

## Letter of Intent for New Academic Program

**Program Name:** Healthcare Systems Engineering Certificate

**Degree Designation:** Graduate Certificate

**Contact Person:** Jason Saleem, Ph.D.

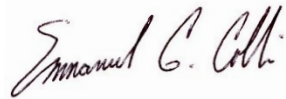
**Department:** Industrial Engineering

**School/College:** J.B. Speed School of Engineering

**Implementation Date:** January 1, 2023

**Accreditation or licensure requirements:** Not applicable

**Dean's Confirmation and Signature:** I, Emmanuel Collins, approve this letter of intent for the creation of a graduate certificate in Healthcare Systems Engineering.



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Emmanuel G. Collins, Ph.D.  
Dean, J.B. Speed School of Engineering

## I. Program Abstract

The purpose of the certificate is to provide a focused study of industrial engineering skills and methods as applied to healthcare delivery systems and processes. The intended audience for this certificate program is our current students in the Department of Industrial Engineering, the UofL Schools of Medicine, Nursing, and Public Health and Information Sciences, and healthcare professionals currently working at local healthcare institutions (e.g., Norton, Baptist, Humana) as well as outside of Louisville. This is envisioned to be a graduate-level certificate program, 9 credit hours, offered to both in-residence students as well as online. Students who complete the certificate program will acquire skills in healthcare engineering, quality of care, patient safety, health IT, clinician support, healthcare analytics, and data visualization. The relationship of this proposed program is complementary to the general field of industrial engineering by offering a focused program of study in the healthcare domain. Conversely, this program offers healthcare professionals an opportunity to acquire industrial engineering skills.

## II. Educational Program Objectives

**Objective:** To provide a focused study of industrial engineering skills and methods as applied to healthcare delivery systems and processes.

**Admission requirements:** Applicants should have previously taken a probability and statistics course such as 'fundamental topics in probability and statistics'. Students who may not have the expected background may be required to take a refresher course. The successful applicant will typically have an undergraduate degree with a GPA of 2.75 or above (on a 4.00 scale). Students whose native language is not English or whose degree is from a non-US accredited institution are required to demonstrate proficiency in the English language as specified by the admission policies of the Speed School of Engineering

**Graduation requirements:** Students will need at least a 3.0 GPA to be awarded the certificate.

### Curriculum:

*9 credit hours of Healthcare Systems Courses:*

- IE 682 Quality of Care and Patient Safety
- IE 684 Health IT and Clinician Support
- IE 662 Predictive Analytics for Decision Making I

### Description of anticipated new courses:

IE 682 Quality of Care and Patient Safety

*Note that this course will be taught through a human factors engineering lens. For example, the methods students will learn, including root cause analysis, healthcare failure mode and effects analysis, and effective checklist design, originate from the field of human factors engineering.*

- healthcare system overview (types of delivery), then considerations of each type below
  - primary care
  - ED, ICU, ambulatory
  - surgery
  - pharmacy and medication safety
- self-care, e-home care
- human error, risk assessment, fault tree, root-cause analysis (RCA)
- Healthcare Failure Mode and Effects Analysis (HFMEA)

- resilience
- qualitative research and quality of care (clinician/patient satisfaction)
- quality engineer
- inclusivity (language, accessibility, underrepresented groups)
- social factors, team, organizational and job design, safety culture
- workflow, operations and scheduling, patient flow
- checklist and infectious control
- handoffs and transitions of care (safety culture in healthcare, interruptions, error recovery)
- examination of social, regulatory, and economic factors unique to health care

#### IE 684 Health IT and Clinician Support

*This course has a focus on the design and evaluation of health IT systems through human factors engineering methods. The following topics reflect specific types of health IT systems that will be discussed (e.g., telehealth system, clinical decision support system etc.), and their impact on clinician work (e.g., EHR downtime, clinician burnout, care coordination etc.).*

- engineering design process
- electronic health record (EHR)
- ironies of automation, EHR downtime
- medical device and FDA guidelines
- mHealth and prototyping
- telehealth
- wearable sensors
- stress, fatigue, workload, burnout, interruption
- technology for older adults
- clinical decision support
- re-design of lab results, after-visit summaries
- information visualization and big data
- alarm design
- care coordination and communication
- e-consultation
- frontiers of AI (image processing, robotic surgery, nursing robots)

#### IE 662 Predictive Analytics for Decision Making I

*This course focuses on predictive analytics methods applied to industrial engineering application areas, such as manufacturing and healthcare systems. Different data types (e.g., streaming data, sensor data, etc.) from real-world scenarios will be shown. Specifically, students will learn how to use the different data types for efficient predictive methods implementation that will support smart decision-making in various manufacturing and healthcare scenarios. For example, predictive analytics in an industrial engineering manufacturing problem ensures that every single detail of a manufacturing process can be tracked and this helps to minimize waste and project future trends related to the project to inform decision making.*

- Data security, accessibility, and sharing
- Ethics in data analysis
- Data preparation and cleansing
- Descriptive statistics
  - Data visualization
  - Data reduction
- Regression

- Linear regression
- Multiple regression
- Classification
  - Logistic regression
  - Decision tree
  - Random forest
- Clustering
  - Methods (centroid, density, hierarchical, etc.)
  - K-means, K-medoids, etc.

