Office of
Research & Best Practices
Michigan Department of Transportation • September 2008

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Implementation a top consideration in MDOT's new strategy for managing SPR, Part II, Program research

In 2002, the International Food Policy Research Institute (IFPRI) in Washington D.C. published a report that examined the relationship between paved road infrastructure and national per capita income in 98 developing and developed countries. The report showed that the average density of paved roads (mile of road per one million inhabitants) in high-income economies is 5,800 percent higher than in low-income economies. It also showed that the average density of roads in good condition is 21,000 percent higher in high-income economies than in low-income economies[1].

So what comes first, a good system of roads or a robust economy? According to a paper by David Aschauer published in the Journal of Monetary Economics in 1989, roads come first. "Empirical analysis indicates that movements in public investment [streets, highways, airports, mass transit] bring forth movements in private-sector output which are as much as four to seven times as large as the public-sector outlays,"[2] Aschauer writes. To strengthen the causal relationship further, a 2005 IFPRI report about poverty in rural China identifies development of road infrastructure as a major contributor to China's steady economic growth since the mid-1980s[3]. A reliable system of transport for goods and people provides a strong backbone for economic vitality.

The *MI Transportation Plan* (pronounced "My" Transportation Plan), adopted in June 2007, is designed to clarify the link between the Michigan's transportation system and the economy. The plan is based on input from stakeholders in all areas of the transportation community in Michigan.

"We established the MI Transportation Plan based on advice and input from all over the state," MDOT Director Kirk Steudle said. "It provides a complete picture of our transportation system today, casts a vision for what it will have to become to meet our needs tomorrow, and sets forth a bold plan for stepping up and meeting the challenges as we head toward the future."

Goals determine focus

The MI Transportation Plan identifies four goal areas for MDOT, and defines performance measures that provide a means for assessing the performance of the department and the transportation system. The goal areas include:

- **Stewardship**: Preserve transportation system investments, protect the environment, and utilize public resources in a responsible manner.
- **Safety and Security:** Continue to improve transportation safety and ensure the security of the transportation system.
- **System Improvement**: Modernize and enhance the transportation system to improve mobility and accessibility.
- **Efficient and Effective Operations**: Improve the efficiency and effectiveness of the transportation system and transportation services, and expand MDOT's coordination and collaboration with partners.

Results indicate effectiveness

The vitality of Michigan's transportation research community, like the link between Michigan's economy and our transportation system, is

Trends reflect new direction of MDOT's research program

MDOT's research investments from FY 2006 through what is proposed for FY 2009 show the beginning of a new trend. This trend reflects the ORBP team's efforts to make the research program more efficient and effective, while focusing investments to support the goal areas identified in the MI Transportation Plan.

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related to the impact of research results on the system. It was with this fact in mind, along with the goal areas identified by the MI Transportation Plan, that MDOT created the Office of Research and Best Practices (ORBP).

"When we first joined research and best practices under the ORBP in 2005, the intent was to provide taxpayers in Michigan the best bang for their buck in transportation research," said MDOT Chief Operating Officer Larry Tibbits. "Ensuring that research results get implemented is an important part of this plan. The ORBP team, with support from top MDOT executives and with the help of peers in other states, has charted a great course to advance these efforts."

Top-level leaders set the course

The challenging economic climate in Michigan today is forcing organizations in every segment of the economy to consider ways to refine operations and get the most out of every invested dollar. The State Planning and Research (SPR), Part II, Program is no exception, but the economy wasn't the only force behind changes to the program. The vision articulated through the MI Transportation Plan by top-level state and MDOT leaders made obvious a need for a more strategic approach to transportation research. "To support the goal areas identified in the MI Transportation Plan," explained ORBP Engineer Calvin Roberts, "we defined a structure for managing the research program that will ensure the relevance of all research while establishing a healthy balance between theoretical research and the practical implementation of research results."

Theory vs. Practice

Questions about the relevance of research and tension between research and implementation are not new. The stage was set for these conflicts over a century ago when, in 1893, the U.S. Congress earmarked $10,000 in the Department of Agriculture's 1894 budget to investigate and disseminate information about U.S. road construction methods, materials and management practices. Secretary of the department at the time, J. Sterling Morton, formed the Office of Road Inquiry (ORI) to administer the funds and manage the efforts.[4]

For the first 20 years of its existence, the ORI conducted a variety of technical studies designed around the accepted practices of road building that were established in the 19th century by early road-building pioneers. Each study was initiated to solve a specific technical problem; very few new theories about road building were generated during this time.

