the assessment process itself, to determine whether any corrective actions are necessary. Every two years, the faculty and the program's constituents, as represented by the External Advisory Board, will consider whether the program objectives are still appropriate. In addition, all graduates are tracked via alumni surveys to insure that they are achieving the desired program objectives within three to five years after graduation. Any suggested changes to either the program or the assessment process are entered into an action item tracking database and tracked by the Dean's Office until complete.

## 10. APPENDICES

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Appendix A – Minutes, University of Louisiana System Board Meeting, December 4, 2009

Appendix B – Minutes, Louisiana Board of Regents' Meeting, June 24, 2010

Appendix C – Full Proposal for Ph.D. in Systems Engineering Submitted to the Louisiana Board of Regents and Approved September 22, 2011