

SOUTH DAKOTA BOARD OF REGENTS

Academic and Student Affairs
Consent

AGENDA ITEM: 5 – B (4)
DATE: December 11-12, 2024

SUBJECT

New Program Request – SDSU – BS in Healthcare Systems Engineering

CONTROLLING STATUTE, RULE, OR POLICY

[BOR Policy 2.3.2](#) – New Programs, Program Modifications, and Inactivation/Termination

BACKGROUND / DISCUSSION

South Dakota State University (SDSU) requests authorization to offer a BS in Healthcare Systems Engineering. Healthcare Systems Engineering is a multidisciplinary field that encompasses a wide range of technologies to enhance human health and well-being. Healthcare Systems Engineering integrates engineering, computer science, data science, and health sciences. The B.S. in Healthcare Systems Engineering program will prepare students for rapidly emerging technologies in artificial intelligence (AI) and machine learning (ML), big data and cybersecurity, health informatics, pharmaceutical development, genetic and tissue engineering, computational physiological modeling, imaging science, as well as healthcare infrastructure, environmental health and safety, rural health, e-health and telemedicine. This program will provide students with a mastery of incorporating engineering principles and mathematical methods and using cutting-edge tools and techniques to bridge knowledge gaps between healthcare professionals and engineers.

The intent to plan has been approved by the Executive Director and was presented to the Board as an informational item at the April 2024 Board meeting.

IMPACT AND RECOMMENDATION

A summary of the program proposal has been included as Attachment I. Additional information on this proposal is available from the Board office by request.

ATTACHMENTS

Attachment I – New Program Request Summary: SDSU – BS in Healthcare Systems Engineering

DRAFT MOTION 20241211_5-B(4):

I move to authorize SDSU to offer a BS in Healthcare Systems Engineering, as presented.

**Full Proposal – BS Healthcare Systems Engineering
South Dakota State University**

BOR Recommendation: The Board of Regents Academic Affairs and the Executive Director support the program request. This program will increase the number of conferred initial STEM degrees in South Dakota while supporting existing industrial sectors with a particular focus on rural healthcare systems.

Program Description:

Healthcare Systems Engineering is a multidisciplinary field that encompasses a wide range of technologies to enhance human health and well-being. Healthcare Systems Engineering integrates engineering, computer science, data science, and health sciences. The B.S. in Healthcare Systems Engineering program will prepare students for rapidly emerging technologies in artificial intelligence (AI) and machine learning (ML), big data and cybersecurity, health informatics, pharmaceutical development, genetic and tissue engineering, computational physiological modeling, imaging science, as well as healthcare infrastructure, environmental health and safety, rural health, e-health, and telemedicine. This program will provide students with a mastery of incorporating engineering principles and mathematical methods and using cutting-edge tools and techniques to bridge knowledge gaps between healthcare professionals and engineers.

Strategic Impact –

SDSU Strategic Impact: The proposed program aligns well with SDSU’s mission and strategic plan, Pathway to Premier 2030. More specifically, it is a perfect fit for the strategic goal “Achieve Excellence Through Transformative Education” which calls for (a) investments in innovative undergraduate and graduate academic programs and (b) adapting pedagogical approaches by engaging learners in new and innovative ways to enhance student success and inspire current and future students. Technological breakthroughs like generative AI and computational modeling in high-resolution anatomic domains will revolutionize the healthcare industry. This is an opportune time to invest in developing and offering this program to equip students with the skills to address future challenges using innovative science, engineering, and computational methods. Such a program does not exist in the institution’s current program array or the region.

The Jerome J. Lohr College of Engineering offers programs in statistics, data science, computer science, mechanical engineering, and electrical engineering that can be easily leveraged to offer the proposed engineering program. In addition, SDSU offers health-related programs from the College of Nursing, College of Natural Sciences, College of Pharmacy and Allied Health Professions, College of Education and Human Sciences, and College of Agriculture, Food & Environmental Sciences. Many of SDSU’s professors are already engaged in healthcare-related research and projects. This existing strength aligns seamlessly with the proposed program, making it a logical and strategic addition to our offerings. This program will also strengthen a collaboration with Dakota State University.

BOR Strategic Impact: The proposed B.S. in Healthcare Systems Engineering aligns with the SDBOR Strategic Plan Goal 4: Workforce and Economic Development which expects South Dakota public universities to create academic programming that responds to the changing educational and workforce skills needed to meet the demands through 2030 and ensure engagement designed to enhance the state’s long-term economy. South Dakota and the US are the leaders and will continue to lead advancements in human and animal healthcare. As healthcare is becoming increasingly complex under technological, economic, social, and regulatory impacts[1],

there is a pressing need for a holistic approach to addressing these challenges through convergent research and education and train future professionals who are ready to serve the healthcare industry. Healthcare systems engineering is a future-focused program to equip students with the skills that will not only be needed to ensure the quality of healthcare to the public but will be critical for the continued growth of the healthcare industry in South Dakota and the US.

