Agendum
Oakland University
Board of Trustees Formal Session
June 27, 2025

MASTER OF SCIENCE DEGREE IN SMART MANUFACTURING
A Recommendation

1. **Division and Department:** Academic Affairs, School of Engineering and Computer Science, Department of Industrial and Systems Engineering.

2. **Introduction:** Oakland University proposes a new Master of Science (MS) degree in Smart Manufacturing. The new program will build upon the academic and research strengths of the Industrial and Systems Engineering Department and the School of Engineering and Computer Science. The program will prepare students in the emerging field of smart manufacturing, which concerns itself with digital twins, data connectivity, data analytics, and simulation of manufacturing systems. The proposed curriculum includes foundation courses in manufacturing as well as depth areas in digital twins, AI in manufacturing, AR/VR, and collaborative robots. This program will further enhance the Department of Industrial and Systems Engineering's offerings at Oakland University, expand research opportunities for both graduate and undergraduate students and elevate the research profile of the department and the university as a whole.

3. **Previous Board Action:** None.

4. **Budget Implications:** The primary source of funding for the program will be graduate tuition. The program is expected to generate a net income for the University starting from the first year itself, and this income is expected to progressively increase for the first few years. By the fifth year of operation, net income is projected to sustain through the program duration. Sustained salary expenses include one full-time faculty member, one part-time instructor, and one graduate assistant. Operating expenses include marketing and library expenses for this new program. The proforma budget is included as Attachment B.

5. **Educational Implications:** The proposed program will introduce three new courses related to advanced Smart Manufacturing topics. The courses include those on collaborative robots, mixed reality, and additive manufacturing. To support the increase in offered courses, the offering frequency of advanced courses will be adjusted based on course enrollment.

6. **Personnel Implications:** To manage the anticipated teaching and administrative load arising from the introduction of program and three new courses, the program will necessitate the hiring of a full-time faculty member starting and one part-time instructor per year. Additionally, the annual hiring of one graduate assistant will be essential to recruit talented graduate students and support undergraduate courses.

7. **University Reviews/Approvals:** The proposed program has been reviewed by the School of Engineering and Computer Science Graduate Committee on Instruction, the School of Engineering and Computer Science Faculty Assembly, the Graduate Council, the Oakland University Senate, and the Executive Vice President for Academic Affairs and Provost.

8. **Recommendation:**

WHEREAS, the MS in Smart Manufacturing degree program is consistent with the objectives contained in Oakland University's Institutional Priorities; and

WHEREAS, the MS in Smart Manufacturing degree program will build on the academic and research strengths of the School of Engineering and Computer Science and provide new educational and community engagement opportunities; now, therefore, be it

RESOLVED, that the Board of Trustees authorizes the School of Engineering and Computer Science to offer the MS in Smart Manufacturing; and, be it further

RESOLVED, that the Executive Vice President for Academic Affairs and Provost will complete annual reviews of the MS in Smart Manufacturing degree program to evaluate academic quality and fiscal viability to determine whether the program should continue.

9. Attachments:

A. Proposal for the MS in Smart Manufacturing degree program.
B. Proforma budget for the MS in Smart Manufacturing degree program.

Submitted to the President
on 6/18, 2025 by

Amy Thompson

Amy Thompson, PH.D.
Executive Vice President
for Academic Affairs and Provost

Recommended on 6/18, 2025
to the Board for Approval by

Ora Pescovitz

Ora Hirsch Pescovitz, M.D.
President

Reviewed by

Joshua D. Merchant, Ph.D.
Chief of Staff and
Secretary to the Board of Trustees

Oakland University
Graduate Council

Title Page

Degree Program Title: Master of Science in Smart Manufacturing

Degree: Master of Science in Smart Manufacturing

Name of Degree Program Coordinator: Dr. Vijitashwa Pandey

Requested Implementation Term: Fall 2025

School or College Governance

Department of Industrial and Systems Engineering

Date Submitted	Date Approved
9/10/2023	9/13/2023

Graduate Committee on Instruction

Date Submitted	Date Approved
9/13/2023	9/21/2023

Dean School or College

Date Submitted	Date Approved
9/29/2023	11/9/2023

University Governance

Graduate Council

Date Submitted	Date Approved
11/15/2023	3/18/2024

Senate

Date Submitted Date Approved

Board of Trustees

Date Submitted Date Approved

Presidents Council

Date Submitted Date Approved

Oakland University

Graduate Council

Table of Contents

I. **Rationale** 6
a. *Describe How the Program Relates to the Institution's Role and Mission* 6
b. *Program Need* 6
c. *Goals and Objectives* 7
d. *Comparison with Other Programs* 7

II. **Academic Unit** 8
a. *How the Goals of the Unit are Served by the Program* 8
b. *How Existing Staff Will Support the Proposed Program* 8
c. *Faculty Qualifications* 8
d. *Current Resources and explain how will the new program impact existing resources* 8

III. **Program Plan** 8
a. *Admission Requirements* 8
b. *Degree Requirements* 9
c. *Curriculum Overview* 10
d. *Academic Direction and Oversight* 12
e. *Interdisciplinary Programs* 12
f. *Accreditation* 13
g. *Program Description* 13
h. *Source of Students* 13
i. *Recruitment Plan* 13
j. *Planned Enrollment* 13
k. *Advising students* 14
l. *Retention Plan* 14
m. *List of Businesses that Would Likely Employ Graduates of the Program* 14

IV. **Off Campus or Distance Delivered Programs** 14

V. **Needs and Costs of the Program** 14
a. *New Resources Needed for the Program* 14
b. *Source of New Resources* 14
c. *5-Year Budget and Revenue from Program* 15
d. *Library – Include library assessment report* 15
e. *Classroom, Laboratory, Space needs* 15
f. *Equipment Needs* 15