*NOTE: There will be an assignment/assessment requiring students to learn HIPPA guidelines prior to working on anything involving health data for any of the above courses.*

Potential for collaboration with other units at UofL and/or articulation with other institutions: The Healthcare Systems Engineering Certificate will be based in the Department of Industrial Engineering and will also coincide with the Online Master of Engineering in Engineering Management (EM) program, an Online MSIE that launched in Fall 2021. That is, students from other IE programs will be able to select the courses to earn the Healthcare Systems Engineering Certificate as well. These collaborative programs are comprised of 8-week, 6-term sessions.

### III. Linkage with the Mission and Strategic Plan

The Healthcare Systems Engineering Certificate aligns with the J.B. Speed School of Engineering’s mission, which includes “To serve the University, the Commonwealth of Kentucky, and the engineering profession by providing high quality educational programs to all students...”. The proposed certificate also supports Goal 1 of the School of Engineering’s strategic plan, which is ‘Educational Excellence’. Specifically, the proposed certificate will help attract motivated, prepared, and talented individuals and engage them with a state-of-the-art certificate program designed to provide a focused study of industrial engineering skills and methods as applied to healthcare delivery systems and processes.

Similarly, the proposed certificate program aligns with UofL’s mission, which includes “teaching diverse undergraduate, graduate, and professional students in order to develop engaged citizens, leaders, and scholars...”. Further, the proposed certificate program supports UofL’s goal of being “a great place to learn” in UofL’s strategic plan by helping to attract and enroll capable, diverse, and engaged students that will be responsive to the workforce needs of the future.

### IV. Student Demand

The following table shows projected enrollments for the first five years of the program. These projected enrollments are based on other UofL certificate program proposals, that are around 5 or 6 for the first year, growing slowly to 12-15 by year 5. Somewhat larger projections are expected for the Healthcare Systems Engineering certificate program due to those external to UofL working in the healthcare industry, awaiting such a program, and being encouraged by their workplace to complete it.

	Year 1	Year 2	Year 3	Year 4	Year 5
Full-Time	0	0	0	0	0

Part-Time	3-5	8-10	12-15	15-20	15-20
Project	\$ <del>14,925</del> <u>15,471</u>	\$ <del>39,800</del> <u>41,256</u>	\$ <del>59,700</del> <u>61,884</u>	\$ <del>74,625</del> <u>77,355</u>	\$ <del>74,625</del> <u>77,355</u>
ed					
tuition	\$ <del>24,875</del> <u>25,785</u>	\$ <del>49,750</del> <u>51,570</u>	\$ <del>74,625</del> <u>77,355</u>	\$ <del>99,500</del> <u>103,140</u>	\$ <del>99,500</del> <u>103,140</u>
revenue (\$\$)					

Current cost per credit hour is \$~~764~~737 for graduate programs at UofL. With 9 credit hours to complete the certificate over the course of 1 year, expected annual revenue per student enrolled is \$~~6876~~6,633 (to the University). Speed School receives 75% of these funds, or approximately \$~~5,157~~4,975 per student. This calculation is for “certificate only” students who would not already be enrolled in one of our graduate programs.

## V. Market Demand

Demand from students is driven by demand from the economic development of the region and the nation. According to the U.S. Bureau of Labor Statistics, employment in the healthcare sector is projected to grow 15% from 2019 to 2029, much faster than the average for all occupations, adding about 2.4 million new jobs.<sup>1</sup> The healthcare sector is projected to add more jobs than any of the other occupational groups. Earning a certificate in Healthcare Systems Engineering is expected to make our students more competitive for jobs in the healthcare sector. Furthermore, MSIE students are expected to have strong interest in the certificate program and to be able to complete the certificate without additional financial cost by taking certificate courses as electives towards their degrees.

## VI. Employer Demand

Please see Appendix A.