[1] Chyu, M-C, et. al (2015). “Healthcare Engineering Defined: A White Paper,” Journal of Healthcare Engineering, Vol. 6, No. 4

Program Summary:

The classification of this program will be 14.2701 [Systems Engineering]. This program is proposed to be offered on-campus. SDSU will seek accreditation for this program from the Accreditation Board for Engineering and Technology (ABET).

Exemption Request: SDSU requests an exemption to the 120-credit hour maximum for a baccalaureate degree program as described in BOR Policy 2.6.1. Policy 2.6.1 notes that exceptions may be granted by the Executive Director in consultation with the Board of Regent’s president for programs that must “comply with specific standards established by external accreditation, licensure, or regulatory bodies or for other compelling reasons.” SDSU requests an exemption for the program to require 130 credit hours in order to meet the Accreditation Board for Engineering and Technology (ABET) accreditation criteria.

Duplication and Competition:

No other South Dakota university currently offers a BS in Healthcare Systems Engineering. USD and SDM offer a BS in Biomedical Engineering and SDSU offers a minor in Biomedical Engineering, but the proposed program differs from BME. Healthcare systems engineering is a field that focuses on optimizing and improving healthcare delivery systems while biomedical engineering tends to focus on the development of prosthetics, medical devices, and instrumentation for the medical industry.

The Integrated Postsecondary Education Data System (IPEDS) for 2022-2023 reporting shows that South Dakota produced a total of 22 undergraduate completers in related fields.

Regental Universities¹:

University	Bachelor’s Degrees Conferred in Biomedical Engineering	Total Number of Bachelor’s Degrees Conferred at Each Institution
SDM – Biomedical Engineering	21	381
University of South Dakota – Biomedical Engineering	1	1166

The number of conferred bachelor's degrees in related fields, specifically Biomedical Engineering, as reported by IPEDs was 22 for all of South Dakota. As you will see below, the opportunities for students with undergraduate degrees in these fields exceed the current number of degrees awarded.

¹ Integrated Postsecondary Education Data System (IPEDS) for 2022-2023

Competitor University Peers²:

Unlike the table above, this table reports undergraduate degree completions in Healthcare Systems Engineering (not Biomedical Engineering) at universities similar to SDSU in mission and size.

University	Bachelor's Degrees Conferred in Healthcare Systems Engineering	Total Number of Bachelor's Degrees Conferred at Each Institution
Oregon State University; BS Industrial Engineering – Healthcare Systems Engineering	43	5829
University of Wisconsin – Madison; BS Healthcare Systems Engineering	95	8121
Northern Illinois University; BS Industrial and Systems Engineering – Health Systems Engineering Emphasis	11	2582

Workforce Outlook/State Need:

Healthcare systems engineering is an emerging field that does not have a specific occupation code. The broad field of systems engineering is in high demand within the state of South Dakota. The annual openings in the occupations related to systems engineering are 18 (11-9041 Architects and Engineering Managers), 59 (17-2112 Industrial Engineers), and 5 (17-2199 Engineering) for a total of 82 annual openings. Each of these areas is also listed as rapidly growing in demand.[2] GlassDoor.com estimates the average salary for a Healthcare Systems Engineer is \$125,277 per year in the United States.[3] As a systems engineer, Industrial Engineers' average salary in South Dakota is \$87,210 and nationally \$99,380.[4]

Many career fields fall under the umbrella of healthcare systems engineers.[1] After completion of a program, jobs a candidate could apply for include the following positions below:

- Applied biomedical engineer
- Continuous improvement specialist
- Healthcare analyst
- Healthcare management engineer
- Healthcare manager
- Health systems engineer
- Hospital process engineer
- Industrial healthcare engineer
- Medical Imaging Engineer
- Public health engineer
- Healthcare engineering faculty
- Systems engineer

The healthcare industry is the fastest-growing industry in the world. The B.S. in Healthcare Systems Engineering program will prepare students for rapidly emerging technologies in artificial intelligence (AI) and machine learning (ML), big data and cybersecurity, health informatics,

² IPEDS, 2022-2023

pharmaceutical development, genetic and tissue engineering, computational physiological modeling, imaging science, healthcare infrastructure, environmental health and safety, rural health, e-health, and telemedicine. This program will provide students with a mastery of incorporating engineering principles and mathematical methods and using cutting-edge tools and techniques to bridge knowledge gaps between healthcare professionals and engineers. Just the AI segment of the healthcare industry alone is projected to grow to nearly \$200B by 2030.[5] The Fourth Industrial Revolution is poised to unlock new business opportunities, shape innovations, and boost economic productivity.

