**MOUNTAIN-PLAINS**
**CONSORTIUM** REGION 8

# TECHNOLOGY TRANSFER PLAN for the MOUNTAIN-PLAINS CONSORTIUM

## Region 8 University Transportation Center

**July 2018**

**Technology Transfer Plan for the Mountain-Plains Consortium (MPC)**

**Region 8 University Transportation Center**

**Denver Tolliver, Director**
**North Dakota State University**

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# 1. STAKEHOLDER IDENTIFICATION AND INVOLVEMENT

Key stakeholders were identified during the development of MPC's proposal and strategic plan. As a regional center, MPC's stakeholder population is diverse. Some parties are attracted to the theme of "Preserving the Existing Transportation System." Others are drawn to MPC's outreach programs that directly impact their needs. Key stakeholder groups are highlighted in this section of the plan.

## 1.1. State Transportation Departments

Most of MPC's match funding comes from state transportation departments in Region 8. Likewise, state transportation departments are the primary recipients and beneficiaries of MPC's research outputs. These stakeholders are involved in MPC's research program in a variety of ways, linking research with technology transfer and identifying paths to implementation.

### 1.1.1. *Target Audiences*

A state department of transportation (DOT) consists of three main audiences: agency leaders, division and program heads, and professional staff. Agency leaders are primarily impacted by MPC's policy-level research. Often, they are more interested in the transfer of knowledge to their employees than gaining new technical knowledge for themselves. Division and program heads are the primary conduits of knowledge transfer within the agencies. They are focused on keeping abreast of changes in practice and broadening their horizons in areas such as planning and management. Professional staff members apply and utilize the knowledge gained from MPC's research program.

There is a fourth audience in state transportation departments: engineering technicians and employees with two-year degrees and/or several years of college. This is a critical component of the workforce. These people perform routine tasks once performed by professional engineers before engineering shortages became acute. Upgrading the skills of these employees is a critical goal of state transportation departments. While they are not the primary recipients of MPC's research outcomes, they do benefit from MPC's technology transfer and workforce development programs.

In serving state DOTs, the transfer of knowledge generated from MPC's research projects and the broader transfer of knowledge through continuous learning are mingled. Both activities are essential, and both are described in MPC's proposal/strategic plan.

### 1.1.2. *Strategies for Involvement in Research Program*

While state transportation departments have common interests, each is unique in several respects. MPC's involvement strategies must fit the agency's culture and "way of doing business."

*Research Panels*. MPC faculty are deeply involved in the research planning process in several states, especially North Dakota, South Dakota, Utah, and Wyoming. MPC faculty and staff jointly participate with DOT engineers in identifying and prioritizing research needs. Most of the research projects matched by state transportation departments are of an applied nature. Hence, DOT stakeholders have clear ideas about how to utilize the results. The key objective is for this information to be reflected in the technology transfer ($T^2$) plan that is required of each MPC project. Much of the interaction within these panels is between MPC faculty and research engineers and division heads.

*Peer Review*. At least one practitioner is typically included as a peer reviewer of an MPC proposal, and in some cases is identified as an external project advisor. During peer review, state DOT experts are asked to comment on the value of the research and its potential impact, as well as on the

technology transfer plan itself. These reviewers may be research engineers, division or section heads, or professional staff.

*Advisory Councils.* Some universities have advisory councils or boards that provide direct input on research priorities and the potential impact of MPC projects on transportation policies and practices. For example, the director of the North Dakota Department of Transportation serves on the Advisory Council of the Upper Great Plains Transportation Institute (UGPTI), MPC's administrative home.

*Strategic Dialogue.* Often, the director and MPC program coordinators converse directly with agency leaders. This form of involvement is especially important in identifying policy and planning research needs.

*Project Advisory Committees.* A large-scale project may have an advisory committee that is specific to the effort. These committees are typically small, ad hoc in nature, and include a stakeholder from the immediate group that will directly benefit from the research. They can be effective in ensuring a seamless transition of research findings into practice. In certain instances, project advisory committees may involve practicing engineers or consultants who provide input on the research plan.

