CENTER FOR AUTOMOTIVE RESEARCH

Examining Michigan Education, Training Resources, and Skills Gaps in Artificial Intelligence: Industry and Academic Perspectives

MAGMA Advisory Council Webinar

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Utilizing AI in Automotive and Electrification
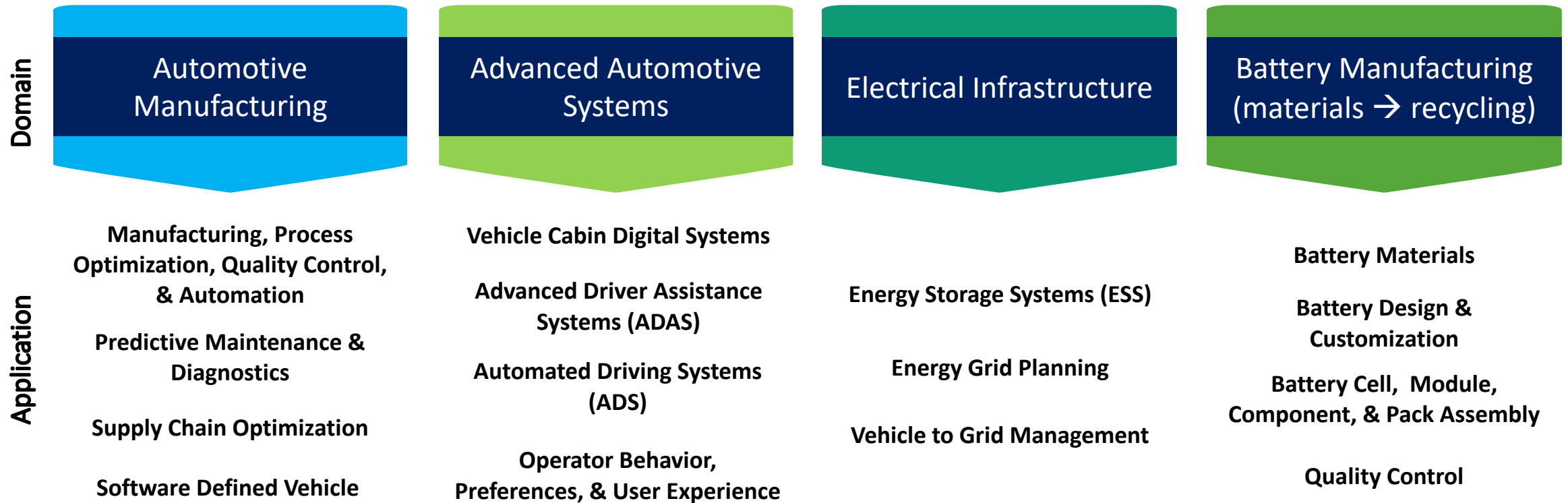## Bridging Education to Employment

- **Advanced computing and artificial intelligence (AI)** is a desirable skillset and a ubiquitous technology utilized across nearly every domain of automotive and electrification industries

- Previous research[1,2] outlined the role of AI in automotive and electrification infrastructure domains

- Review of Michigan undergraduate institutions outlined programs, major/minor degree concentrations, and coursework in AI across multiple disciplines

- Necessary to identify resources from education, training, and continuing education that prepare the upcoming and existing workforce

