

Waiting for Change

The Introduction of Innovation to Transportation Technology

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Introduction

Early in 2005, the TRB Superpave Committee declared victory in the 12-year campaign to implement the results of the asphalt research findings from the Strategic Highway Research Program. These findings were made publicly available in 1993 under the rubric of “Superpave” and by early 2005 every state department of transportation reported in a committee survey that the specifications derived from the Superpave research had been adopted or plans were in place for adoption in the near future. Apparently a successful conclusion had been reached and the declaration of “victory” was warranted.

But doesn't 12 years seem like a long wait to see the fruits of research in the orchards of everyday practice? And the victory is really far from complete. Use of the Superpave standards among county and local agencies, which exercise care and custody of the bulk of asphalt roadways in America, is limited to 20 states. And in those 20, local application of Superpave is far from universal.

Why do we have to wait so long for innovation? What can be done to shorten the wait? Before exploring those questions, let's review two stories from Iowa highway history.

Slipform Paving: Born in Iowa

Ames, Iowa is the birthplace of slipform concrete paving. The engineering principles were first conceived in 1946 by Jim Allen and Bert Myers of the Iowa State Highway Commission Materials and Testing Laboratory and in 1947, Allen and Myers rolled out a prototype slipform pavement that was 3 in. thick and 18 in. wide. The following year they cast a sidewalk at the Highway Commission Lab that was 6 in. thick by 3ft. wide. In 1949, 2 experimental pavements were placed in O'Brien and Cerro counties, Iowa. These were real roads with two adjacent lanes, each 10ft. wide.

After that, progress seemed to halt. Actually it was only hidden from view. The Highway Commission continued its research; a self-propelled paver was developed for instance, but it became evident to the Commission that it could not, by itself, develop practical, commercial-scale slipform paver. At some point, the Quad City Construction Co. became

involved and, in 1955, that firm introduced the first commercial slipform paving equipment.

In 1956, slipform paving moved out of Iowa when the Colorado Division of Highways approved the first instance of slip-form paving on an Interstate Highway. By 1964, 4,000 centerline miles of slipformed pavement had been placed in the US. An impressive number when viewed in the abstract, but most of those 4,000 miles were confined to only four states—Iowa, Colorado, Oklahoma and California. Furthermore, 75% of those 4000 miles were on secondary highways. Only a few hundred miles were placed on Interstate Highways, despite Colorado's pioneering efforts—and this at the time when the Interstate Highway construction boom was in full swing across the country.

As early as 1958, the Oklahoma Turnpike Commission had demonstrated that slipform paving had reduced the cost of concrete pavement by 35 to 45 cents per square yard, a substantial savings at that time. The capital cost of a slipform paving train was only about 50% that of more conventional equipment and yielded a better riding pavement with reduced construction time. Better – faster – cheaper, the highway engineer's trifecta.

Even so, traditional formwork paving was not displaced from regular practice until 30 or more years after Johnson's and Myers' first real highway paving project. A very long time to wait.

Anson Marston, Chief MacDonald and the Mud Roads Platform

Every engineer in Iowa has heard the name Anson Marston. In his day, the early years of the 20th century, he was Dean of Engineering at Iowa State University, one of the founders and first chairman of the Highway Research Board, today's TRB, and the first Chief Engineer of the Iowa State Highway Commission. Upon assuming this latter role in 1904, he remarked that Iowa's state roads, none of which was paved, would be a disgrace to even a barbarian. In 1913, Marston was succeeded as Chief Engineer by his prize student, Thomas MacDonald, arguably the best highway engineer ever, and, ultimately, the father of today's Interstate Highway System. Thus was Iowa blessed. Yet, when Chief MacDonald left the Commission in 1919 to join the U.S. Bureau of Public Roads, the Iowa state highway system was still one of dirt roads.

In 1916, William L. Harding was elected Governor of Iowa by campaigning against a bond issue that would have raised money to pave state highways. Author Pete Davies called this the "mud roads platform." On Election Day in 1919, however, the citizens of Iowa changed their minds and approved a bond issue for state road paving. By 1925 the Lincoln Highway, today's U.S. 30, was paved across Iowa from the Mississippi River to the Missouri River.