By early 1918, the office, since renamed the Bureau of Public Roads (BPR), was widely believed to have resolved all technical issues facing the U.S. roadway system, and had begun to shift their focus to the remaining problems, which they believed had to do with finance and management. The *Scientific American* that year communicated the confidence of the BPR operations in an article about their lab, "Samples of rock and other building material are made to tell their story," the article described, "... so well and completely that once a test is finished, those who are to make roads know to a certainty just what they can expect of the material, just how it will wear, just what value it has as a foundation or surface material."[5]

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By the end of 1918, however, after the main arteries of the U.S. roadway system failed under the heavy truck traffic required to support World War I, this confidence was shattered.[6] A year later, the BPR adopted research methods that were more scientific. The new methods emphasized numerical results and the development of new theories above practical application.

Since then, the balance between theory and practice in transportation research has continued to shift back and forth, both at the national level and within individual states.

Old patterns in modern times

From 1940 through the middle of the 1980s, all MDOT research was initiated and conducted internally. Like the ORI at the beginning of the 20th century, research projects within MDOT were based on clearly-defined technical needs. Consequently, implementation of results was very high, but new discoveries were almost non-existent.

During the 1990s, MDOT began to hire universities in Michigan and private consultants to conduct research. From then until now, innovation and the generation of new theories have increased, but measurable implementation of results has declined.

"Since we began to partner with universities and consultants in the 1990s, we've completed a great many excellent, compelling research projects," Roberts explained. "Unfortunately, we have not been able to accurately measure the impact of our investments. The new structure of our research program, as outlined in the new *Research and Implementation Manual*, will help us and our research partners aim for measurable results."

Roberts' assertion is supported by Skip Paul, director of the Louisiana Transportation Research Center (LTRC). The LTRC manages the Louisiana DOT's research program; they sent a representative to participate in the peer exchange effort sponsored by the ORBP in December 2007.

"Before we made implementation a focus of our research program, we conducted a lot of great research, but I don't think any of it solved DOT problems," Paul said. "Since we adopted an implementation-based approach in 1991, research that produces results has really taken off, and we can prove it with data."

Achieving a balance

Making the switch from theoretical to practical research works against common practices in academia. After all, it's simply not possible to stretch the intellectual envelope and discover new things without the consistent and purposeful generation of questions and ideas that theoretical research provides. Also, university research communities depend on the generation of new theories to advance fields of study. The experience of the BPR in the early 20th century is a dramatic example of what can happen in the absence of theoretical research.

"We're not denying the importance of or discouraging the pursuit of theoretical research," Roberts explained, "rather, we're asking our research

partners to consider ways to approach transportation problems through research that will produce outcomes, not just output."

In Louisiana, the LTRC experienced a great deal of resistance from researchers when they began to make implementation of results a priority. Paul pointed out two ways that the research community in Louisiana continues to support the generation of new theories while achieving results that can be implemented. "At the LTRC we use up to two percent of our research funding as a match on National Cooperative Highway Research Program (NCHRP) and National Science Foundation (NSF) projects," he explained. "Beyond that, our research partners have learned how to work theoretical elements into projects that solve DOT problems."

"Our program is successful," Paul continued, "because it encourages our partners to use practical research as a springboard for the theoretical, instead of conducting theoretical research and then determining if it can be used to solve a problem in the real world."

Research for the right reasons

Today, as our roadways age and grow increasingly crowded, as budgets tighten and as the links between effective transportation systems and economic vitality become clearer, a healthy balance between discovering the future while making the most of the present is more important than ever.

"We're looking at research from a business perspective," Roberts explained. "The entire plan, as described in the new research and implementation manual, is designed to make sure we're doing the right research, and our concentration on implementation will make sure all research is conducted in ways that are relevant and useful now."

References

1. Cesar Queiroz, R Haas and Y Cai 1994. National Economic Development and Prosperity Related to Paved Road Infrastructure. *Transportation Research Record* 1455:147-152
2. David A Aschauer 1988. Is public expenditure productive? *Journal of Monetary Economics* 23: 177-200
3. Shenggen Fan, L Zhang and X Zhang 2002. Growth, Inequality, and Poverty in Rural China: The Role of Public Investments. IFPRI Research Report 125.
4. Bruce E Seely 1987, *Building the American Highway System* (p. 12). Philadelphia:Temple University Press.
5. Extracting Stories from Stone: Roadbuilding Reduced to a Science. *Scientific American* 118:186.
6. Prevost Hubbard 1919. Efficiency of Bituminous Surfaces and Pavements under Motor-Truck Traffic. *Public Roads* 1, no 10.

Research trends

From FY 2000 to FY 2004, bridge and pavement research projects accounted for approximately 71 percent of research spending (see Figure 1A). From FY 2006 through FY 2009, similar projects total about 48 percent of the research, while the *Special Projects* and *ITS, Safety, and Operations* focus areas account for approximately 52 percent (see Figure 1B).