- Changing needs within automotive and electrification industries require employer perspectives about essential job skills and skills gaps
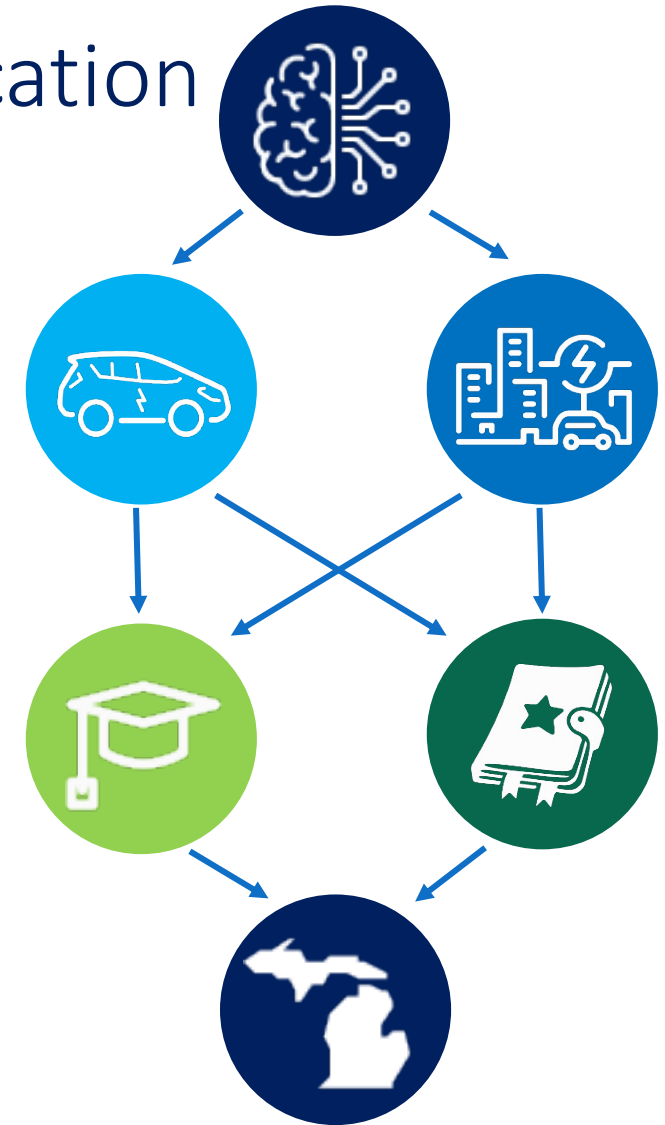
1 CAR Report, October 2023
2 CAR Report, November 2023

Role of AI/ML Across Automotive and Electrification Industry Sectors

Domain

| Automotive Manufacturing | Advanced Automotive Systems | Electrical Infrastructure | Battery Manufacturing (materials → recycling) |

Application

Automotive Manufacturing
- Manufacturing, Process Optimization, Quality Control, & Automation
- Predictive Maintenance & Diagnostics
- Supply Chain Optimization
- Software Defined Vehicle

Advanced Automotive Systems
- Vehicle Cabin Digital Systems
- Advanced Driver Assistance Systems (ADAS)
- Automated Driving Systems (ADS)
- Operator Behavior, Preferences, & User Experience

Electrical Infrastructure
- Energy Storage Systems (ESS)
- Energy Grid Planning
- Vehicle to Grid Management

Battery Manufacturing
- Battery Materials
- Battery Design & Customization
- Battery Cell, Module, Component, & Pack Assembly
- Quality Control

Source: CAR Analysis

CAR Research Study
Examining Education and Training Gaps for AI Skills

- Estimate the education and training gaps between preparedness of students entering workforce and current employer needs

- Focus on advanced computing and AI in conjunction with relevant disciplines for EV Jobs

- Examine programs within Associate and Bachelor's degree granting institutions in Michigan (community colleges, universities)

- Outline the skills required, training resources, and skills gaps in jobs at private organizations from automotive, electrification, and supporting industries

Method
Academic and Industry Domains

Academic Institutions	Private Organizations
Academic institutions were included in sample if classified as Michigan Associate and Baccalaureate institutions with schools, major or minor concentrations, or coursework in each area	Private organizations were included if classified as Michigan employers in automotive, electrification, and supporting industries (e.g., suppliers, benchmarking, materials and battery recycling, and software applications)
Disciplines Electrical Engineering, Computer Eng., Mechanical Eng., Computer Science, Engineering Technology, Computer & Eng. Technology, Cybersecurity, Data science, Information systems, Artificial Intelligence	**Industries** Automotive Original Equipment Manufacturers (OEMs), Suppliers, Electrical systems Developers, Benchmarking/Technology Optimization solutions, Computing Technologies
Institutions + Individuals Contacted: 17 **Total Interviewed (M2, R1, R2^3):** 4	**Organizations + Individuals Contacted:** 16 **Total Interviewed:** 4
(Michigan) Colleges with 4-year degree in AI: 1 **Colleges with undergraduate courses in AI:** ??	**Proportion with on-the-job training in AI:** 50% **Proportion with knowledge of training resources in AI:** 75%

2 Carnegie College Classifications

Academic Perspectives

Academic Perspectives
Advanced Computing and AI Undergraduate Offerings in Michigan