VI. **Program Assessment Plan** 15

VII. **Appendices** 16
A. Abbreviated Faculty Vitae 16
B. Degree Requirements 20
C. Typical Student Plan of Study – Full-Time Schedule 23
D. Detailed New Course Descriptions or Syllabi 24
E. Proforma Budget 25
F. Library Budget Report 27
G. Graduate Assessment Plan 35
H. Support Letters 31
I. Survey Data 44

c. List the Goals and Objectives of the Program

Graduate students who complete the Master of Science in Smart Manufacturing will be able to:

- Goal 1: Develop systems level understanding of smart manufacturing tools that can assist with enterprise level planning and decision making, understanding tradeoffs, and considering societal and ethical implications of smart manufacturing.
- Goal 2: Demonstrate the transferability of their academic learning with applied projects aligned with industry and societal needs.
- Goal 3: Demonstrate proficiency in the fundamentals of manufacturing systems and their analysis through mathematical tools, experimentation and software.
- Goal 4: Implement and analyze smart manufacturing tools such as digital twins, AR/VR systems, Collaborative Robots for a variety of application areas.
- Goal 5: Explore technical conferences and journals, make presentations on smart manufacturing topics, and contribute to research in the field.

The program assessment plan has been outlined in **Appendix G** of this document.

d. Comparison to Other Similar Programs

Universities are increasingly realizing the need for offering courses and programs in smart manufacturing. Smart manufacturing graduate programs are also finding traction internationally, particularly in Europe and Singapore. Since smart manufacturing programs are interdisciplinary and tends to be offered with the help of multiple departments, the titles can be slightly different. We provide a list of some programs in this area:

Institution	Degree	College	Credits	Concentrations	Options
Northeastern University	Advanced and Intelligent Manufacturing, MS	College of Engineering	32 credits	Courses from: • Industrial Engineering • Operations Research • Materials Engineering • Mechanical Engineering • Engineering Management	
Nanyang Technical University, Singapore	M.S. in Smart Manufacturing	College of Engineering	30 credits	No concentrations	
Simon Fraser University, Canada	MS in Smart Manufacturing and Systems	School of Mechatronic Systems Engineering	30 credits	No concentrations	

Applicants should have an undergraduate GPA of at least 3.0 on a 4.0 scale for regular admission. If the applicant's undergraduate GPA is between 2.7 and 3.0 on a 4.0 scale, admission with limited standing may be offered.

Any required degree, certificate or licensing:
Admission is open to students with a bachelor's in any field of engineering. Students with background in computer science, engineering technology and related fields may be admitted with conditions – such as taking additional preparatory coursework

Academic term(s) and deadlines for applications for admission:
To be considered for graduate admission, applicants must submit all Graduate Application Requirements and additional department requirements by the published application deadlines. The applications will be processed on a rolling basis. These dates may be different for International Students:

- For fall semester: February 15 (early), April 15 (regular), and July 15 (late)
- For winter semester: October 1 (early) and November 15 (regular)
- For summer semester: March 1 (regular)

Specific admission requirements such as additional letters of recommendation, statement of objectives, personal interview, or special exams:
To be considered for graduate admission, applicants must submit all required materials to the graduate school website.

- Official Transcripts: Official transcripts are required from all post-secondary educational institutions from which the applicant earned a degree (beginning with first baccalaureate) and all enrollment in graduate level course work beyond the bachelor's degree. International university transcripts must be evaluated per university guidelines.
- Letters of Recommendation: Two letters of recommendation are required for admission, with at least one from an academic faculty familiar with the candidate's academic performance.
- TOEFL/IETLS: Foreign applicants who do not have a degree from an English-speaking institution must provide scores for the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IETLS).
- GRE: Applicants must submit official scores from the Graduate Record Examination (GRE) if they graduated from an institution not accredited by a regional accrediting agency of the USA. GRE requirement can be waived if at least one of the following is true: (1) Applicant's last degree is from a U.S. institution accredited by a regional accrediting agency. (2) Applicant's overall GPA from last degree is at least 3.0 on a 4.0 scale. (3) Applicant has worked in the USA for at least two years in the engineering profession. To request a waiver, applicants must submit a "Request to Waive GRE" form to the Graduate School as part of the application packet.

b. Degree Requirements

To be awarded the Master of Science in Smart Manufacturing degree the student must:

- Successfully complete a minimum of 32 credits of graduate level work as specified below. Course credit will not be awarded for work applied toward another degree.
- Earn a grade-point average of at least 3.0 in courses applied toward the degree.
- Satisfy all requirements concerning Academic Progress.

- ISE 5467: PLM Apps: Throughput Simulation (2 credits)
- ISE 5461: PLM Apps: Product Data Management (2 credits)

Artificial Intelligence:
Required course (4 credits)
- ISE 5512: Artificial Intelligence in Manufacturing (4 credits)

Additional course (4 credits)
- ISE 5435: Data Analytics (4 credits)
- ME 5310: Machine Learning in Engineering Design (4 credits)
- CSI 5130: Artificial Intelligence (4 credits)
- ISE 5483: Production Systems and Workflow Analysis (4 credits)
- Additional theory course listed above (4 credits).