### 1.1.3.  *Delivery Strategies*

Most state DOTs have limited travel budgets. Therefore, research results must be delivered in a cost-effective manner that does not require substantial travel. The primary mechanisms embraced by state DOTs are: (1) on-site delivery, (2) interactive video, (3) webinars, (4) email, (5) online (flexible) learning, and (6) annual DOT state engineering conferences.

On-site delivery is an effective means of knowledge transfer. But, it requires planning, marketing, and the dedication of time by DOT employees. Conflicts frequently arise, causing intended recipients to miss events. Because of time constraints and conflicts during the business day, on-site delivery is not a stand-alone method of technology transfer. The seminars must be recorded and archived for optimal effect. In this way, participants who miss part or all of an event can view it in a more flexible setting. In addition, recorded events allow participants to return to a seminar later, review it, and reinforce their knowledge. Interactive video and webinars are nearly as effective as on-site events, but they also encounter business-day conflicts. Like on-site events, videoconferences and webinars are most effective when they are recorded and archived.

Emails to a contact list are useful in reaching some practitioners. However, the email must have a catchy title, be short and concise, and contain URL links to more detailed documents. Furthermore, the frequency of emails cannot be burdensome and recipients must have a straightforward way of opting out of the list. Online (on-demand) learning is popular with DOT audiences because of its flexibility and 24/7 access. This has led to the development of self-paced online modules offered by the Transportation Learning Network (TLN).

A number of state DOTs, such as UDOT, hold annual engineering conferences featuring oral and poster presentations. These types of presentations tend to be effective delivery mechanisms. In addition, starting in 2019, MPC will offer an annual university research workshop for state DOTs and other clients in the region. At these events, the results of MPC research projects will be presented and feedback obtained from DOT personnel. The intimate nature of the workshops will allow DOT engineers and program managers to interact with MPC researchers and provide suggestions and feedback for future research.

## 1.2. Metropolitan Planning Organizations

In addition to state transportation departments, Metropolitan Planning Organizations (MPOs) are primary stakeholders and target audiences. Although MPC's research can be used by any MPO in the region, the ones listed in Table 1 are key partners and potential recipients.

| Table 1: MPO Stakeholders in the Mountain-Plains Consortium | |
| --- | --- |
| Denver Regional COG (CO) | Wasatch Front Regional Council (UT) |
| North Front Range MPO (CO) | Cache MPO (Logan, UT) |
| Fargo-Moorhead Metropolitan COG (ND) | Cheyenne MPO (WY) |
| Grand Forks-E. Grand Forks MPO (ND) | Casper Area MPO (WY) |

## 1.3. County Stakeholders

MPC's primary theme of Preserving the Existing Transportation System is of keen interest to county governments and associations. The associations listed in Table 2 are strategic partners that offer avenues for dissemination of research results. In addition, they offer valuable input regarding the interests of their members. The North Dakota Association of Counties serves on UGPTI's Advisory Council.

| Table 2: Strategic County Stakeholders in the Mountain-Plains Consortium | |
| --- | --- |
| North Dakota Association of Counties | Western North Dakota Energy Association |
| South Dakota Association of Counties | Associations of County Engineers |
| Utah Association of Counties | (multiple states)[1] |

In addition to associations of county officials, MPC collaborates with the state affiliates of the Association of County Engineers throughout the region, especially in North Dakota, South Dakota, and Wyoming. In many cases, the MPC universities work directly with county governments on research and technology transfer projects. Several of these counties are listed in Table 3.

| Table 3: Local County Stakeholders in the Mountain-Plains Consortium | |
| --- | --- |
| Denver County, CO | Laramie County, WY |
| Larimer County, CO | Albany County, WY |
| Cache County, UT | Cass County, ND |
| Salt Lake County, UT | |

## 1.4. City Stakeholders

City associations and municipal leagues (Table 4) are strategic partners and vehicles for disseminating research results. In addition, they offer valuable input regarding the interests of their members. The North Dakota League of Cities serves on UGPTI's Advisory Council. In addition to municipal leagues, MPC works closely with individual cities in the region on research, technology transfer, and workforce development activities. These key stakeholders are listed in Table 5.