Undergraduate Programs & Concentrations

Computer Science

Engineering

Artificial Intelligence

Automated Design

Industry 4.0

Cybersecurity

Computer Engineering

Civil Engineering

Course offerings

Link and Visual Analysis

Cloud Computing

Risk Analysis

EV system design/charging

Optimization

Generative AI

Natural Language Processing

Deep Learning

Computer Vision

Machine Learning

Industrial Robotics

Neural Networks

ML for Autonomous Driving

Advanced Programming

Biometrics

Data mining

Programs and Coursework summarized from sample of participating institutions, list is not comprehensive

Academic Perspectives
Training and Career Development opportunities

- Co-op thesis projects provide method for synthesizing applied knowledge

- Research assistantships in faculty research labs enable students to conduct research, present findings at conferences, contribute to publications

- Coding and software development experience helps advance students within research labs

- Automotive national competition programs (e.g., Formula 1 program, EcoCAR EV Challenge[4])

- Capstone courses to prepare students for employment in field of study

- Alternating coursework with cooperative education (co-op) placements each semester for applied learning in industry

4 EcoCAR EV Challenge

Academic Perspectives
Talent Recruitment, Retention, and Training

Attracting and retaining students in Michigan

- <u>Strategies/Successes:</u> Elementary → High school Summer camps[5], Competitions
Topics: Cybersecurity, Python, AI, Robotics, Autodrive Challenge[6] (SAE)

- <u>Challenges</u>: Competing with other states, regions for talent; internships with industry have barriers (e.g., geographic limitations, lack of housing); limited representation in engineering and computer science programs/disciplines across all cultures, gender, etc.

Methods for current workforce to gain training with their institution

- Professional development courses, continuing education, certification programs, Masters programs (Engineering, Autonomy, EV, ML)

