

Game-changing ideas in transportation research

While transformative technologies in transportation often begin simply as ideas, the gap between concept and practice can be formidable. Because the greatest innovations often involve the highest risks, funding for such research can be difficult to obtain. The NCHRP Innovations Deserving Exploratory Analysis (IDEA) program helps inventors take promising but unproven ideas in transportation engineering to the next level.

The next big idea

NCHRP's Highway IDEA program provides grants of up to \$150,000 for eight to 10 projects a year. "We're interested in high-risk but potentially game-changing concepts in transportation," says Jon Williams, IDEA program director. The program is a complement to traditional applied research. "We want to hear the big ideas—those untested but visionary concepts that might not otherwise have a platform to develop," he says.

Created in 1988 as part of the Strategic Highway Research Program, the IDEA program was transferred to TRB in 1992 and is now funded by state highway agencies via AASHTO. The NCHRP IDEA program, which focuses on highway transportation systems, is one of three active IDEA programs along with Transit IDEA and Rail Safety IDEA.

The NCHRP IDEA program is open to anyone with an innovative idea to solve a highway problem, and so far it has funded or approved 184 projects. Of 162 completed projects, one in six has been successfully commercialized, and many more show great promise.

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"For such high-risk projects, we thought one in 10 would be a great success rate," says Inam Jawed, a senior program officer at TRB who manages the NCHRP IDEA program. "So we feel really good about a rate of one in six."

Reducing risk in bridge assembly

One of IDEA's success stories involves the development of a laser measurement system to dramatically increase the efficiency of the way steel bridge girders are assembled.



The Bridge Virtual Assembly System's laser detection allows bridge girders to be fitted via a computer model rather than manually in fabrication shops.

Developed by Paul Fuchs of Fuchs Consulting in Leesburg, Va., the Bridge Virtual Assembly System allows fabricators to generate 3-D computer models of girders to ensure that they will fit when assembled in the field.

Virtual fitting replaces a laborious manual process that can account for as much as 15 percent of manufacturing costs. It also increases accuracy by providing digital records that are orders of magnitude more detailed than typical paper records.

"Ensuring accuracy is critical to preventing costly errors in which girders get to the field and turn out not to fit," says Fuchs. "This system helps catch errors in the shop, before girders reach the field." When an error is discovered, the system provides precise and traceable documentation of what a fabricator produced, which can be critical to finding out what went wrong.

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The complexity of this system required development over many years to overcome both technical and institutional hurdles. "A system like this requires buy-in from fabricators, states, and FHWA," says Fuchs, since all three must agree on any changes to standard procedures. That's a process that took more than 15 years, and wouldn't have been possible without the assistance of the NCHRP IDEA program in 2007.

With an IDEA grant, Fuchs was able to test the system at the facilities of steel bridge fabricators in Pennsylvania and South Dakota, demonstrating its ability to work in a shop environment.

"The IDEA program was central to getting us where we are with the system," says Fuchs, "especially with initial system development."

The project also led directly to a follow-up pooled fund study in which the system could be put to the test. The system was recently used for the first time to manufacture a bridge in Tennessee, and will be used for a second production job on a bridge in Virginia.

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Environmental and performance benefits with bio-asphalt

Another IDEA-funded project is helping to address two problems at once: decreasing the environmental impacts of swine farming while producing a better method for incorporating recycled tire rubber into asphalt.

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While using recycled rubber in asphalt is both environmentally friendly and can improve pavement performance, mixing it with asphalt binder can be difficult. The process requires extensive grinding of the rubber, which can reduce the rubber's performance benefits by damaging its structure. These mixtures can also require more energy for heating and pumping, making some contractors reluctant to use them.



An IDEA project has unlikely partners in an effort to improve asphalt modification.

IDEA-funded research by Elham Fini of North Carolina A&T State University is using swine manure to help rubber and asphalt work better together by developing a bio-binder alternative to the petroleum-based binder typically used in asphalt. "This binder reacts with the surface of rubber particles to produce a better mixture that is easier to pump and has a longer storage time," says Fini.

The resulting bio-asphalt also reduces construction costs and ensures that rubber-based asphalt will perform more consistently. Cost savings come from both the lower costs of using recycled rubber and the fact that farmers will pay to have swine manure reclaimed, which is also very beneficial to the environment. Where typical asphalt costs around \$2 a gallon, Fini's bio-asphalt could cost as little as 50 cents a gallon.

While the environmental and cost benefits are important, the project's main goal was to improve pavement performance. "We were looking to develop a better pavement," says Fini. "What we found was a solution that also helps the environment."

With the first phase of the project nearly complete, several companies are showing interest in funding further development of the product. "We hope with the help of NCHRP and industry to bring the technology closer to market," says Fini. "The aim is not only to enhance the properties of rubber-modified asphalt but also to facilitate and promote scrap rubber application."

Building a better bridge beam

One of the IDEA program's most successful projects was funded by both the NCHRP IDEA program and the now closed High-Speed Rail IDEA program: developing a hybrid-composite bridge beam for highway and railroad construction. This beam combines concrete, steel, and a fiber-reinforced plastic shell to obtain the best combination of compressive strength, tensile strength, weight, and corrosion resistance.

"Fiber-reinforced polymer composites have long been used to build airplanes, boats, and anything else that benefits from the combination of high strength, light weight, and corrosion resistance," says beam inventor John Hillman of HCB Inc. "We had the epiphany that you could combine concrete and steel with advanced composites to create a beam that's really efficient and utilizes material in the most structurally efficient manner."

At about one-tenth the weight of a typical precast concrete girder of the same length, the beam is far less costly to ship and much easier to erect, making it well suited to accelerated bridge construction. It also resists cracking and rusting, reduces the carbon footprint of structures by requiring fewer delivery trucks, and increases bridge service life to more than 100 years.



The hybrid-composite beam uses a tested technology to make structures lightweight, strong, and corrosion resistant.

To date, Hillman's hybrid-composite beam has been installed in 18 highway bridges in nine states and is receiving tremendous interest internationally. Hillman is convinced that composites will one day be as commonplace in the transportation industry as they are in other industries.

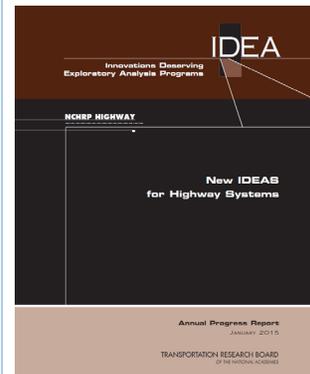
A distinct place in transportation research

Moving forward, the IDEA program will continue to play its singular role in the transportation research landscape.

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"This is a unique program," says Williams. "Instead of simply saying no to unconventional ideas that don't fit into their research programs, transportation agencies can send them to us."

"Generally research is funded when it looks promising or is already a proven concept," says Iowa DOT's Sandra Larson, chair for six years of the project panel that oversees the NCHRP IDEA program. "The IDEA program is really unique among transportation research programs in providing seed money to explore unproven ideas."



The program's annual progress report includes descriptions and updates for all ongoing and completed projects.

It is also noteworthy, she adds, in its level of success. "I'm amazed by the impacts some of the products funded by the IDEA program are making," says Larson. "The program really is making an incredible difference in the transportation world."

A recently published report, *Products with an Impact or Potential Impact on Current Highway Practice—Notable Examples* (www.trb.org/Main/Blurbs/172600.aspx), highlights commercialized and other promising NCHRP IDEA products. Additional information about the NCHRP IDEA program may be found at www.trb.org/IDEA Program/IDEA Highway.aspx.

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