UMEC Technology Transfer Plan

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Introduction

The Urban Mobility & Equity Center (UMEC) is committed to technology transfer, as is Morgan State University. In July 2017, the university officially established the Office of Technology Transfer (OTT). The office has provided technical support to UMEC, and its staff reviews research at various stages of technology development, from proposal to prototype, for possible disclosures of intellectual property (IP) and patenting, as well as commercialization/licensing of technologies.

Those involved in technology transfer administration are:

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UMEC's director, Dr. Andrew Farkas, directs the center's research, and manages the resulting technology transfer activities.

1.0 Technology Transfer – Goals and Performance Measures

1.1 GOALS

UMEC research often focuses on improving processes – such as developing algorithms to improve feeder service to transit, a connected vehicle transit signal priority system and an ECO-adaptive cruise control system for buses. It also seeks to understand driver behavior, including how best to communicate fluid information to drivers and how drivers interact with new technology. The term technology includes, but is not limited to, in-vehicle technology, connected and autonomous vehicles, connected infrastructure, information provision, and new materials.

While individual projects have individual goals, the overarching goal of UMEC's research is to improve mobility in an equitable and sustainable fashion.

This Technology Transfer Plan (TTP) is designed to accomplish several goals for the Urban Mobility & Equity Center.

These goals are:

- To support the mission of UMEC, which seeks to bolster the scientific foundation and discern equity implications for policies that focus on urban mobility. UMEC's research contributes to the body of knowledge on which planning and policies are based. UMEC also provides technical assistance to communities and nurtures the next generation of transportation professionals through a variety of programs.
- To ensure that the federally funded research conducted by UMEC provides a public service and that taxpayers receive valuable knowledge in return for the tax dollars spent.
- To build Morgan State University's reputation for research by promoting UMEC's research.
- To foster a culture of innovation.
- To safeguard intellectual property and patentable subject matter.
- To align with the mission of Morgan State University, through collaborative pursuits, scholarly research, creative endeavors, and dedicated public service. The University gives significant priority to addressing societal problems, particularly those prevalent in urban communities.

UMEC's research projects center on three research themes:

- Transit/paratransit and freight planning and operations to improve mobility, access and cost efficiency;
- Buyer acceptance, affordability and government promotion of connected and automated vehicles, including social equity considerations during diffusion of technology; and
- Distribution of transportation costs and benefits, including equity of user fees and taxes that fund infrastructure and services.

Research is enabled through the specifically equipped laboratories and skilled practitioners. Morgan is home to the Safety and Behavioral Analysis (SABA) Center, which has two driving simulators and software – some of which was coded here – that creates realistic roads and allows for route choice. The 6-year-old Structures and Material Laboratories includes an earthquake simulator that goes up to 8.0 on the Richter scale, a smaller shake table, and a machine that can do static and dynamic testing and torsion in a temperature-controlled chamber. A freeze thaw chamber and a scanning vibrometer, as well as machines that measure force, are available, and overhead cranes can ferry samples up to 5 tons. The robotics lab includes drones, and Morgan has just opened the Center for Reverse Engineering and Assured Microelectronics (CREAM), which will help the tech and intelligence communities prevent penetration and manipulation of cyber infrastructure. Two types of research are sponsored by UMEC:

- **core research**, supported by University Transportation Center (UTC) base funds allocated to member universities, is a flexible program to develop core capabilities within each university and provide "seed funding" for higher-risk, basic, or potentially multi-phased projects; and
- **competitively selected research** is proposed by UMEC researchers from broad categories central to UMEC's mission. Funded separately from core research, these projects consist of collaborative, and advanced or applied research to solve mobility challenges and lead to public policy recommendations or new tools/innovations. The project proposals would be expected to gain stakeholder (e.g., state DOT) cooperation and commitment.

1.2 PERFORMANCE MEASURES

UMEC is aware that research undertaken at the University should produce measurable outputs, outcomes, and impacts, as well as influence transportation and society. Research proposals must include recommendations for implementation and deployment.

1.2.1 Outputs

Research outputs include practices, new or improved processes, technology, software, training, inventions, methods or other products resulting from research and development activities. Outputs also include algorithms or models used by transportation educators as well as completed final reports.