## VII. Academic Demand

- 1. If this is not a program that is designed for students to enter the workforce immediately after graduation, please indicate the skills that graduates will attain, the types of graduate programs the graduates are most likely to attend, and the types of jobs graduates will eventually seek.** This program is designed for students to enter or remain in the workforce upon completion.
- 2. Will this program replace or enhance any existing programs(s) or tracks, concentrations, or specializations within an existing program? If yes, please specify.** This program will not replace an existing one. The program will coincide with and enhance existing Department of Industrial Engineering programs: the Online Master of Engineering in Engineering Management (EM) program and an Online MSIE that launched in Fall 2021. That is, students from other IE programs will be able to select the courses to earn the Healthcare Systems Engineering Certificate as well. These collaborative programs are comprised of 8-week, 6-term sessions.
- 3. In the table(s) below, provide information about similar programs based on CIP codes. Institutions**

<sup>1</sup> U.S. Bureau of Labor Statistics; <https://www.bls.gov/ooh/healthcare/home.htm>

may list other programs that are similar but may be classified in a different CIP code. A search for similar programs by CIP can be conducted at

<https://dataportal.cpe.ky.gov/KYAcademicProgInventory.aspx>. Please contact the Program Approval and Review Coordinator, [Leslie Harper](#), for assistance in determining a CIP code.

Copy the table below as needed to address all similar programs.

Note: Although this information is required by CPE for degree programs, certificate programs should also complete this table so that they can better consider how competition will effect enrollment projections.

<b>Similar Program 1:</b>	
<b>Institution:</b>	University of Louisville, School of Public Health & Information Sciences
<b>Program Name:</b>	Master of Science in Health Data Analytics (MSHDA)
<p><b>Comparison of Objectives/Focus/Curriculum to Similar Programs:</b> <i>Explain the differences in curriculum, focus, and/or objectives. If the proposed program curriculum does not differ substantially from existing programs, then <u>describe potential collaborations with other institutions.</u></i></p>	<p>The MSHDA program’s objective is to teach students how to leverage data, models, analytics methods and tools to solve challenges within the healthcare industry. Our proposed certificate program differs in that it provides a focused study of industrial engineering skills and methods as applied in healthcare delivery systems and processes. We primarily focus on human factors concepts and models, patient safety approaches, survey of healthcare IT and novel platforms, and predictive modeling techniques for decision making.</p> <p>While the 2 of the 3 proposed courses are unique (with no potential overlap with any other UofL course), the 3<sup>rd</sup> course (IE 662 Predictive Analytics for Decision Making I) has content that can only be found across several courses in Public Health. <b>We purposely designed IE 662 to cover a broad range of topics (with focus on application, and less theory) to allow our students to be able to identify the appropriate methods and employ them to aid ‘decision making.’</b> With this course, students would get the most important concepts of predictive analytics and decision making within a single course.</p> <p>In summary, while the MSHDA appears to be focused solely on health data analytics, through our certificate (in Industrial Engineering), students in our program will acquire skills in healthcare engineering, quality of care, patient safety, health IT, and clinician support, while using predictive analytics to achieve prescriptive outcomes for decision making.</p>
<p><b>Comparison of Student Populations:</b> <i>Describe how your target student population is different from those at other institutions and explain how your program reaches this new population (e.g. the proposed program is completely online</i></p>	<p>The intended audience for this certificate program is our current students in the Department of Industrial Engineering, the UofL Schools of Medicine, Nursing, and Public Health and Information Sciences, and healthcare professionals currently working at local healthcare institutions (e.g., Norton, Baptist, Humana) as well as outside of Louisville. Our program will be offered to both in-residence students as well as online. MSHDA is offered online only; the primary difference in target audience is that our program will reach in-residence students in addition to being offered online.</p>

<i>while other programs are face-to-face or hybrid).</i>	
<b>Access to Existing Programs:</b> <i>Explain how/why existing programs cannot reach your target population and/or provide evidence that existing programs do not have the capacity to meet current student demand (e.g. the number of students on enrollment waiting list).</i>	Given that students in our program will also acquire skills in healthcare engineering, quality of care, patient safety, health IT, and clinician support, the target audience is different than those students who are only interested in health data analytics, the focus of the MSHDA.
<b>Feedback from Other Institutions:</b> <i>Summarize the feedback from colleagues at institutions with similar programs.</i>	N/A

## VIII. Funding Sources

1. **Will additional faculty be needed?** No additional faculty will be needed.