AR/VR Applications:
Required course (4 credits)
- ISE 5442: Virtual and Augmented Reality Systems (4 credits, already offered as special topics)

Additional course (4 credits)
- ISE 5443: Automotive User Experience (4 credits, already offered as special topics)
- ISE 5XXX: Mixed Reality Applications in Manufacturing (4 credits, new course)
- CSI 6550: Advanced Visual Computing (4 credits)
- ECE 5510: Machine Vision (4 credits)

Collaborative Robots:
Required (4 credits):
- ISE 5XXX: Collaborative Robots in Manufacturing (4 credits, new course)

Additional course (4 credits)
- ISE 5422: Robotic Systems (4 credits)
- ISE 5423: Industrial Automation Systems (4 credits)
- ECE 5551: Human Robot Interaction (4 credits)

General Electives (8 credits):
Select 8 credits of 5000- and/or 6000-level courses from the disciplines of ISE (excluding ISE 5001, 5002, and 5003), SYS, ECE, ME, or CSE (excluding CSE 5005, 5006, 5007, and 5008). Note that the satisfaction of the prerequisites for any given course on this list may depend upon the engineering discipline of the student's B.S. degree.

Thesis Option: Although the Smart Manufacturing master's degree requirements may be satisfied by taking only coursework, a master's thesis (ISE 6998) may be included as part of the program in place of general elective courses. Students electing a thesis option must accumulate 8 credits of ISE 6998. Successful completion and defense of a thesis is a prerequisite for earning thesis credits. Students choosing the thesis option must select an advisory committee, which is composed of at least three faculty members from the Department of Industrial and Systems Engineering. The selection of the committee and the plan of study must be approved by the ISE Department chair.

Typical plan of study for students enrolled full-time in the program:
Included in **Appendix C**

f. Accreditation

Not applicable

g. Prepare a Brief Description of the Program

The MS in Smart Manufacturing will require students to complete 32 credits hours. The framework of the course requirements is as follows. Students will select one from a set of theory courses to gain foundations in the mathematical underpinnings of smart manufacturing (4 credits). They will also select three required courses (12 credits), categorized into Manufacturing Foundations, Manufacturing System Modeling and Analysis, and Broader Concepts.The students will then select 8 credits from one of the four depth areas of digital twins, AR/VR, AI and Collaborative robots. In these depth areas, there will be a required course catering directly to the depth area and another course to supplement the student's learning closely aligned with the depth area. The students will also have the opportunity to take 8 credits from anywhere in the engineering school to tailor their degree towards their interests and job prospects. Finally, the students will also have the opportunity to choose a thesis option where they will be able to work on a focused project with a thesis advisor and thereby contribute to research in the field.

h. Source of Students

- Graduates from OU undergraduate engineering programs - all majors.
- Graduates from other closely related programs including physics, math, chemistry, engineering technology and others.
- Graduates from other institutions in Michigan and elsewhere in the US.
- Early to mid-career engineering professionals looking to gain a knowledge of smart manufacturing.
- International students with an engineering or STEM background.

i. Recruitment Plan

The MS in Smart Manufacturing program will be advertised through a variety of avenues and the university UCM will be an integral part of the process (approved costs included in the proforma budget). New advertising campaign utilizing brochures, social media, email campaigns, and word of mouth will be extensively utilized. The department will also ask the industrial advisory board of the department and the school to spread the word about the new program. Information will also be disseminated through professional organizations such as SAE, ASME among others. Finally, the department will use its vast connections with the local industry to advertise the program and also attract early and mid-career professionals looking to upskill. The department has also hosted lunch and learn events and will use them as an opportunity to advertise the program.

j. Planned Program Enrollment

The first year enrollment is expected to be 20 new students. This number is expected to grow steadily to about 30 new students per year (total program enrollment ~60). This number is mid-way between the enrollment of the ISE masters and the Engineering Management master's – both offered by the ISE Department.

b. Source of New Resources

Costs will be offset by tuition revenue from this program (included in Appendix E). The program is expected to be positive in the first year of implementation itself.

c. 5-Year Budget and Revenue from Program

Attached in **Appendix E**.

d. Library Assessment Report

Attached in **Appendix F**.

e. Classroom, Laboratory, Space Needs

Not applicable. Existing resources in the ISE dept will be used.

f. Equipment Needs

Not applicable. Existing resources in the ISE dept will be used.

VI. Program Assessment Plan

Attached in **Appendix G.**

VII. Appendices

a. Abbreviated Faculty Vitae
b. Degree Requirements
c. Typical Student Plan of Study – Full-Time Schedule
d. Detailed New Course Descriptions or Syllabi
e. Proforma Budget
f. Library Budget Report
g. Graduate Assessment Plan
h. Support Letters
i. Survey Data

Oakland University

Graduate Council

Faculty Name Vijitashwa Pandey Title Associate Professor School School of Engineering and Computer Science	Office EC 502	Office Phone 248-370-4044 Office Email pandey2@oakland.edu
Degrees – School – Year PhD, University of Illinois at Urbana-Champaign, 2008	**Research Interest** Systems Engineering, Design for Manufacture, Engineering Design, Design Optimization.	

Grants Awarded

- US Army GVSC 2020 (PI): A Decision-Based Mobility Model for Semi and Fully Autonomous Vehicles (continuation). Amount: $76,852.
- Fiat-Chrysler Automobiles, 2018-19 (PI), "Alignment Repair Strategies to Reduce Warranty Costs Using a Probabilistic Decision Model". Amount: $50,000.
- US Army GVSC 2019 (PI): A Decision-Based Mobility Model for Semi and Fully Autonomous Vehicles (continuation). Amount: $67,462.
- US Army TARDEC, 2018 (PI): "A Decision-Based Mobility Model for Semi and Fully Autonomous Vehicles". Amount: $79,550.
- US Army TARDEC, 2018 (Co-PI): "Modeling and Simulation of Repairable Systems for Depot Maintenance and Warranty Forecasting using an Effective Age Approach (Continuation)". Amount: $79,501.
- Fiat-Chrysler Automobiles, 2017 (PI), "Guiding Point-of-Alignment Repairs to Reduce Warranty Costs Predicted by a Probabilistic Decision Model". Amount: $50,000.
- US Army TARDEC, 2017 (Co-PI), "Modeling and Simulation of Repairable Systems for Depot Maintenance and Warranty Forecasting using an Effective Age Approach (Continuation)", Amount: $78,097.
- US Army TARDEC, 2016 (Co-PI), "Modeling and Simulation of Repairable Systems for Depot Maintenance and Warranty Forecasting using an Effective Age Approach". Amount: $75,170.
- DTE Energy (PI): "A PLM Focused Optimal Design of DTE Powerplants." Amount: $35,000
- US Army TARDEC (Co-PI): "Optimal Operation and Depot Maintenance of Repairable Systems". Amount: $75,303