Performance measures for outputs include the number of projects that have advanced their technology readiness level; annual number of technical reports published; articles in peer-reviewed journals; and the number of papers published or presented at conferences, symposia, workshops or meetings.

The expected outputs for the upcoming fiscal year are:

1. UMEC expects to develop models that address concepts such as congestion pricing, emergency traffic patrols, and last-mile fresh food delivery systems.
2. It also expects to develop technologies, techniques or predictive methods in areas such as signalized intersections, vehicle routing and traffic state prediction.
3. UMEC will actively address policy-related issues to help provide good science behind public policy.

Target goals for outputs are found in the table in section 1.2.4.

1.2.2 Outcomes

An outcome incorporates new technologies, techniques or practices, and this includes changes made to the transportation system, or its regulatory, legislative, or policy framework. An outcome also includes expanded understanding of drivers' behaviors, attitudes and preferences.

Performance measures of outcomes include the number of technical transfer activities, especially those that offer implementation or deployment guidance, and the number of research deliverables disseminated from each research project. Also included are measures that address policies, such as task force participation, testimony, recommendations for legislation, and partnerships.

The expected outcomes for the upcoming fiscal year include:

1. 1 Full-scale adoption of a new technology technique, algorithms, tools, or practice within the next two years.
2. 2 Public discussion of research results.

Target goals for outcomes are found in the table in section 1.2.4.

1.2.3 Impacts

An impact is on the transportation system or society in general, such as reduced fatalities, more equitable transportation systems, improved technology and operating costs, community impacts, environmental benefits, and a well-prepared workforce. Research has an impact when it changes behavior, practices, decisions, policies, regulations or social action. Impacts will be measured through commercial metrics such as IP disclosures, patents and executed licenses. Impacts also will be gauged through the adoption of technology and harder-to-measure adoption of societal and transportation system changes based on a greater understanding of transportation users' preferences. A final measurement of impact will be the number of transportation students involved in the research, who, as future transportation professionals, will influence the field for several decades. This also will address workforce considerations of diversity, since UMEC is housed at a historic black college and university (HBCU).

The expected outcomes for the upcoming fiscal year include the following:

1. UMEC will focus on equity as it pertains to mobility and affordability in the transportation system, focusing on practices such as managed lanes and evacuation.
2. It also will seek to understand driver behavior, particularly regarding a future traffic mix that includes connected vehicles and autonomous vehicles (CVs and AVs) and more information and technology for drivers, which will impact both fuel consumption and safety.
3. UMEC will continue to focus on technology transfer as a means of impact.
4. UMEC's research is expected to result in broader changes to the transportation system and society.
5. Workforce development will continue with students majoring in transportation, as well as those studying civil engineering, at the undergraduate, master's and doctoral levels.

Target goals for impacts are found in the table in section 1.2.4.

1.2.4 Target Goals

	Goals	Research Performance Measures	Projected
			FY 2019
Output #1 (technology focused)	Develop inventions, new methodologies, or products	Technologies graduating to new technology readiness level (or possibly up 2 TR levels, TBD)	5
Output #2	Disseminate research results through publications, conference papers, and policy papers	Number of technical reports published	7
		Number of papers published through peer-reviewed journals	3
		Number of papers presented in conferences, symposia, workshops, and meetings	6
Outcome #1 (technology focused)	Incorporate or modify new technologies, techniques or practices	Number of technology transfer activities that offer implementation or deployment guidance	2
Outcome #2	Increase traction of public policy & legislation based on involvement with task	Task force participation; testimony; partnerships; final reports	4

	forces, legislators, etc.		
Impact #1 (technology focused)	Technology deployed	Number of instances of technology adoption or commercialization	2
Impact #2	Fuel consumption and safety and operation of the transportation system	Number of instances of research documenting a behavior, practice or technology that increases fuel conservation or safety.	3
Impact #3	Improvements to mobility of transportation systems	IP disclosures, patents, licenses that serve to increase the mobility of passengers and goods	3
Impact #4	Equity in urban mobility and transportation system changes	Number of instance of research influencing policies (including regulatory policies), legislation, or social actions equitably.	1
Impact #5	Workforce development	Enlarge the number of trained and educated transportation professionals	20

2.0 Technology Transfer – Stakeholders

Both core research and competitively selected research may lead to technology transfer of a product or process, and one role of researchers is to communicate the value of their work. In conducting UMEC research, researchers should identify stakeholders, understand their needs and determine how the research outcome could address those needs. In addition, they are available to assist shareholders in implementing and deploying research outputs.