2. **Faculty Workload**

This proposed certificate program is not expected to impact current faculty workloads. ~~The new certificate program will be supported, in part, by existing courses. Any new course development will be offset by a reduction in teaching load for a faculty member's work plan such that workload percentages are consistent with department expectations. Additional faculty (or staff) resources are not needed and should not be needed at any point in the future with regard to the proposed certificate program. Two of the courses will be supported by recently hired faculty members as part of their normal teaching load. The third course will be supported by a faculty member who received a reduction in teaching load to develop the new course. All three courses are currently under development and will be offered regardless of the proposed certificate program.~~

3. **Budgetary rationale.**

Current cost per credit hour is ~~\$764,737~~ for graduate programs at UofL. With 9 credit hours to complete the certificate over the course of 1 year, expected annual revenue per student enrolled is ~~\$6876,6,633~~ (to the University). Speed School receives 75% of these funds, or approximately ~~\$5,1574,975~~ per student. This calculation is for "certificate only" students who would not already be enrolled in one of our graduate programs. Using the conservative "bottom range" estimates from Section IV 'Student Demand', the certificate program is expected to generate about ~~\$263,675364K~~ over the first 5 years in marginal revenue for UofL. SSOE expects to retain 75% of graduate tuition or about ~~\$197,756273K~~ total over the 5 year period. Expected program expenses will be about ~~\$25K~~ per year for marketing expenses.

4. **Please provide a reasonable estimate of program expenditures related to marketing and**





Library Support	0	0	0	0	0	0
Facilities, technology or equipment	0	0	0	0	0	0
Other (please describe below the table)	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$1025,000
<b>Total Projected Expenses</b>	<b>\$25,000</b>	<b>\$25,000</b>	<b>\$25,000</b>	<b>\$25,000</b>	<b>\$25,000</b>	<b>\$1025,000</b>

\* Note on expenses: Additional expenses will arise from marketing costs (\$25,000 per year).

## IX. Online Delivery

Academic units wanting to create new online degrees or certificates will be required to complete the following section demonstrating that the program will meet the criteria for online programs at UofL. If you cannot agree to the terms outlined, please make a case for why you cannot or should not agree to certain elements, although the reasons must be substantiated with evidence. Units wishing to create a program that is not online do not need to complete this section.

- 1. Distance Education:** The certification program will be offered 100% online with asynchronous classes. The certificate program will also be offered to our in-residence students. Our in-residence students will have the option to take certain courses from the certificate program in person or online.
- 2. Library Resources.** Students will use the online resources of the library to look up articles related to the Healthcare Systems Engineering Certificate courses. A letter of support from University Libraries is provided.
- 3. Please complete Appendix A.** Completed.
- 4. Online Program Best Practices**

Please indicate whether the academic unit will design the program in accordance with the following best practices for online programs by placing an "X" in the appropriate column. Please give serious consideration to each recommendation understanding that online programs are primarily intended for adults who are working, have a family, or other potential commitments or circumstances that would make it difficult to attend a program on campus or a program with designated meeting times.

Yes	No	Online Program Best Practice
x		8-week courses <i>For undergraduate programs, this would be major classes at a minimum although also recommended for general education classes</i>
x		Allow part-time enrollment
x		Admit students at least two times/year

x		Asynchronous classes (no regular required meeting times)
x		100% online (in-person experiences that can be done off-site do not affect this factor, meaning it would still be considered 100% online even if the student has to do in-person assignments where they live)
x		Graduate-level programs will not require the GRE, GMAT or other standardized tests for admission

**5. Quality Program Practices**

Please indicate whether the academic unit will design the program in accordance with the following best practices for online programs by placing an "X" in the appropriate column.

Yes	No	Quality Program Practice
x		Require all faculty who will be developing and/or teaching in the program to go through Delphi U or have gone through an equivalent training
x		Require all faculty developing online courses to partner with an instructional designer in the Delphi Center and adhere to established deadlines for course creation

**6. Academic units that cannot agree to recommendations in Sections 3 and 4 above should explain why and provide substantiation.**

## Appendix A. Employer Demand

1. If the program is designed for students to enter the workforce immediately, please complete the following table (see resources below the table)
2. Please provide source of employer demand information and time frame for the projections:

Type of Job	State Avg Wage	State # of openings (Annual)	State Growth Projections: (%)	Regional Avg Wage	Regional # of openings (Annual)	Regional Growth Projections (%)	National Avg Wage	National # of openings	National Growth Projections (%)
Management Analysts	\$77,780	1,020	18.78%	\$84,753	4,564	16.39%	\$95,560	99,900	13.5%
Business Operations Specialists	\$69,010	921	9.29%	\$70,633	5,745	9.00%	\$80,220	119,600	6.3%
Industrial Engineers	\$80,480	727	0.69%	\$80,877	2,619	9.36%	\$93,660	22,600	8.3%
Transportation, Storage, and Distribution Managers	\$89,480	283	15.28%	\$94,357	994	10.79%	\$103,320	11,400	5.6%
Production Managers	\$98,790	302	7.82%	\$104,477	1,558	5.37%	\$115,110	13,800	0.70%

Data gathered from the Bureau of Labor Statistics' [Occupational Outlook Handbook](#) and [Occupational Employment Statistics](#); and the Projections Managing Partnership's [State Occupational Projections](#) (2016-2026). Please note that national projections are for the period of 2016-2026.