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[1] The precise association name may vary somewhat from state to state.  For example, in Wyoming, the official title is: Wyoming Association of County Engineers & Road Superintendents

| Table 4: Strategic Municipal Stakeholders in the Mountain-Plains Consortium | |
|---|---|
| Colorado Municipal League | South Dakota Municipal League |
| North Dakota League of Cities | Wyoming Association of Municipalities |
| Utah League of Cities and Towns | |

| Table 5: Primary City Stakeholders in the Mountain-Plains Consortium | |
|---|---|
| City of Denver, CO | City of Logan, UT |
| City of Fort Collins, CO | Salt Lake City, UT |
| City of Fargo, ND | Nibley City, UT |
| City of Grand Forks, CO | City of Laramie, WY |
| Park City, UT | City of Cheyenne, WY |

## 1.5.    Native American Indian Stakeholders

MPC has an impressive record of tribal outreach and technology transfer accomplishments. To achieve its goals, MPC works with *collaborators*, such as tribal colleges, technology assistance centers, and federal and state agencies with common objectives. These collaborators include Federal Land Highways, Federal Highway Administration, Bureau of Indian Affairs, U.S. Department of Agriculture, and state transportation departments in Region 8. The *stakeholders* (and actual targets of MPC's efforts) are the Indian nations and tribes, themselves. A current list of Native American stakeholders is presented in Table 6. Hopefully, this list will continue to grow over time.

| Table 6: Native American Indian Stakeholders in the Mountain-Plains Consortium | |
|---|---|
| Mandan/Hidatsa/Arikara Nation | Northwestern Shoshone Tribe of Utah |
| Turtle Mountain Band of Chippewa Indians | Navajo Indian Tribes of Utah |
| Standing Rock Sioux Tribe | Wind River Arapaho Tribes of Wyoming |
| Spirit Lake Tribe | Wind River Shoshone Tribes of Wyoming |
| Paiute Indian Tribe of Utah | |

## 1.6.    Private Industry Stakeholders

Most of MPC's match funding comes from government entities—e.g., state, regional, and local. Nevertheless, MPC collaborates with a wide range of businesses and industry associations. Many of these entities are beneficiaries of MPC's technology transfer and workforce development efforts.

MPC collaborates with consulting firms, construction companies, road builders, and asphalt and cement industries on an ad hoc basis. The Associated General Contractors of North Dakota is a leading member of UGPTI's Advisory Council. In addition, MPC partners with energy and agricultural producers who have strong interests in the state of repair of roads, bridges, and other transportation infrastructure in the region; as well as with Class I and regional railroads. Other partners include motor carriers, technology firms, and logistics service providers.

## 2.    STAKEHOLDER PARTICIPATION IN RESEARCH PROGRAM

Stakeholder engagement is a continuous process that takes place at the strategic and operational levels. Stakeholders play important roles in research project selection and the development of technology transfer plans. It is this continuous engagement that assures research and associated technology transfer are defined and delivered in a manner to best fulfill clients' needs.

### 2.1.    The Technology Transfer Component of an MPC Research Proposal

The technology transfer plan starts with the research project proposal. Each MPC proposal is required to have a description of the tangible outcomes and products and a technology transfer strategy. The directly-relevant parts of MPC's proposal guidelines are shown in Table 7. The proposal itself must demonstrate the proposers' understanding of the needs and circumstances of potential adopters and effectively communicate the value of the expected results. During the peer review process, reviewers are asked to rate the project on a scale from 0 to 5 in terms of its potential for the delivery of "outcomes and tangible products."