The *Special Projects* area includes those that don't fit nicely under the others, or have some other distinguishing characteristic. "The University of Detroit-Mercy University Transportation Center [UTC] is grouped under Special Projects," ORBP Administrative Engineer Andre Clover explained. "It's a packaged research project with multiple jobs that address several of the department's special focus issues and needs."

The jump in the *ITS, Safety, and Operations* focus area is largely because of heavy capital investments in ITS equipment in recent years, but the ORBP team expects this focus area to continue to grow. ITS technologies hold a great deal of promise for MDOT and for the state of Michigan.

"Building a business case for this kind of research is easy because projects can dramatically impact several departmental goal areas," Roberts said. ITS technologies have proven effective in research projects involving lane and road departure prevention, collision avoidance, congestion man-

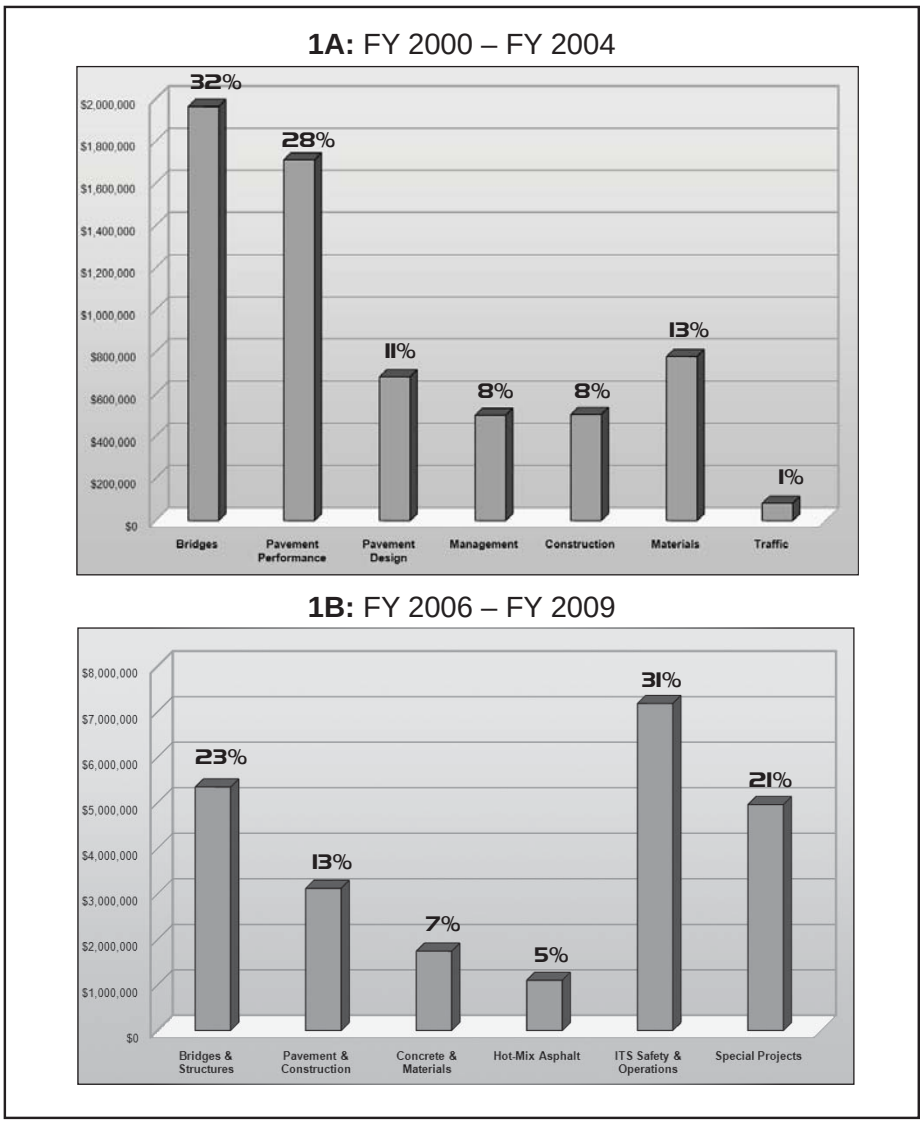

Figure 1: MDOT transportation research investments by focus area.

agement, work zone traffic control, and others. Also, Michigan's unique combination of auto makers, high-tech businesses, and cutting-edge ITS researchers within close proximity to each other helps support a compelling case for further investment.