- Faculty in K-12 need additional training (limited resources, time to advance skills in AI, training programs in development for teachers)
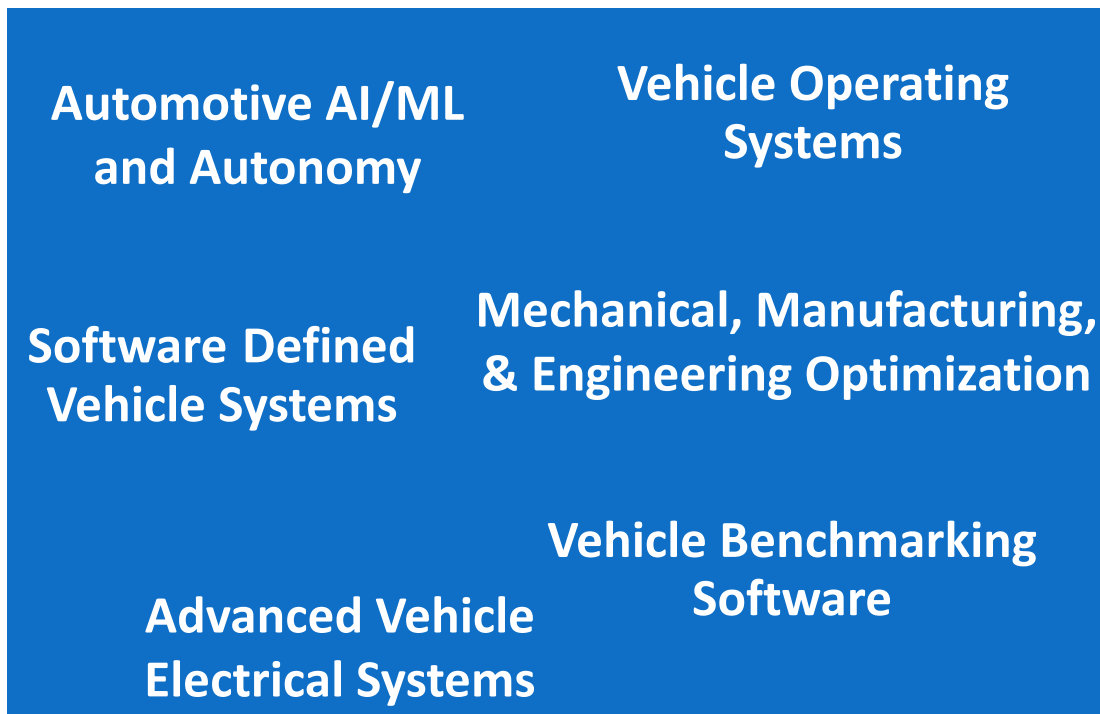
Industry Perspectives
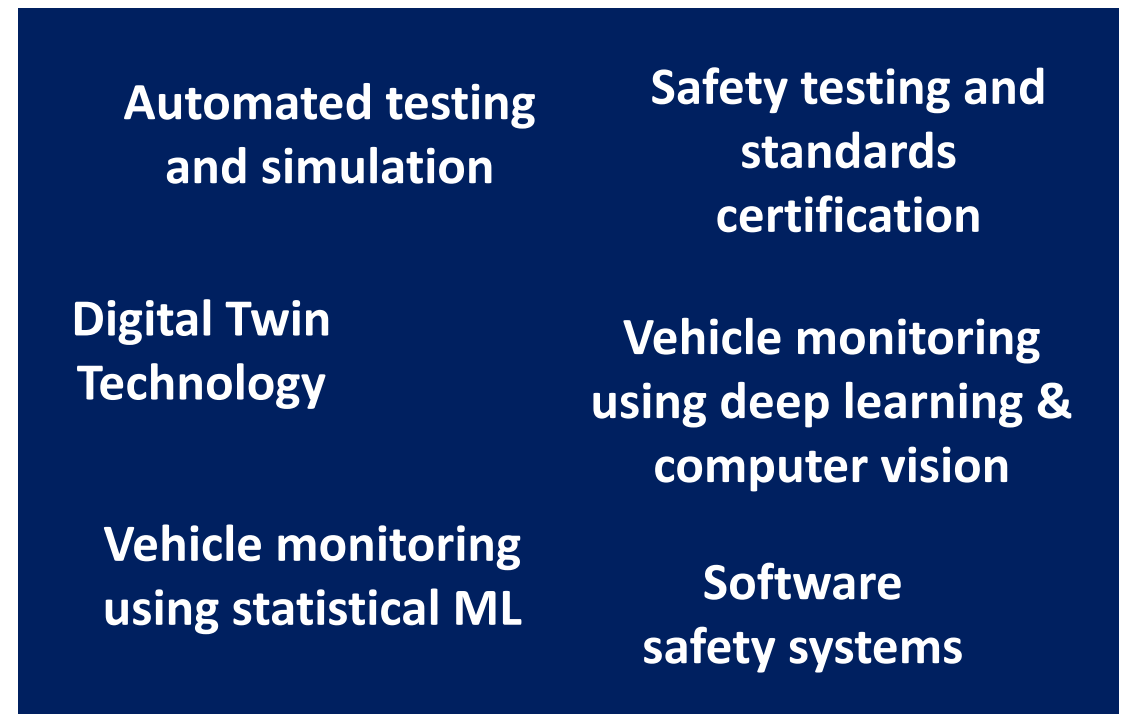
Industry Perspectives

Organizational Utilization of Artificial Intelligence

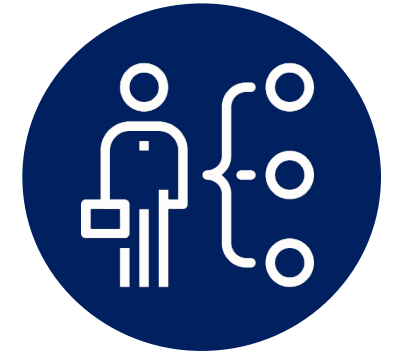### Industries that utilize AI in EV and electrification domains

Automotive AI/ML and Autonomy

Vehicle Operating Systems

Software Defined Vehicle Systems

Mechanical, Manufacturing, & Engineering Optimization

Advanced Vehicle Electrical Systems

Vehicle Benchmarking Software

Advanced computing and AI methods used within the organization

Automated testing and simulation

Safety testing and standards certification

Digital Twin Technology

Vehicle monitoring using deep learning & computer vision

Vehicle monitoring using statistical ML

Software safety systems

Industry Perspectives
AI Job Skills and Potential Skills Gaps

Critical Job Skills in Advanced computing and AI

- Basic and advanced programming/coding skills, data analytics, simulation, process optimization/automation, robotics, AI product development

- For automotive systems/industry: combined AI/ML knowledge with domain knowledge, understanding of latency and sensing requirements of vehicle systems, Functional safety certification requirements (FuSA; ASIL, and QM), ISO[6] and ASPICE standards for software systems, understanding of automotive architecture (hardware & software)