### 2.2.    The Technology Transfer Work Plan

The description of the technology transfer plan in the research proposal must be succinct so that peer reviewers can efficiently review it and comment on the overall merits of the proposal. However, a more detailed $T^2$ plan is required within 30 days of the selection of a research proposal. Stakeholders must be involved in or review the plan. The technology transfer work plan is expected to address the 10-point checklist.[2] The projected budget must include time and cost allowances for technology transfer. A project is not complete until the technology transfer objectives are achieved. A principal investigator's record of technology transfer may be considered in determining eligibility for future MPC funding.

## 3.    ORGANIZING FOR MAXIMUM EFFECTIVENESS

The technology transfer component of MPC's program is organized strategically and operationally. It starts with a clear understanding of the personnel and centers involved, their roles, and the contexts within which they operate on a daily basis. At the same time, synergies are achieved in the pooled distribution and repository system for $T^2$ that is based in ongoing commitments by MPC partners.

### 3.1.    Faculty Involvement and Constraints

Faculty are recognized primarily for the number of publications, journal rankings, and citations. While the service component of PTE evaluations is part of the record, it is not the primary focus of faculty members. From their perspective, publications, conferences, and webinars are the most desirable means of technology transfer. While the principal investigator must lead the initial technology transfer effort, implementation of research outcomes is best achieved when the findings are carried forward by technology transfer specialists. Working with faculty, these specialists condense the research outcomes into extended delivery, implementation, and training efforts in which practitioners are trained in the technologies and practices.

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[2] Epstein, A. K. and N. V. Santiago. *Developing and Executing Your Technology Transfer Plan: A 10-point Checklist*, Volpe Center, U.S. Department of Transportation, May, 2018 Draft.

| Table 7: MPC Research Proposal Guidelines (Abridged) | |
|---|---|
| *Expected Outcomes* | Provide a description of the expected outcomes in terms of potential findings and impacts, including advances in modeling, practices, and procedures; implications for future research; and how the results of the project can be used by practitioners. Describe any tangible products beyond the research report, including prototype software, equipment, guidebooks, or instructional manuals that may emanate from the project. |
| *Technology Transfer* | Provide a technology transfer plan for your project. Describe the process you will use for transferring your findings to other researchers, professionals and practitioners. The goal should be further development, commercialization and practical applications for the results of your research. Ultimately, technology transfer should sustain economic growth and improve efficiency, safety, and/or cost effectiveness through the development and commercialization of new technologies and practices. Technology transfer may occur through (but is not limited to) conferences, workshops, web pages, social media, and seminars. Please list how you intend to fulfill this requirement and remember to report your technology transfer activities in the PPPR for this project. |
| *Work Plan* | Describe the major tasks or steps in the project, along with an expected timeline. The tasks should be numbered and an expected completion date assigned to each one. Instead of calendar dates, the timeline should be expressed in months from the starting date. Typically, a work plan includes steps such as the completion (and testing) of questionnaires, lab tests, field tests or data collection efforts, input or focus group meetings, and critical steps such as the initial runs and calibrations of models. A draft report and other milestone events should be included, as well as **a technology transfer plan** that includes a research seminar via the Transportation Learning Network and/or plans to collaborate with an LTAP or TTAP center (if appropriate). If the research is basic in nature, other dissemination methods may be substituted for the TLN, LTAP, or TTAP distribution channels. |

## 3.2.   Collaboration of Faculty and T² Specialists

Each university has specialists to help researchers in the design of technology transfer strategies. Principal investigators are expected to utilize these internal resources. In addition, MPC researchers are expected to work closely with the LTAP center in their states, as well as with other groups that specialize in technology transfer.

In four of the states in the region, the LTAP center is affiliated with the MPC university. LTAP centers are focused on implementation and the transfer of knowledge into practice. Where feasible, MPC principal investigators partner with LTAP technology transfer specialists to identify an agreed upon "handoff" or transition plan before the project is initiated. LTAP funds can be used as match for MPC projects, which provides a natural basis for partnerships.