An estimate of employment opportunities for graduates within the state of South Dakota was determined using the CIP code for systems engineering 14.2701 and its translation to SOC (Standard Occupational Classification) codes: 11-9041 Architects and Engineering Managers, 17-2112 Industrial Engineers, and 17-2199 Engineering, all others. The South Dakota current employment numbers and projected growth for these occupations are (in order) 247 (8.9%), 744 (19.1%), and 96 (2.1%). The weighted projected increase in these occupations is 15.3% or a change from 1087 current jobs to 1253 projected jobs in 2030. [6][7]

[1] Healthcare Degree, Healthcare Systems Engineer, <https://www.healthcaredegree.com/administration/healthcare-systems-engineer> (visited September 10, 2024)

[2] Dept of Labor & Regulations Occupational Employment Projections – Long Term, 2022-2032 data, https://dlr.sd.gov/lmic/menu_projections_occupation_statewide.aspx (visited September 4, 2024)

[3] GlassDoor.com

[4] O*NET OnLine, National Center for O*NET Development, www.onetonline.org/. Accessed 16 August 2024. South Dakota source: Projections Central 2020-2030 long-term projections external site.

<https://projectionscentral.org/Projections/LongTerm/>; United States source: Bureau of Labor Statistics 2022- 2032 employment projections <https://www.bls.gov/emp/>

[5] Stewart, C. (2024). AI in healthcare -statistics & facts., <https://www.statista.com/topics/10011/ai-in-healthcare/#topicOverview> (visited September 5, 2024)

[6] CIP SOC Crosswalk from National Center for Education Statistics <https://nces.ed.gov/ipeds/cipcode/post3.aspx?y=56>

[7] SD Dept of Labor & Regulations Occupational Employment Projections – Long Term, 2022-2032, https://dlr.sd.gov/lmic/menu_projections_occupation_statewide.aspx (visited September 4, 2024)

Student Learning Outcomes:

Program accreditation is available through the Accreditation Board for Engineering and Technology (ABET). All engineering programs accredited by ABET must demonstrate achievement of the following student outcomes. Therefore, after completion of this program, students should have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

6. An ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies.

Program outcomes will be assessed through the Fundamentals of Engineering (FE) exam, employment rates, and post-graduate surveys.

Projected Enrollment:

ESTIMATES	FISCAL YEARS*					
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31
Students new to the university	3	10	12	15	17	20
Students from other university programs	3	5	5	5	5	5
Students off-campus or distance continuing students		5	16	26	35	39
Total students in the program (fall)	6	20	33	46	57	64
Program credit hours (major Courses)**	180	594	990	1380	1710	1920
Graduates			2	4	12	20
*Do not include current fiscal year.						
Appendix B – Budget.						

Enrollment estimates were based on self-reported survey interest noted by present students in Mechanical Engineering, Electrical Engineering, and Computer Science and inquiries from potential students for academic programs that incorporate engineering and healthcare. The Healthcare Systems Engineering major would serve an emerging industry and is not currently available in the region. SDSU's major would be one of a few in the nation. Healthcare Systems Engineering integrates engineering, computer science, data science, and health sciences. In fall 2023, over 980 students were enrolled in the related undergraduate engineering programs at SDSU. The college also looked at the number of students enrolled in the biomedical engineering minor which ranges between 13 and 22 students per year. Based on student feedback and current enrollment, the Jerome J. Lohr College of Engineering anticipates growing the Healthcare Systems Engineering program to 25 new students per year by year 6. Retention rates of 80% year to year were used to estimate continuing student enrollment.

Projected Revenue/Expenses:

FINANCIAL HEALTH SUMMARY						
	1st	2nd	3rd	4th	5th	6th
	FY26	FY27	FY28	FY29	FY30	FY31
TUITION & FEE REVENUES	42,765	142,494	246,248	360,834	445,649	506,006
PROGRAM EXPENSES	25,000	5,190	79,327	219,386	225,783	150,783
NET (T&F REVENUES LESS PROGRAM EXPENSES)	17,765	137,304	166,921	141,449	219,865	355,223
OTHER SUPPORTING REVENUES	-	-	-	-	-	-
NET AFTER OTHER SUPPORTING REVENUES	17,765	137,304	166,921	141,449	219,865	355,223

SDSU is not seeking additional state resources for the Healthcare Systems Engineering major. The university already provides most of the necessary courses for this interdisciplinary program. The new courses, except the capstone courses, will also be offered in other programs. Initial costs will involve reallocating faculty workloads to develop and deliver courses. As the program expands in years 3 and 4, there may be a need to hire additional faculty. The budget includes funds for start-up and typical expenses associated with a tenure-track faculty member, as needed based on the level of instruction required.

The estimated number of students required to break even in the program is estimated to be 7 new students each year or 19 total students in the program each year. This estimate is based on the baseline expenses (excluding one-time expenses for start-up packages or equipment) and the tuition net of HEFF plus discipline fees which equals \$285.10. There would need to be 529 credit hours annually to cover the costs and this amounts to 19 total students. Using a retention rate year over year of 80%, the number of first-year students is estimated to be 7 each year to cover the program costs.