Skills Gaps observed among incoming or existing employees

- Translating simulation experience to hands-on applications

- Understanding of client needs for data presentation, work-flow

- Individuals with advanced computing & AI skills are missing automotive domain knowledge/ those with domain knowledge lack AI/ML skills*

Consistent theme among all industry stakeholders

Industry Perspectives
Recruitment & Retention Challenges and Training Resources

Challenges with recruitment and retention in technical roles, attracting talent to Michigan

- Limited skills in automation

- Competition with other industries for talent (e.g., software, semiconductors)

- Recruitment to MI in comparison to other states (e.g., CA) due to compensation and geographic appeal between automotive and software industries

- Can be difficult to find skilled employee without an advanced degree

- Students from computer sciences don't recognize automotive/electrification infrastructure as career path, but SDV automotive companies like Rivian, Lucid attracting more software engineers

Internal training resources

- In development for some companies

- Mentorship teams that match senior and junior-level employees

- Existing training programs limited to informal courses led by subject-matter experts (SMEs)

Industry Perspectives
Training Opportunities
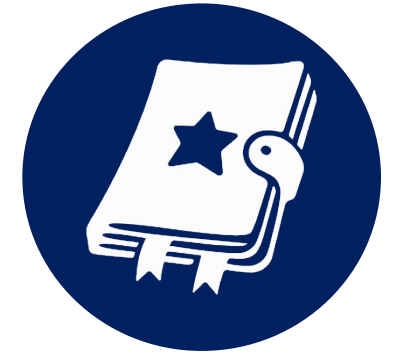
Employees pursuing self-training

- Self-training observed using online courses (Coursera, Udemy, edX, Udacity, etc.) in AI and advanced computing

- Online forums and communities (e.g., Stack Overflow, Reddit, LinkedIn)

- Leadership/management may vary on support for employee self-training

Where should skills be obtained?

- Short-term, intensive training programs focused on practical skills (e.g., partnership with Microsoft, Amazon Web Services (AWS) on emerging AI trends)

- Hands-on training needed in education, extra-curricular competitions

- Conference attendance for workshops, latest research, networking opportunities

- Discussions with professional associations (ASME) about implementing ML training in undergraduate engineering training

Training for the Future of Mobility
Boosting AI Skills for EV Jobs

- Collegiate coursework emerging into disciplines outside of computer sciences, CS remains primary discipline for AI training, ***Only 1 Michigan university offers undergraduate degree in AI***
- Need for AI skills is becoming universal, training needs to begin early (K-12), Need to train the trainers
- Applied learning at summer camps and scientific competitions (software defined vehicles, autonomous vehicles)

- Automotive and vehicle software systems industries place high value on combination of AI computing and domain knowledge
- Skills gaps highlight need for training in entry-level roles (on-the-job training or support for continued education)
- Talent pipeline between AI-trained students and automotive/electrification industry in Michigan limited due to competition with software industry, gap may be closed by focusing on programs beyond engineering discipline

Krusemark, L. (2023). Examining Education, Training Resources, and Skills Gaps in Artificial Intelligence: Industry and Academic Perspectives. Center for Automotive Research, Ann Arbor, Michigan.

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Participating Organizations

AQUINAS COLLEGE

Apex.AI

CMU CENTRAL MICHIGAN UNIVERSITY

caresoft TECHNOLOGIES

FERRIS STATE UNIVERSITY

CAR thanks those individuals and organizations that participated in interviews for this research

Ford

Kettering UNIVERSITY

RAMPF discover the future

Michigan Technological University 1885

M UNIVERSITY OF MICHIGAN

TOYOTA

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2. Krusemark, L., Ganguly, S., Kulicki, A., Prakah-Asante, K., & Prasad, K.V. (2023). Examining Education and Training Resources and Skills Gaps for EV Jobs: Industry and Academic Perspectives. Center for Automotive Research, Ann Arbor, Michigan.

3. About the EcoCAR EV Challenge – Advanced Vehicle Technology Competitions (avtcseries.org)

4. College classifications: Carnegie Classifications, College Tiers, and What They Mean | Academic Influence

5. Summer Camps (ltu.edu), Summer Camp 2023 | MIDAS (umich.edu)

6. AutoDrive Challenge (sae.org),

7. ISO Standards for the Automotive Industry | ISMS.online