The North Dakota LTAP has created a program called Road Ready Research (R3) that is directly supportive of MPC's theme of Preserving the Existing Transportation System. R3 papers summarize and share information about key roadway topics. The papers meld research findings with best practices in a way that allows roadway owners to understand and implement improvement processes. R3 is a conduit for transferring theme-related MPC research results to roadway practitioners.

However, some MPC topics may not be of immediate interest to LTAP's primary audiences. In these cases, the P.I. must identify other organizations or $T^2$ specialists who can help in the implementation phase of the project (and beyond). As the lead agency, the Upper Great Plains Transportation Institute takes a holistic view of technology transfer within the region. UGPTI itself is staffed with several $T^2$ specialists and has the Transportation Learning Network, which is a partnership with four state transportation departments in the region.

## 3.3.   The Transportation Learning Network

TLN is focused on career learning for transportation employees and for meeting workforce development goals. However, part of TLN's knowledge transfer plan involves research outcomes from MPC projects. MPC researchers are asked to offer webinars via TLN, which can reach a broad audience within the region. These webinars are recorded and archived, which increases the viewing audience and reinforces the learning experience. TLN operates a Learning Management System (LMS) for accessing recorded sessions. The LMS has over 6,700 registered users in the cities, counties, and state DOTs of Montana, North Dakota, South Dakota, and Wyoming.

## 3.4.   Addressing Common Obstacles

Many $T^2$ efforts stall or fail because the effort is not sustained over time. A sustained $T^2$ is not a reasonable expectation of faculty, so additional personnel and resources are needed to achieve implementation. Other efforts fail because: (1) the results are not in a form that can be directly used by practitioners, (2) the payoff or benefits of the technology have not been adequately conveyed to practitioners, (3) the perceived risks of adopting new technologies or practices are exaggerated, and (4) the research has identified a possibly better solution than the originally proposed research. In the first case, additional work by the P.I. may be required if a $T^2$ specialist cannot repackage the results. In the second and third cases, obstacles can often be overcome through improved messaging by a $T^2$ specialist. In the fourth case, a follow up project on implementation may be needed.

## 4.   DISSEMINATION OF RESEARCH RESULTS

MPC research results are disseminated in a variety of ways, including:
- Final reports
- Project briefs
- Journal articles and conference papers
- Workshops
- Conferences
- Videoconferences
- Webinars
- Broadcast emails
- Online modules
- Webpage postings and displays

A final research report includes a complete description of the project, approach, methodology, findings, conclusions, impacts, and recommendations developed from the project. The report documents the data (which are archived pursuant to a data management plan), the analyses performed, and results achieved.

Within two months of the completion of a project, the final report is published on MPC's website and sent to the following organizations: The Transportation Research Board (Transport Research International Documentation database), the National Transportation Library, the U.S. DOT's Research Hub, the Transportation Library (of Northwestern University), the Volpe National Transportation Systems Center, FHWA's Research Library, and the U.S. Department of Commerce.

MPC's website and HTML emails are essential communication tools in disseminating research accomplishments. The impact of MPC research, education, and technology transfer programs are emphasized in the *Annual Highlights* report. *MPC news* provides short digests of current activities and accomplishments. Using online email services, MPC can maintain a large diverse client base and connect with members through contact lists of more than 5,000 individuals, who receive information in a visually appealing and interactive manner. Through its email service, MPC can analyze the effectiveness and click rate of emails. In addition to these tools, MPC makes extensive use of Social Media, including Facebook and Twitter. The latter is a useful tool to connect with others interested in transportation through hashtags in Twitter posts (e.g. #transportation). Facebook is a useful platform to help recognize MPC successes.

## 5.   GOALS, OBJECTIVES, AND PERFORMANCE MEASURES

MPC's goals, objectives, and performance measures related to research dissemination and technology transfer are described in this section of the plan. The goals represent desired outcomes. They are not directly measurable—i.e., changes in the goals cannot be directly traced to MPC research. Nevertheless, measurable objectives are derived from these goals. The performance measures presented in Table 8 are linked to the objectives presented in Table 9.