Engaging stakeholders is essential throughout the research process. The center's director, staff and researchers speak informally with stakeholders at state agencies and community groups. Periodic meetings of the UMEC Advisory Committee (identified below) provides a forum for these discussions. As research is completed, more structured opportunities for engagement, such as forums and webinars, will be planned.

Partnering with stakeholders may bring new resources into the process and clarify objectives and challenges. Although stakeholders are divided into external and internal categories for descriptive purposes, in reality they overlap and intermingle.

2.1 INTERNAL STAKEHOLDERS

Internal stakeholders include:

- those who deploy research, such as the Office of Technology Transfer staff at Morgan
- the faculty who conduct the research at Morgan and guide possible implementation
- the Office of Sponsored Programs & Research
- The Office of Restricted Funds Accounting at Morgan
- Students, including those who serve as research assistants

2.2 EXTERNAL STAKEHOLDERS

External Stakeholders include:

- Funding partners
- Consortium partners and their faculty, their students and their offices of sponsored programs and research
- U.S. Department of Transportation
- Maryland Department of Transportation. Research for MDOT always includes a technology transfer component. Researchers interact throughout the research process with the department's technical lead and often present to upper management officials who have deployment responsibilities.
- Virginia Department of Transportation. Presentations made at meetings and conferences will be of interest to state DOT practitioners.
- UMEC Advisory Committee, which includes state and federal officials, a city director of transportation, representatives from private engineering firms, a transportation planner, and a transportation lobbyist. The advisory committee meets four times a year and provides valuable insight into possible channels for deployment and implementation of research as well as oversight of the research process.
- Peer reviewers, who evaluate proposals for funding. All projects are evaluated by at least three reviewers.
- Corporate partners
- Baltimore Metropolitan Council, which is the planning agency for the Baltimore Regional Transportation Board
- Software developers, particularly with regard to code written here and algorithms

2.3 ASSISTING STAKEHOLDERS IN IMPLEMENTING AND DEPLOYING RESEARCH OUTPUTS

Communication at every stage of research is the key to assisting stakeholders. As research garners results, UMEC is developing plans to hold research symposiums, which could be co-sponsored by our stakeholders. Forums will present the research in a more interactive format and focus on how results might be implemented. These could include webinars, workshops, videos, emails and recordings of seminars and presentations.

If stakeholders want to adopt a tool or technology developed as a result of UMEC research, the researchers can be consulted on best practices for the deployment. If the research is to be translated into policy or legislation, researchers and staff are available to ensure that policymakers and legislators fully understand the research concepts and results. If needed, the center will develop tools – such as training materials, guides and fact sheets – to help with understanding and implementation.

2.4 INCREASING CORPORATE RESEARCH SUPPORT

The UMEC Advisory Committee includes government officials and private sector representatives, but future goals for UMEC include attracting corporate partners who might be interested in supporting research projects, developing strategies to expand the UMEC portfolio into areas such as compliance and optimization, and marketing our research capabilities to potential partners.

3.0 Technology Transfer – Intellectual Property

As part of the evaluation and rewarding of research grants, all research will be reviewed with technology transfer goals in mind. Principal investigators (PIs) will be encouraged to consider implications for broad-based intellectual property development and licensing, both through informal discussions and formal comments on the structure and goals of the research.

- When a research grant is awarded and the project is listed on the UMEC website, the Morgan State University Office of Technology Transfer (OTT) will be notified about the nature of the research. The OTT will also be sent the completed research report before it is made public, in order to assess whether intellectual property rights exist and proceed with protection (e.g., file a provisional patent application). USDOT will retain the right to use any IP developed under the Morgan State grants sponsored by DOT on a non-exclusive basis. The OTT may also be apprised of research in progress and determine that IP can be protected at an earlier point in time.
- During the course of the research project, all PIs will be required to submit semi-annual progress reports that include data/progress toward technology transfer.