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More detail, similar trends

Examining the data from a more detailed perspective also indicates new trends. A year-by-year breakdown of research investments between FY 2000 and what is proposed for FY 2009 shows investments into traditional areas, such as structures, construction and materials, declining or staying the same while investments in ITS, safety, and special projects areas are growing rapidly (see Figure 2).

Total investments in research have increased considerably in the past 10 years. In FY 2000, MDOT spent $650,000 on research. By FY 2006, that number had climbed to approximately $3.4M. The projected spending for FY 2009 is over $6.2M, 62 percent of which is destined for ITS, safety, and special projects areas.

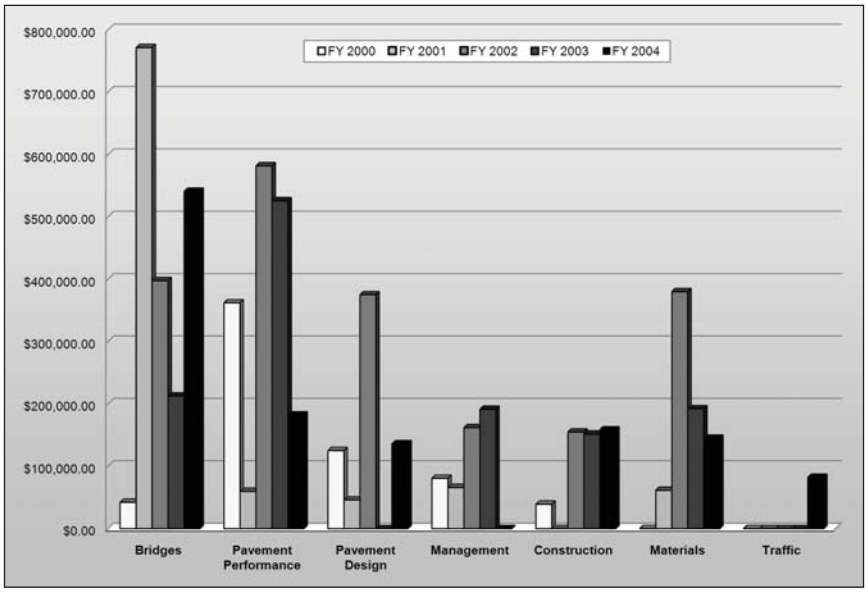
New plan will yield better results

Beginning in FY 2010, all research projects will be managed through a structure of four Research Advisory Committees (RACs) that will oversee a total of 18 focus areas. Each focus area will be administered by a focus area manager (FAM).

Implementation of research results will be addressed throughout the entire research cycle. Every project proposal will include an implementation plan, and every project will be assigned an implementation manager (IM) to ensure that the plan is followed. Upon project completion, a recommendation for implementation will be required as part of the final report.

"The over arching goal of the research program is to enhance the effectiveness of the department," Roberts said. "The new strategic framework that we've defined will help us focus the research in the right areas, and stressing implementation will help us gather and measure the results."

2A: FY 2000 – FY 2004



2B: FY 2006 – FY 2009

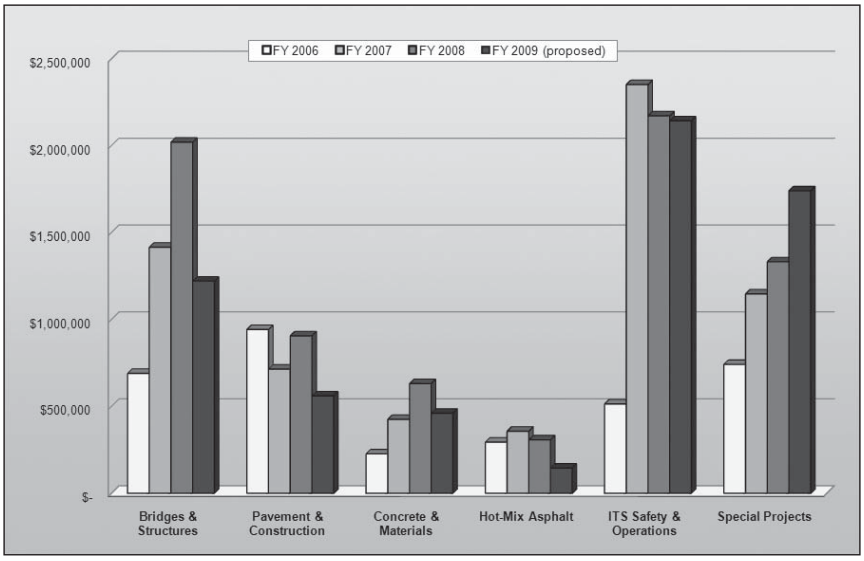


Figure 2: MDOT transportation research investments by focus area and year.

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