### 5.1.  Goals

- Enhanced levels of knowledge in the disciplines related to transportation, with special emphasis on preserving the existing transportation system
- Improved methods and practices in transportation organizations, particularly with respect to preserving the existing transportation system
- Improved knowledge and skills in transportation workers, especially those workers focused on preserving the existing transportation system

### 5.2.  Performance Measures

| Table 8: Key MPC Performance Measures | |
|---|---|
| *Measure* | *Indication* |
| 1.  MPC reports viewed, downloaded, or requested | A primary measure of client interest in MPC's research results |
| 2.  Journal articles published from MPC projects<br>3.  Conference presentations from MPC projects | The scope and reach of MPC's research dissemination efforts |
| 4.  Citations and references to MPC research | MPC's impact on the direction of research |
| 5.  Webinars, videoconferences, presentations | The scale of MPC's technology transfer efforts |
| 6.  Conferences and workshops sponsored or delivered | Direct engagement of practitioners and transfer of knowledge |
| 7.  Participants/attendees at events 5 and 6 above | The extended impact of MPC's technology transfer efforts |

| Table 8: Key MPC Performance Measures | |
|---|---|
| *Measure* | *Indication* |
| 8. Match funding ($) provided by clients | The perceived value of MPC's research to practitioners and potential adopters |
| 9. Patents issued | The value of MPC's research in commercial applications |
| 10. Licensing agreements | |
| 11. Registration in online learning modules | The impact of MPC's knowledge transfer efforts in enhancing worker skills |
| 12. Research recommendations implemented | The impact of MPC's research on practice |

Performance measure # 12 is somewhat subjective and difficult to obtain. It requires follow up surveys beyond the end of the project. A significant interval of time may elapse between the end of a report and the implementation of recommendations. In the past, this measure has been reflected in MPC's success stories. These stories may include efficiency gains resulting from the implementation of research findings—e.g., reduced maintenance cost, longer asset life, reduced hours of vehicle delay, or reduced freight delivery cost. However, all projects do not lend themselves to these types of quantification. Because of the time lag involved and the qualitative nature of many assessments, measure # 12 will not be reported in tabular form.

## 5.3. Objectives

The objectives in Table 9 are derived from the goals presented in 5.1. For purposes of convenience, the objectives are linked to the performance measures by number. Research dissemination and other forms of technology transfer may be accomplished with the same or similar activities. Therefore, a given performance measure may be linked to more than one objective. MPC has direct control over the dissemination of research results and outreach/training efforts. However, implementation decisions are made by transportation agencies, businesses, and associations. For some types of research (e.g., policy), dissemination goes a long way toward implementation. For example, agency leaders do not necessarily need $T^2$ specialists to help them decide whether to implement a policy recommendation. Nevertheless, implementation is embedded in MPC's research processes from the inception of a proposal to the outcomes and tangible products.

## 6. TRACKING AND REPORTING OF RESEARCH OUTPUTS, OUTCOMES, AND IMPACTS

MPC has a proven tracking and performance reporting system that has been in place for some time. In this system, principal investigators are responsible for the reporting requirements of projects. The program coordinators at the universities are responsible for collecting and reporting research outputs, outcomes, and impacts through their contributions to the Program Progress Performance Reports (PPPRs), which are submitted twice per year.