3.1 COMMERCIALIZATION/LICENSING

Morgan State's OTT has established patent policies and procedures that include the licensing of inventions and distribution of any proceeds that are received by this office. The OTT assures that all net revenue received from licensing activities is properly distributed to the inventors and their departments through the standard University practices, and according to the MSU Board of Regents Patent Policy. Gross revenue includes up-front payments, technology purchases, option fees, minimum annual licensing fees, technology transfer fees, technology development payments, and royalties. Net revenue is derived by subtracting patent, marketing, licensing costs, and donors and contractors who perform work on behalf of the OTT; those costs may be returned to the OTT, according to the University's patent policy.

Distribution of net revenues are then allocated to the inventor (50%), and the remainder of the proceeds are shared by the Center, Department, OTT and other units and parties, as appropriate.

- PIs who believe they may have patentable subject matter are strongly encouraged to contact the OTT and submit an Intellectual Property Disclosure (IPD) Form to initiate the IP disclosure process. In the case where IP is jointly owned with someone from another organization, then additional coordination is required with the other inventor and/or technology transfer office, as applicable.
- With respect to stakeholder involvement, the OTT socializes the plan with the department and the UMEC to determine whether the IPD should be approved. The sponsors of any funding

associated with the IP are required to be informed of the filing of the IPD per the sponsors' requirements, which are to be aligned with federal guidelines.

- The OTT will determine whether the IP should move through the patent process, designated as a copyright, or treated as a trade secret. In some cases, the copyright may even include the release as open source software, as governed by an accepted license such as Apache or MIT, e.g., that allows for commercialization of the technology. If the IP is to be protected via the patent process, the typical sequence would be to protect it through a U.S. provisional patent, with an option to protect the IP within a year (under current federal direction) through a fuller patent application. The OTT will also determine whether an international patent is required.

- PIs are encouraged to seek other sources of internal or external funding that effectively encourage commercialization of a product. Morgan State instituted a program called I-GAP, which allows for ideas to be realized through proof of concept or prototype support. Outside of the University, the Maryland Innovation Initiative (MII) and Maryland Industrial Partnerships (MIPS) are two of the numerous sources from the State of Maryland that will also assist in furthering research and technology development.

- A market assessment to be led/conducted by the OTT will determine if the PI has developed an application suited to commercial use. The OTT will have a Business Opportunity Plan developed as part of an MII award, which may be an actual business plan, or the basis for one. A business plan is required in order to understand a prospective entrepreneur's intent to operate a commercial entity based on the licensing of Morgan State University IP.

- Based on a positive market assessment, the OTT will typically seek to find a commercial entity to license the technology, enhance the core technology, and monetize the opportunity. Licensing priority will be given to local startup companies, effectively promoting economic development within the City of Baltimore. The commercial pathway may be developed that provides a template for other sources of funding, other business milestones, to include marketing and sales, and technical milestones that show progress towards realization of a prototype or product.

- The Office of Technology Transfer is responsible for collecting revenues associated with licenses issued to the commercial sector or with products and services provided directly from Morgan State. Those revenues are subject to a "waterfall schedule," whereby the proceeds generated from net revenues are designated according to the patent policy, which may include allocations to the inventor or respective research department, as mentioned above.

4.0 Technology Transfer – Disseminating Results

UMEC not only publicizes its research awards and findings, but it also markets its research to a wider audience whenever possible. A final research report describes the research subject, the methodology

used, the results and the conclusions and recommendations drawn from those results, but accompanying articles and social media items are used to make that research understandable for a non-technical audience.

- UMEC will comply with the requirements of the University Transportation Centers Program to disseminate information. Information available on the website will be accessible to those with disabilities.
- Press releases and content about research results will be developed and submitted to external media and used in-house for social media, newsletters, websites, etc.
- Fact sheets, videos and other materials to market research to industry and policy makers can be developed with the help of UMEC staff.
- PIs are strongly encouraged to submit research results to peer-reviewed journals, and UMEC provides editorial support.
- An exhibitor booth at TRB showcases current research and research capabilities.
- UMEC has developed an email list of 450 people interested in UMEC's research and workforce development programs; they receive newsletters twice a year.