Most Recent Publications (limit to 6)

- Pandey, V., Murthy, S.V. and Corona, S.N., 2022. Work alone then meet: Cognitive attributes and team interaction in engineering design using evolutionary algorithms. Applied Soft Computing, p.108989.
- Basieva, I., Pandey, V. and Khrennikova, P., 2022. More Causes Less Effect: Destructive Interference in Decision Making. Entropy, 24(5), p.725.
- Malik, A.A. and Pandey, V., 2022, August. Drive the Cobots Aright: Guidelines for Industrial Application of Cobots. In International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (Vol. 86250, p. V005T05A015). American Society of Mechanical Engineers
- Pandey, V. and Basieva, I., 2022. Quantum Explanations for Interference Effects in Engineering Decision Making. SAE International Journal of Advances and Current Practices in Mobility, 4(2022-01-0215).
- Kassoumeh, S., Pandey, V., Gorsich, D. and Jayakumar, P., 2021. Value of Information in Multi-Attribute Decisions with Applications in Ground Vehicle Autonomy. Journal of Autonomous Vehicles and Systems, 1(4), p.041006.
- Pandey, V., Bos, J.P., Ewing, J., Kysar, S., Oommen, T., Smith, W., Jayakumar, P. and Gorsich, D., 2021. Decision-Making for Autonomous Mobility Using Remotely Sensed Terrain Parameters in Off-Road Environments. SAE International Journal of Advances and Current Practices in Mobility, 3(2021-01-0233), pp.1682-1689.

Graduate Courses Taught (relevant to new degree)	**Prospective Graduate Courses (relevant to new degree)**
ISE 4434/5434: Design for Manufacture and Assembly Analysis	• ISE 5XXX: Collaborative Robots in Manufacturing

Oakland University

Graduate Council

Faculty Name: Hyungil Kim

Title: Assistant Professor

School: School of Engineering and Computer Science

Office: EC 504

Office Phone: 248)370-4896

Office Email: hyungilkim@oakland.edu

Degrees – School – Year
PhD – Virginia Tech – 2017
MS – Korea University – 2000
BS – Korea University - 1998

Research Interest: Human factors and ergonomics, Extended reality, Intelligent Transportation Systems

Grants Awarded

- Co-PI, US Army Ground Vehicle Systems Center ($954,750), Multi-Objective Rapid Generation of Virtual Environments and Data Analysis in Multi-User Immersive Gaming Environments for Testing New Crew Interface Concepts, with Co-PIs WG Louie, M. Kessentini, D. Zytko, & K. Malik, 2023-2025, Awarded
- Co-PI, US Army Ground Vehicle Systems Center ($1,472,494), Virtual Experimentation for Soldier Evaluation of Autonomous and Non-Autonomous Technologies Using Multi-User Immersive Gaming Environments, with Co-PIs WG Louie & D. Zytko, 2023-2025, Awarded
- PI, General Motors & Augmented Reality Center at Oakland University ($33,064), Immersive Driving Experience Using a VR Head-Mounted Display, 2022-2023, Awarded

Most Recent Publications (limit to 6)

- Albawaneh, A., Agnihothram, V., Wu, J., Singla, G., & Kim, H. (2023). Augmented Reality for Warehouse: Aid System for Foreign Workers. In *2023 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)* (pp. 432-433). IEEE.
- Kim, H., & Doerzaph, Z. (2022). Road user attitudes toward automated shuttle operation: pre and post-deployment surveys. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 66, No. 1, pp. 315-319). Sage CA: Los Angeles, CA: SAGE Publications.
- Kim, H., & Gabbard, J. L. (2022). Assessing Distraction Potential of Augmented Reality Head-up Displays for Vehicle Drivers. Human Factors, 64(5), 852-865.
- Greatbatch, R. L., Kim, H., & Doerzaph, Z. (2022). The Effects of Augmented Reality Head-Up Display Graphics on Driver Situation Awareness and Takeover Performance in Driving Automation Systems. In 2022 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW) (pp. 521-522). IEEE.
- Kim, H., Song, M., & Doerzaph, Z. (2022). Is Driving Automation Used as Intended? Real-world Use of Partially Automated Driving Systems and their Safety Consequences. Transportation Research Record, 2676(1), 30-37.
- Kim, H., Martin, S., Tawari, A., Misu, T., & Gabbard, J. L. (2020). Toward Real-Time Estimation of Driver Situation Awareness: An Eye-tracking Approach based on Moving Objects of Interest. In 2020 IEEE Intelligent Vehicles Symposium (IV) (pp. 1035-1041). IEEE.