In the future, the combined PPPR/$T^2$ report will highlight the performance measures listed in Table 8. Supplemental information will be collected from MPC's website software, electronic enrollments in videoconferences and webinars, and information provided by online video and email management services. As noted in Table 8, MPC's website will generate information on the number of times individual research reports are viewed or downloaded and insights about traffic in other areas of the website—e.g., research briefs, project descriptions, and links to webinars and video conferences.

| Table 9: Technology Transfer Objectives | | |
|---|---|---|
| *Objective* | *Discussion* | *Performance Measures* |
| Disseminate MPC research results as broadly as possible | MPC research expands the base of knowledge for practitioners and researchers in academia and public and private agencies. Reaching the broadest possible audience expands the potential impacts of the research. | 1, 2, 3 |
| Influence the direction and quality of research | MPC should be a leader in research, especially in its main thematic fields. MPC research should influence critical thinking and the direction of knowledge quests within the research community. | 4 |
| Deliver research results to transportation practitioners | Reports, journals articles, and conference presentations are critical indicators. However, direct engagement of practitioners is desirable and often necessary to assist in implementation. | 5, 6, 7 |
| Conduct research valued by potential users and technology adopters | The potential for outcomes and tangible products is one of MPC's project review/selection criteria. In addition, the match funds provided by clients indicate their expectations for usable outcomes. | 8 |
| Upgrade/refresh the knowledge of workers in state DOTs | Research findings (from MPC reports and other sources) must be distilled into practical sets of instructions to fully realize implementation benefits. | 5, 6, 7, 11 |
| Spur commercialization and widespread deployment of new technologies and practices | Commercialization increases opportunities for long-term benefits from the technologies generated from R & D projects. | 9 and 10 |

MPC uses an online email management system for sharing student and faculty accomplishments and successes and for announcing the release of new publications. This system allows the number of "opens" and "click-throughs" to be monitored. Similarly, webinars, videoconferences and learning modules are archived in an online learning management system or online video hosting service. These tools allow MPC to compile the number of views and time spent by viewers in the system.

## 7.    COMMERCIALIZING RESEARCH OUTCOMES

All MPC universities have well-established processes for commercializing research outcomes. Guidelines are similar across institutions, especially with respect to federally funded research. For purposes of illustrating this process, the critical steps and procedures followed at North Dakota State University are presented. In essence, the commercialization process entails the following steps:

1. **IP Identification**: A determination of whether or not the research outcome is an intellectual property (IP) that warrants protection.
2. **Invention Disclosure:** If the researcher or some other stakeholder determines that the research outcome is an intellectual property, then the lead inventor fills out an Invention Reporting form and submits it to the Technology Transfer Office (TTO). For software, there is a separate Software Reporting form.

3. **IP Disclosure Evaluation**: The TTO evaluates the invention disclosure to determine its commercial potential and the appropriate type of protection—e.g., patent, copyright, or trademark.
4. **IP Protection**: If the TTO decides to pursue IP protection, then the inventor(s) assigns the invention to the University. Subsequently, the Research Foundation pursues the appropriate IP protection.[3]
5. **Market Research**: The Research Foundation explores the marketplace in terms of potential commercial value, marketability, and the potential for further development. Market research activities include web searches, one-on-one contacts, and subscriptions to industry market research reports.
6. **Licensee Research**: The market research effort includes the identification of potential licensees. In addition, the Research Foundation's staff regularly attends conferences to discuss technologies developed at the University with potential licensees.
7. **Commercialization**: Depending on the outcome of the market research, the Research Foundation selects one of the following options: (a) license the invention to an outside commercial entity, (b) request that the inventor complete additional research before pursuing further commercialization activities, (c) license the invention to a faculty member's startup company, or (d) release or return the invention to the government or inventor according to policy and any applicable contractual or governmental obligations

## 8. LICENSING REVENUES

All MPC universities have established procedures for licensing inventions and determining the distribution of revenues received from them. For example, NDSU's Research Foundation negotiates agreements with companies that typically include licensing fees, royalty payments, and patent cost reimbursements. Net revenue is distributed according to a formula in which 40% is shared by the inventor(s). The remaining share is split between the Research Foundation and the other units (e.g., the departments or colleges) with which the inventors are affiliated. The Research Foundation typically retains 25% to 30% of the royalties to cover salaries and other expenses.[4]

In NDSU's case, the licensing policy requires that each unit "*allocate remaining net royalties to be utilized principally in support of research.*" Some units establish endowment accounts that receive some of the royalties generated from the original IP, with the stipulation that these revenues are used to support the research program or provide scholarships. All revenues originating from research discoveries returned to UGPTI by NDSU are used to fund transportation research by faculty and doctoral students. The Research Foundation uses any reimbursement for patent costs to help sustain its ability to protect new discoveries. Similar policies and revenue-sharing agreements are in place at all MPC universities.