Communications is key to enhancing the value of a research outcome throughout the process – not only at the conclusion. There should be communications activities for each phase of research and development, including identifying champions and stakeholders, publishing research alerts, and conducting showcases. Researchers should plan such activities in coordination with the communications manager at UMEC, who should work with the University's public relations manager and those of other collaborating institutions.

4.1 HOW RESEARCH OUTPUTS, OUTCOMES AND IMPACTS WILL BE TRACKED AND REPORTED

- The research projects awarded grants and the names of the PIs will be posted on the UMEC website.

- All research reports will be published on the UMEC website, and original research will be archived in accordance with UMEC's data management plan. Final reports also will be submitted to the Transportation Research Board, the U.S. DOT's research hub, Northwestern University's Transportation Library, the Volpe National Transportation Systems Center, the Federal Highway Administration Research Library, and the National Technical Information Service, as well as the appropriate stakeholders, such as state agencies or corporate partners.

- Researchers are required to submit semi-annual reports detailing technology transfer activities.

- Progress reports, which include information about performance measures, will be published twice a year on the UMEC website.

5.0 Technology Transfer – Building Brand Awareness

Morgan State University is a Carnegie-classified Doctoral Research Institution offering more than 70 academic programs leading to Bachelor's degrees as well as programs at the Master's and doctoral levels. Recently, Morgan was officially designated as Maryland's Premier Public Urban Research University. Marketing UMEC's – and by extension Morgan's – research and research capabilities is one of the goals of this plan.

- UMEC publications, including technical papers and newsletters, will be copyrighted with the Morgan State University copyright.
- All instructional and print materials shall include the UMEC logo, denote the DOT funding grant, and where appropriate, include a copyright notice.
- PIs are encouraged to submit articles about their research to peer-reviewed journals and to make presentations at conferences.
- Both completed and ongoing research will be promoted through social media platforms and on the UMEC website.
- Programs aimed at developing the next-generation transportation workforce – such as the Summer Transportation Institute, the Middle School Summer Transportation Initiative, Teacher Transportation Institute and internships and fellowships – will be promoted through social media platforms and on the UMEC website.
- As a result of UMEC research activities, innovations conceived and developed by researchers will be featured on social media and the UMEC website to further a culture of innovation.

6.0 Technology Transfer – Risk Mitigation

Conducting research always carries risks. An unexpected leap forward in technology in the private sector, for example, could render the research outdated before it's completed. A researcher may not be able to finish the project due to health concerns. Another institution could convince a researcher to join its faculty instead. Valuable research could be placed prematurely in the public domain, possibly forfeiting any right to monetize it.

Whenever possible, UMEC will mitigate risk with careful planning. A system of regular review and required documentation is already in place, and the frequency of reviews can be increased on an as-needed basis. Patents will be secured as quickly as possible, and using peer reviewers ensures that innovative research gets funding priority. All three institutions in UMEC boast a cadre of experienced researchers with a proven track record of timely completion of projects and a wide variety of expertise.

Office of Technology Transfer
UMEC Intellectual Property and Technology Transfer Strategy

Mission Statement:

UMEC seeks to bolster the scientific foundation and discern equity implications for policies that focus on urban mobility.

UMEC IP Tech Transfer Strategic Goals	Plan	OTT Actions
Support Mission Statement	IP Licensing to Existing and New Businesses	Broad Based Intellectual Property Development/Licensing
Build UMEC Reputation	Build & Reinforce Recognizable Brand	Build IP Portfolio (Patents, Trademarks and Copyrights)
Document Benefit to the State and Nation	Secure Recognition for the Center	Part of OTT Marketing Effort

Intellectual Property (IP) and Publications	Technology Transfer/Licensing	Notes
Publications	Publications themselves are copyright-driven, although there may be something patentable within; disseminate knowledge	Protect IP and Publish
Patentable Subject Matter (Patent Rights)	Priority to local companies	Exclusive, limited and non-exclusive licenses and options
Government Reports of Inventions	Patentable Disclosures to USDOT (Bayh-Dole Act)	Assure IP is protected, as provided under US Govt. Funding
Trademark	Include related TMs in materials and agreements	Develop Logo/Brand (Trademark)
Copyright	Copyright notices on print/instructional materials/software	Distribution of © material with logo brand