What happened in 1919 that allowed "good roads" to trump "mud roads?" Probably many things. A successful conclusion of World War I released pent-up economic demand. More and more citizens were becoming motorists-- frustrated motorists trapped by bad weather and bad roads. Returning servicemen needed jobs. The crystallizing

event, however, was the passage that summer through Iowa, and Ames, of the Trans-Continental Military Convoy. This convoy of more than 80 U.S. Army trucks traveled from Washington, DC to San Francisco to demonstrate the strategic feasibility of coast to coast military transportation. What was really demonstrated was the parlous state of American roads, as the convoy took almost 3 months to complete its journey. The message was not lost on Iowa and the many other states and communities that authorized road bond issues in 1919.

Lessons

These anecdotes from Iowa history might be entertaining, but they are also instructive about the nature of innovation in public works. A number of points stand out.

1. Technology R&D takes time—lots of time.

Visionary technologist Buckminster Fuller once remarked that there is no instant baby. While the 9 years from 1946 to 1955 is much longer than 9 months, to bring a complex technology from conception to commercialization in so short a time is flat out amazing. Nonetheless, this R&D project required great patience on the part of the Iowa State Highway Commission, which no doubt had many other post-war demands to meet. This is a lesson for all of us. It is gratifying to see a growing emphasis on longer-term, more conceptual research at the federal level. While we can't ignore the necessity to use research to solve immediate problems, such research is not the pathway to innovation. Johnson and Myers had the right idea. So did the Highway Commission.

2. Public – private partnership in technology development pays off.

The circumstances by which the Quad City Construction Co. became involved in the development of slipform paving are difficult to discern, but clearly this involvement turned a research project into technology. Road building in America has always been a public – private partnership so it's logical that the partnership should extend to R&D. In reality, however, barriers have been erected that inhibit such collaboration. Nevertheless, recent years have seen a growing trend toward active private stakeholder involvement in the planning and oversight of national research programs. An example of this is the recently released Concrete Pavement Research Road Map developed by Iowa State University on behalf of the Federal Highway Administration. The guidance and participation of many private sector experts and stakeholders greatly enriched the vision of where concrete pavement technology needs to go and outlined the path to get there.

Direct involvement of individual private firms in government sponsored R&D is a trickier situation. Intellectual property rights must be observed, but unfair competitive advantage for any one entity is not a desirable outcome of public works research. In recent years, partnering devices have been introduced that allow access to private sector expertise without compromising marketplace freedom. The test equipment that enables the Superpave system was developed through such partnering devices.

3. *State by state diffusion is the slow way to do technology transfer.*

Yet it is still the most common method. It is a myth that an obviously better technology will be readily adopted by practitioners without the need for an elaborate technology transfer effort. Being better, faster and cheaper was not enough to lead to the rapid introduction of slipform paving. In the absence of an organized technology transfer effort, each state had to repeat the same painful learning experiences of states that had already implemented the technology. In 1959 California became the fourth state to seriously adopt slipform paving. Initially the highway department struggled mightily to determine how long the sliding forms on the paver should be and repeated mistakes that Iowa, Oklahoma and Colorado had already made and corrected. Thus is the introduction of innovation slowed.

In 1993, AASHTO, FHWA and TRB initiated an organized effort to introduce the technologies developed as part of the Strategic Highway Research Program. Many novel technology transfer devices were tried to accelerate the pace of innovation. Not all of these devices worked, but one that did was the Lead States Program. As any new technology is introduced, there are always some agencies that move to the lead in adoption, much like the highway agencies of Iowa, Colorado and Oklahoma did in the adoption of slipform paving. Recognizing this, AASHTO organized the early leaders in the adoption of the various SHRP technologies into teams of “Lead States.”

These teams, comprising state DOT staff members knowledgeable in the application of the SHRP technologies, then shared their expertise with other agencies that had not yet tried the technologies. The teams engaged in both general tech transfer with all state DOTs and specific training for DOTs actively adopting the new technologies. Iowa was a Lead State for Anti-Icing/Roadway Weather Information Systems and for Innovative Pavement Maintenance Materials. Iowa’s Lee Smithson was the Team Coordinator for the latter team.