Graduate Courses Taught (relevant to new degree)

- ISE4900/5900, SYS5900 Virtual & Augmented Reality
- ISE4900/5900, SYS5900 Automotive User Experience

Prospective Graduate Courses (relevant to new degree)

- ISE4900/5900, SYS5900 Extended Reality in Manufacturing Applications

Broader Concepts: Complete 4 credits from the following:					
Required (at least 4 credits):					
ISE 5487	ISE 5487: Foundations of Systems Engineering	4			
ISE 5488	ISE 5488: Advanced Systems Engineering	4			
ISE 5540	ISE 5540: Occupational Biomechanics	4			
ISE 5410	ISE 5410 - Supply Chain Modeling and Analysis	4			
DEPTH AREAS					
Digital Twins:					
Required course (4 credits)					
ISE 54XX:	Digital Twins in Smart Manufacturing	4			
Additional courses (4 credits)					
ISE 5560	Product Lifecycle Management	4			
ISE 5462	PLM Apps: Robotic Systems	2			
ISE 5463	PLM Apps: Ergonomics	2			
ISE 5466	PLM Apps: Change Management	2			
ISE 5467	PLM Apps: Throughput Simulation	2			
ISE 5461	PLM Apps: Product Data Management	2			
AI in Manufacturing:					
Required course (4 credits)					
ISE 5512:	Artificial Intelligence in Manufacturing	4			
Additional courses (4 credits)					
ISE 5435	Data Analytics	4			
ME 5310	Machine Learning in Engineering Design	4			
CSI 5130	Artificial Intelligence	4			
ISE 5483	Production Systems and Workflow Analysis	4			
-	Additional theory course listed above.	4			

AR/VR in Manufacturing:
Required course (4 credits)

APPENDIX C

Typical Plan of Study – Full-Time Schedule

Student Schedule: Digital Twins Depth Area		
Fall I ISE: 5XXX: Digital Twins in Smart Manufacturing ISE 5442: Virtual and Augmented Reality Systems	**Winter I** ISE 5562: PLM Apps: Robotic Systems (2 credits) ISE 5563: PLM Apps: Ergonomics (2 credits) ISE 5517: Statistical Methods in Engineering	**Summer I** ISE 5464: Design for Manufacturing and Assembly Analysis
Fall II ISE 5435: Data Analytics ISE 5581: Lean Principles and Application	**Winter II** ISE 5487: Foundations of Systems Engineering	**Summer II**

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APPENDIX E

Proforma Budget
Insert Budget using Proforma Budget Template

SBRC Proforma Template **MS in Smart Manufacturing** **FY2025**

Most Likely Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		20	22	25	25	30
1st Year Cohort Revenue		292,800	$322,080	$366,000	$366,000	$439,200
2nd Year Cohort Revenue		$ -	$292,800	$322,080	$366,000	$366,000
3rd Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
4th Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
Gross Tuition Revenue		$292,800	$614,880	$688,080	$732,000	$805,200
Less: Avg Financial Aid (30%)		$ -	$ -	$ -	$ -	$ -
Net Tuition Revenue		**$292,800**	**$614,880**	**$688,080**	**$732,000**	**$805,200**
Expenses						
Salaries						
Faculty Salaries	6101	$90,000	$92,250	$94,556	$96,920	$99,343
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301	$6,000	$6,000			
Graduate Assistant	6311	$10,685	$10,685	$10,685	$10,685	$10,685
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**106,685**	**$108,935**	**$105,241**	**$107,605**	**$110,028**

APPENDIX F

Library Budget Report

Attached Separately as a pdf file.

Oakland University

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Aligning Program Goals, Student Learning Outcomes, and Assessment Measures

The goals of the Master of Science in Smart Manufacturing program and their mapping to student learning outcomes are listed below.

Program Goals	Student Learning Outcomes	Assessment Methods
Goal 1: Develop systems level understanding of smart manufacturing tools that can assist with enterprise level planning and decision making, understanding tradeoffs, and considering societal and ethical implications of smart manufacturing.	Students will demonstrate an ability to design and analyze a product or process to satisfy a client's needs subject to constraints.	• External review of key courses • Student course evaluations
Goal 2: Demonstrate the transferability of their academic learning with applied projects aligned with industry and societal needs.	Students will demonstrate an ability to apply the skills and knowledge necessary for mathematical, scientific, and engineering practices.	
Goal 3: Demonstrate proficiency in the fundamentals of manufacturing systems and their analysis through mathematical tools, experimentation and software.	Students will demonstrate an ability to interpret graphical, numerical, and textual data.	
Goal 4: Implement and analyze smart manufacturing tools such as digital twins, AR/VR systems, Collaborative Robots for a variety of application areas.	Students will demonstrate an ability to use modern engineering tools.	
Goal 5: Explore technical conferences and journals, make presentations on smart manufacturing topics, and contribute to research in the field.	Students will demonstrate an ability to recognize when information is needed and to have the ability to locate, evaluate, and use effectively the needed information.	

APPENDIX H

Support Letters

STELLANTIS

22 September 2023

Vijitashwa Pandey, PhD
Interim Dept. Chair and Associate Professor
Industrial and Systems Engineering Department
Engineering Center Room 502
Oakland University
115 Library Drive, Rochester MI 48309

Dear Dr. Pandey,

I am writing to express my support for the proposed MS program in Smart Manufacturing at Oakland University.

Stellantis recognizes the critical role of data connectivity and digitalization in the automotive industry. The goal of Stellantis' Data Academy states: "Stellantis aims to become a data-driven company. The integration of data in all aspects of our business and the development of employees' skills in data is a major objective for the company."

From my experience in Manufacturing Engineering at Stellantis, the need for theoretical acumen and practical experience in the concept of digital twins, tools like AR/VR, and application of AI are growing as data connectivity and digitalization transform the plant floor. These knowledge domains are not addressed by traditional Manufacturing programs but extend naturally from the current ISE framework. I believe the proposed program would prepare graduate engineering students to meet these evolving challenges.

I am looking forward to hearing more on the implementation of this program.