## 9. INCREASING CORPORATE SUPPORT

As noted earlier, most state DOTs in the region want to match MPC's research program to address critical needs in Preserving the Existing Transportation System, as do many county and city

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[3] The Research Foundation is an independent, not-for-profit organization established to support North Dakota State University in achieving its instructional, research, public service, and academic goals. The foundation provides private support for the University by protecting, adding value to, and commercializing intellectual property that is developed through research activities. Similar entities exist at all MPC universities.

[4] Each MPC University has a similar revenue distribution formula. However, the shares may vary across institutions.

governments. Nevertheless, a range of strategies will be pursued to increase corporate research support, including leveraging existing university assets (such as research and technology parks and business incubators), expanding industrial sponsored research, and increasing private industry's access to MPC faculty and students.

*Research and Technology Parks*. All MPC universities have research and technology (R&T) parks, which house private-sector partners actively engaged in research and development at the universities. These parks are synergistic environments, conducive to discovery and innovation. Residence in a park provides a company with access to faculty and graduate students, as well as a head start in recruiting. Creative pursuits are currently underway at several R&T parks in material sciences, nanotechnology, robotics, sensors/micro-electronics, and information technology—fields which are essential to transportation research. In addition, collaborative efforts are moving forward in structural health monitoring; material resiliency, performance, and longevity; advanced wireless and real-time communication/data systems; unmanned aircraft systems and remote sensing technologies; vehicle and freight yard automation; electric vehicles and power systems; cybersecurity; and additional areas. Private-sector partners are involved in these efforts.

*Business Incubators*. Each MPC research park has a business incubator which offers space, facilities, and services to entrepreneurs. Incubators provide nascent businesses with tools to succeed in a dynamic economy. Their services typically include: comprehensive business assistance, client networking, financial planning, and accessing venture capital. For example, the incubator at NDSU's R&T Park houses the Small Business Development Center (SBDC) and the Bank of North Dakota's technology hub. The SBDC helps start-up companies with business plans, financial modeling, and marketing. The Bank of North Dakota (the only state-owned bank in the nation) has a variety of financial options for startups. Similarly, the Department of Commerce's *Innovate North Dakota* program provides start-up funding in phases. In addition to monetary support, the incubator offers basic entrepreneurial training (e.g., "boot camps") to new company founders. Incubators are good sources of in-kind match for MPC research projects.

*Technology Marketing Strategy*. While many assets are in place, increasing corporate research support will require marketing efforts targeted at tenants (and potential tenants) of research parks. These efforts will focus on potential deployment opportunities in transportation for emerging technologies. In addition, the marketing efforts will emphasize broader synergies. Collectively, the MPC universities can offer extended access to faculty, students, and opportunities across the region. In addition, MPC is developing a strategic plan for Technology and Smart Transportation Systems, which will highlight the individual and collective capabilities of the universities for long-term collaborative partnerships with private industry. With this consortial plan in place, new marketing efforts can be developed. However, MPC's project selection must match its strategic plan/proposal.

*Road Builder and Construction Industry Support*. The greatest potential for corporate research support within MPC's thematic realm lies with road and bridge builders, the asphalt and concrete industries, and private engineering companies. The development/deployment of new surfacing, patching, and filling materials (as well as admixtures) are areas where additional corporate support may be possible. Consulting firms, specifically bridge engineering designers, may participate in the development of research proposals and serve on technical advisory committees. However, when state DOTs provide match funding, they may prefer for private companies to become involved after the research phase is completed and changes in practice have been delineated. This prevents some companies from being given competitive advantages over others in the market.