How much more quickly might slipform paving have been adopted if Iowa, Colorado and Oklahoma had been organized into a Lead States Team in 1958?

4. *Introduction of technological innovation is not the logical extension of research.*

People cannot leave their past experience behind. On any topic of consequence, whether it’s the best way to build concrete roads or the value of good roads as public policy, if most people think about it at all, they have already made up their minds. Introduction of innovation, then, requires the changing of men’s minds. In other words, it requires effective communications. The findings of the research must be the core of the message, but it’s equally important that the message is listened to. And this is the lesson to be drawn from the Transcontinental Military Convoy and the final triumph of good roads over mud roads in Iowa.

While the convoy might have had an underlying national security objective, it was also a hugely successful public relations campaign on behalf of better roads. Every time the convoy bogged down in mud or sand, had to repair or replace a bridge before it could cross a creek, it was widely reported. By the time the convoy reached San

Francisco everyone in America must have known just how bad America's roads really were. The convoy was supported and accompanied by car and truck manufacturers, tire and oil companies, was met and feted by local businessmen and civic officials and good roads advocates. At almost all of the overnight stops the convoy made, there were community barbecues, open-air dances and speeches from good roads advocates delivering the facts and figures. When Iowans and other Americans went to the polls in 1919, they passed more than \$200,000,000 in state and local bond authorizations, a staggering amount in those days. So staggering, in fact, it took highway agencies and the construction industry years to get organized to spend it all. The following year Congress passed a federal aid highway bill that defined the federal-state partnership that continues today. Clearly the message was listened to. Iowa and America had had enough of mud roads.

Lessons Learned?

What is being done today within the transportation community to drive innovation and change men's minds? Have the lessons of the past improved the way we introduce innovations into engineering practice? The short answer is yes, the lessons have been learned. The transportation community is more willing to attempt long-term research than it was 20 years ago. Technology transfer today is much more sophisticated in approach than it once was. Private sector participation in the planning and conduct of federally sponsored research is now commonplace. Communications has been recognized as a vital part of the tech transfer process. One example will illustrate how things have changed.

With the coming of the new millennium, AASHTO created the Technology Implementation Group (TIG). The TIG, whose members are all senior officials of state DOTs, has as its purpose the identification and promotion of promising, but under-utilized technologies. The TIG also has liaison members from FHWA, TRB, the National Association of County Engineers and the American Road and Transportation Builders Association. If the TIG had existed in 1958, one of the technologies picked for promotion would undoubtedly have been slipform concrete paving.

The TIG prosecutes the implementation of these under-utilized technologies through the use of Lead States teams similar to those used in the deployment of SHRP technologies. Frequently these teams include private sector experts in addition to the state DOT personnel familiar with the technology. The teams are provided staff support by AASHTO and FHWA. In addition, AASHTO has contracted with a communications firm to make sure the necessary communications skills are available to TIG and the Lead States teams.

All of this is supported by a pooled fund subscribed to by the individual state DOTs.

Currently, TIG is supporting the aggressive implementation of a dozen innovative technologies and procedures that range from pre-cast bridge elements and accelerated

construction to road safety audits and pre-stressed cable median barriers. Three more technologies will be selected this fall.

Further Reading

This short paper captures informal remarks made on August 18th, 2005 at the Mid-Continent Transportation Research Symposium in Ames, Iowa. The paper attempts to maintain the informal tenor of the luncheon remarks and detailed references have not been provided. The bulk of the factual information was drawn from two books and a website. These were:

Davies, Pete. *American Road: The Story of an Epic Transcontinental Journey at the Dawn of the Motor Age*. Henry Holt and Co., New York, NY, USA, 2002.

Highway Research Board. *Highway Research Record Number 98: Symposium on Slip-Form Paving*. National Academy of Sciences, Washington, DC, 1965

American Concrete Pavement Association. *History in Highways: 100 Years of Innovation*.

<http://www.pavement.com/pavtech/abtconc/history.html>