Sincerely,

Christopher Sion
Technical Fellow – Manufacturing Engineering
Phone: (248) 425-8606

STELLANTIS

Oakland University

Graduate Council

Jody J. Hand
MBB Instructor LSS & RPS
Stellantis
800 Chrysler Dr.
Auburn Hills, MI 48326
Jody.Hand@Stellantis.com
248-379-1090
09/25/2023

SECS Executive Committee
Oakland University School of Engineering and Computer Science
Masters in Smart Manufacturing Program

Dear SECS Executive Committee,

I write to endorse the proposed Master's in Smart Manufacturing program at Oakland University. As a Stellantis employee, I firmly believe this program will be an asset for our industry. The automotive sector, including Stellantis, is progressively adopting smart manufacturing practices. Oakland University's program, with its forward-looking curriculum and industry collaboration, will cultivate a talent pool equipped to drive innovation, meet industry demands, and contribute to the regional economy.

This program aligns with our industry's needs. Graduates will possess the expertise necessary to lead transformative initiatives. Additionally, the program's potential to stimulate economic growth in the region through innovation and skilled talent development is a win-win proposition.

In conclusion, I support the Master's in Smart Manufacturing program at Oakland University. This promises to elevate our industry, providing a skilled workforce that can navigate the era of smart manufacturing effectively. I look forward to the positive impact this program will have on Stellantis, our industry, and the local community.

Please feel free to contact me for further information or discussions on this vital initiative.

Sincerely,

Jody J. Hand

MBB Instructor LSS & RPS
Stellantis

September 25, 2023

Vijitashwa Pandey, PhD
Interim Dept. Chair and Associate Professor
Industrial and Systems Engineering Department
Engineering Center Room 502
Oakland University
115 Library Drive, Rochester MI 48309

Dear Dr. Pandey,

I am writing to express my enthusiasm and support for the proposed Masters level program in Smart Manufacturing at Oakland University School of Engineering, recently brought to my attention by Christopher Slon, Technical Fellow at Stellantis.

To provide some context, Dimensional Control Systems (DCS) is a pioneering Quality Management System solution provider. Our software products, known as QDM and 3DCS, are instrumental in engineering, monitoring, and troubleshooting parameters related to product quality and the processes utilized to achieve that level of performance. As an integral part of the Sandvik Corporation, within the Sandvik Manufacturing Solutions division, we play a pivotal role in ensuring the quality and efficiency of manufacturing processes across various industries, including automotive, aerospace, medical devices, electronics, industrial machinery, and their intricate supply chains.

Sandvik Corporation, our parent company, is renowned for its array of engineered products that encompass digital technologies, mirroring the innovations at the heart of DCS. Sandvik boasts a diverse portfolio that includes Computer Aided Manufacturing (CAM) and Metrology software through brands like Mastercam and Metrologic, as well as Additive Manufacturing solutions. However, it is most prominently recognized for its tooling solutions under the Coromant and SECO brands, along with a significant presence in the mining equipment sector. Notably,

Please do not hesitate to reach out if you require any further insights, contributions, or collaboration as this program takes shape. I look forward to witnessing the positive impact it will undoubtedly have on the manufacturing landscape.

Thank you for your dedication and vision in advancing education and innovation in Smart Manufacturing.

Regards,

Donald Jasurda

Director of Sales

Dimensional Control Systems, Inc.

A Sandvik Corporation Business Unit

Dimensional Control Systems
2805 Bellingham
Troy, MI 48083

Phone 248.269.9[illegible]
Fax 248.269.9[illegible]
Email sales@3dcs.com
Web www.3dcs.com

Please feel free to contact me at keenan.obrie@stellantis.com or 248-821-9721 for further information or discussions on this program proposal.

Sincerely,

Keenan O'Brien

Digital Process Engineering Center Manager

Stellantis

OAKLAND UNIVERSITY.

School of Engineering and Computer Science

10/03/2023

Vijitashwa Pandey, PhD
Interim Chair, Industrial and Systems Engineering Department
Oakland University,
Rochester MI 48309

Dr. Pandey,

As the chair of the Mechanical Engineering Department in the School of Engineering and Computer Science, I express my full support for the **MS in Smart Manufacturing** program proposed by the department of Industrial and Systems Engineering.

We think that the tools you will provide in the program will be critical to modern digital manufacturing field. We are particularly pleased to see that you chose to include two manufacture related ME courses in the program. Overall, the ME department is very excited to see this new program, and we fully support it.

Sincerely,

Xia Wang, Ph.D.
Professor and Interim Chair
Department of Mechanical Engineering
Oakland University
402 Engineering Center
115 Library Drive, Rochester, MI, 48309
Tel: 248-370-2224; Fax: 248-370-4416

Oakland University
Graduate Council

10/30/2023

Vijitashwa Pandey, PhD
Chair, Industrial and Systems Engineering Department
Oakland University,
Rochester MI 48309

Dr. Pandey,

As the interim chair of the Computer Science and Engineering Department in the School of Engineering and Computer Science, I express my full support for the **MS in Smart Manufacturing** program proposed by ISE.

Dr. Steven Wilson, Chair of CSE GAC Committee and I feel that the tools to be provided in the program will be critical to manufacturing engineers graduating from OU. We are also encouraged to see the potential inter-departmental cooperation through this program. We wish the program success!

Sincerely,

Hua Ming, Ph.D., Steven Wilson, PhD.,
Dept of Computer Science & Engineering
School of Engineering & Computer Science
Oakland University

Timeline

Typical Timeline for Approving Program Proposal

The following table contains critical points in the internal and external review process for program which is to begin in Fall semester. These dates assume that the process is not delayed by significant revisions.

Date	Event	Materials Needed
April 20x1	Review and approval of complete proposal by School of College	Completed proposal.
May 20x1 through June 20x1	Informal review by Graduate School	Completed proposal.
June 20x1	Completion of Library Report.	Completed proposal.
Sept 20x1	Initial review of complete proposal by the Graduate Council. (2 readings)	Completed proposal.
Nov 20x1	Final reviews of revised proposals by the Senate Planning Review Committee and by the Senate Budget Review Committee.	Completed proposal.
Jan. 20x2	Review by the University Senate (2 readings)	Final proposal and final cost estimate.
March 20x2	Review by Board of Trustees.	Final proposal.
May 20x2	Release by Provost to advertise	Final proposal
June 20x2	Presentation to Academic Affairs Officers Committee of the Presidents Council of State Colleges and Universities	Final proposal.
Sept. 20x2	AA approval for program start	Release curriculum code

SBRC Proforma Template

MS in Smart Manufacturing

FY2025

Most Likely Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		20	22	25	25	30
1st Year Cohort Revenue		$ 292,800	$ 322,080	$ 366,000	$ 366,000	$ 439,200
2nd Year Cohort Revenue		$ -	$ 292,800	$ 322,080	$ 366,000	$ 366,000
3rd Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
4th Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
Gross Tuition Revenue		$ 292,800	$ 614,880	$ 688,080	$ 732,000	$ 805,200
Less: Avg Financial Aid (30%)		$ -	$ -	$ -	$ -	$ -
Net Tuition Revenue		**$ 292,800**	**$ 614,880**	**$ 688,080**	**$ 732,000**	**$ 805,200**
Expenses						
Salaries						
Faculty Salaries	6101	$ 90,000	$ 92,250	$ 94,556	$ 96,920	$ 99,343
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301	$ 6,000	$ 6,000			
Graduate Assistant	6311	$ 10,685	$ 10,685	$ 10,685	$ 10,685	$ 10,685
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 106,685**	**$ 108,935**	**$ 105,241**	**$ 107,605**	**$ 110,028**
Fringe Benefits	6701	$ 39,000	$ 39,963	$ 40,470	$ 41,482	$ 42,519
Total Compensation		**$ 145,685**	**$ 148,898**	**$ 145,711**	**$ 149,087**	**$ 152,547**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	14,640.00	14,640.00	14,640.00	14,640.00	14,640.00
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 15,000	$ 10,000	$ 5,000	$ 5,000
Library	7401	$ 10,491	$ 11,540	$ 12,694	$ 13,964	$ 15,361
Faculty Startup Funding		$ 20,000	$ 20,000			
Total Operating Expenses		$ 70,131	$ 61,180	$ 37,334	$ 33,604	$ 35,001
Total Expenses		**$ 215,816**	**$ 210,078**	**$ 183,045**	**$ 182,691**	**$ 187,548**
University Overhead		$ 60,000	$ 126,000	$ 141,000	$ 150,000	$ 165,000
Net Income (Loss)		**$ 16,984**	**$ 278,802**	**$ 364,035**	**$ 399,309**	**$ 452,652**

SBRC Proforma Template

MS in Smart Manufacturing

FY2025

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M.S. in Smart Manufacturing

Board of Trustees

M.S. in Smart Manufacturing

Department of Industrial and Systems Engineering
School of Engineering and Computer Science

Presented by: Vijitashwa Pandey

OAKLAND UNIVERSITY

Summary of Need/Market Analysis

Smart manufacturing: Enabling **factories that think** — using digital twins, connected sensors, data analytics, and AI to self-optimize production systems in real time.

Government push:

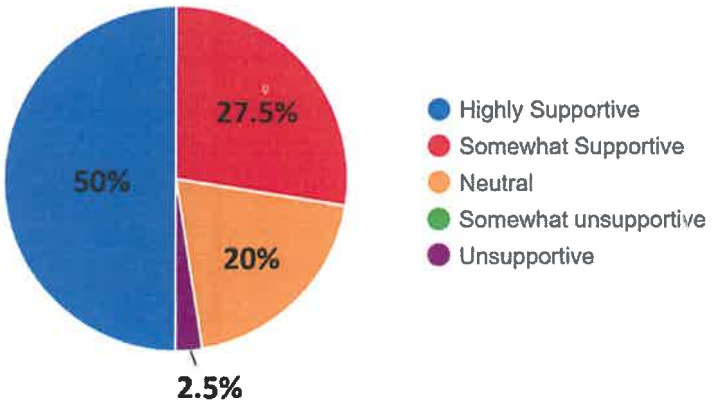
- White House strategic objectives: "Lead the future of smart manufacturing" and "Expand and Diversify the Advanced Manufacturing Talent Pool".
- NSF funding priorities indicate that the government is aggressively looking to train individuals in all aspects of Smart Manufacturing.

Overwhelming support from industry:

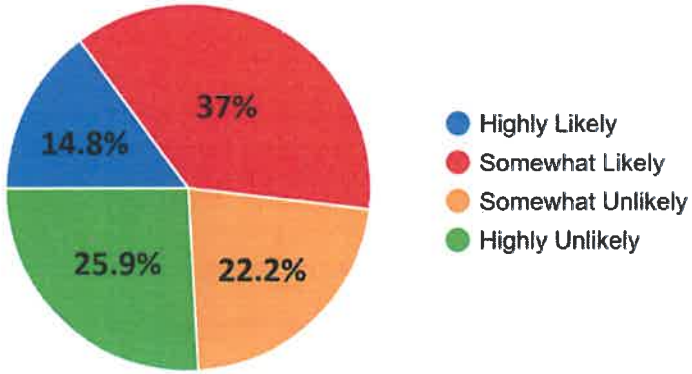
- *"We tend to rely on collaboration with universities in other countries to build our global talent."*
- *"Stellantis recognizes the critical role of data connectivity and digitalization in the automotive industry"*
- *"We see a significant US talent gap in the development of digital twins, collaborative robots, augmented/virtual reality, and AI."*

Summary of Need/Market Analysis

Student interest: 77.5% supportive



52% interested in applying (>10 competing programs in SECS):



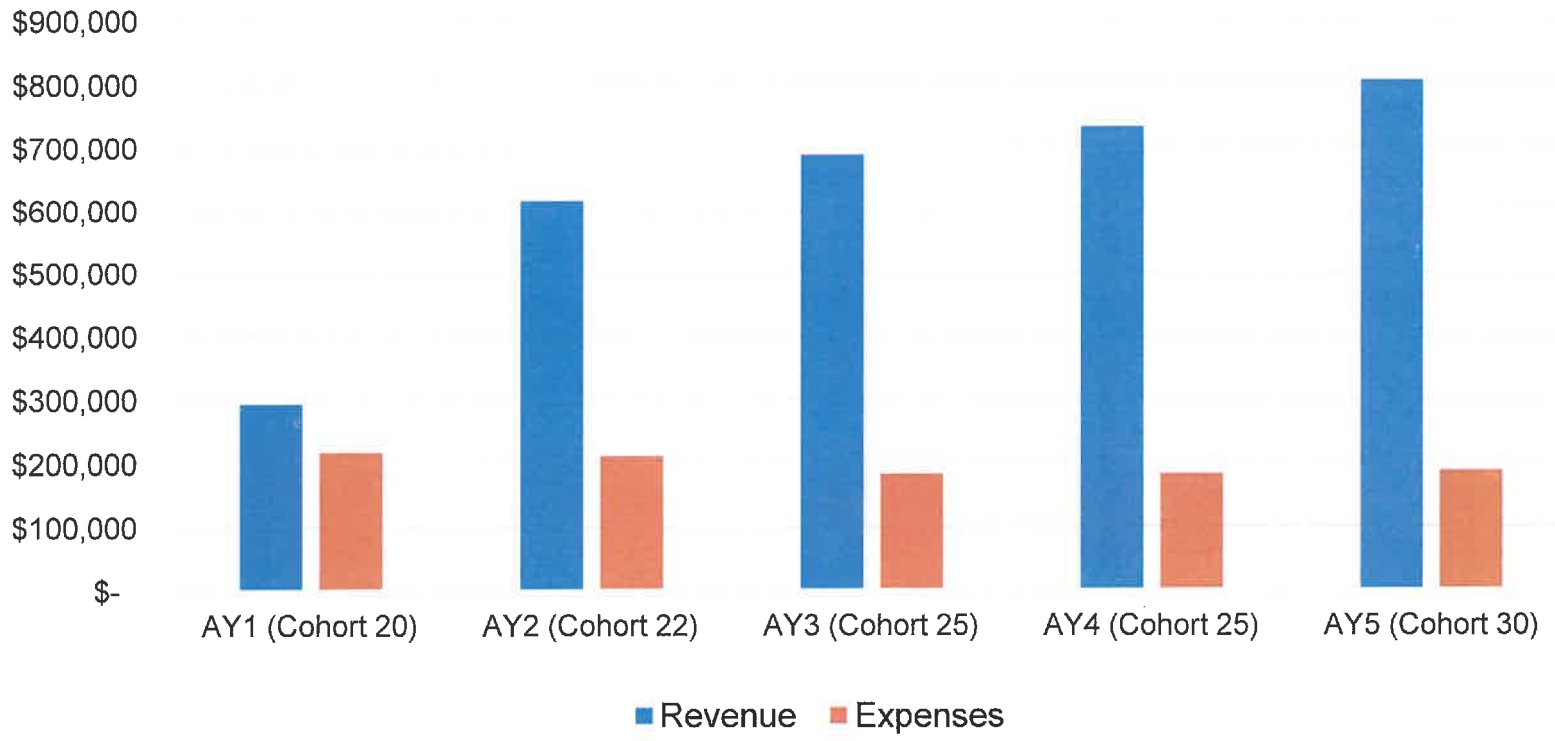
Goals and objectives:

- Create and sustain a program that will graduate students in the upcoming **field of smart manufacturing.**
- Harmonize the department and the school's **research** towards this critical new area of manufacturing.
- Create a pathway for **research and development grants** from the federal and state government, as well as local industry.
- Increase the **visibility** of the department, school and the university.
- Attract national and international students, thereby **increase enrollment.**

Curriculum Overview

- The MS in Smart Manufacturing will require students to complete **32 credits hours.**
- The program framework:
  - A **theory course** addressing mathematical underpinnings of smart manufacturing **(4 credits).**
  - Three **required courses** (**12 credits),** categorized into:
    - Manufacturing Foundations,
    - Manufacturing System Modeling and Analysis, and,
    - Broader Concepts.
  - Courses from one of the four **depth areas** of (**8 credits)**
    - Digital twins
    - AR/VR
    - AI, and,
    - Collaborative robots.
  - Electives (**8 credits)** to tailor their degree towards their interests and job prospects.
    - Can be replaced with thesis credits.

Proforma


$900,000
$800,000
$700,000
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AY1 (Cohort 20)
AY2 (Cohort 22)
AY3 (Cohort 25)
AY4 (Cohort 25)
AY5 (Cohort 30)
Revenue
Expenses

ROI - Return on Investment

- Provide Michigan and the country with **highly trained graduates** in smart manufacturing.
- **Research opportunities** for graduate and undergraduate students.
- **Alignment** with Federal and State funding and workforce development priorities.
- **Synergy** with other SECS departments on research and teaching.
- Student **retention** through mentoring, networking opportunities, professional development, and continuous improvement.

Questions

Thank you!