Benefits Via Research In IDOH

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First, I would like to briefly consider the IDOH Research Program. Secondly, I will give some examples of positive benefits received from the IDOH Research Program. I want to first present the IDOH Research Program as it does little good to mention the benefits of the program if one doesn’t understand the program nor know how to receive the benefits from the program.

First, a word about research in general and in particular, highway research. As engineers, accountants, and managers, you know that research is a powerful tool for your business. The potential for significant paybacks in research is quite large. It’s not uncommon in research to have cost/benefit ratios of 1 to 5, 1 to 10, or even 1 to 20. At a recent Region 5 and 7 Research Management Conference, held in Springfield, Illinois, each attending state indicated that the savings realized from just one research project more than offset the entire cost of their research program.

Unfortunately, highway research funding has often fallen short of the research need. This is especially true when we see that $111 million was spent on highway research nationwide in 1973, and only ½ that much was spent in 1982, even though we know the needs were many times greater. Furthermore, hi-tech industry, typically, spends 30-50 times more of its gross sales revenue on research than does the highway industry. Even the lowest tech industries spend eight times more on research than the highway industry. Another way to think of this is the highway industry spends less than 1/10 of 1 percent of its gross revenue on research. That’s shocking when we see that the United States spends over $40 billion annually on highways or $175 for every man, woman and child in the U.S.

Let’s briefly talk about the IDOH Research Program and some important background material so you can see how you can receive benefits from the program. The purpose of the IDOH Research Program is to engage in research and development of new ideas that will ultimately lead to an efficient and effective method of accomplishing its mission. New products or materials offered by vendors for IDOH usage shall also be given due consideration. Results and findings of the Research Program benefits other states as well as cities, counties, and towns in Indiana.

IDOH has established a Research Committee to fulfill this purpose and to address and prioritize the numerous research requests that are
received. The following people serve on the Research Committee and devote many hours to the Research Program, making it a success:

Paul Owens, Dep. Dir. Eng. & Mgmt. Services Chairman
Dick Howden, Deputy Director Field Operations
Max Hunter, Eng. of Construction
Bob Eskew, Chief, Division of Materials and Tests
Ken Mellinger, Chief, Division of Maintenance
Clint Venable, Chief, Division of Traffic
Murray Cantrall, Chief, Div. of Program Development
Barry K. Partridge, Chief, Div. of Research, Secretary

Good support and assistance is also received from John Breitwieser and Gary Dalporto from the Federal Highway Administration. The Research Program also receives technical support from the approximately 57 Civil Engineering faculty members at Purdue University through the Joint Highway Research Program. Under the fine leadership of Professor Michael, head of the School of Civil Engineering, these faculty members provide expertise in the areas of:

- Structures
- Transportation
- Hydraulics
- Environmental
- Construction
- Geotechnical
- Surveying and Mapping
- Materials

Types of research the RC oversee include:

- HPR Part II Research-Federall Funded
- 100% State Funded Research
- Experimental Projects and Experimental Feature Studies (Local Agencies are involved in these studies)
- Pooled Fund Research Among States and FHWA
- FHWA Implementation Tasks
- FHWA Demonstration Projects
- National Cooperative Highway Research Program (NCHRP)

The current IDOH Research Program consists of approximately 79 projects, including 19 experimental feature studies with cities, counties, and the state. Funding in the Research Program consists of $300,000 to JHRP (state money which goes to Purdue) and $800,000 HPR money (federal money).

Quarterly, the Research Committee solicits research needs from:

IDOH offices, divisions, districts
Metropolitan Planning Organization (MPO) needs through the Division of Program Development
Local Agency needs through the Division of Local Assistance
Joint Highway Research Board
FHWA Divisional Office

These research needs are prioritized annually by the Research Committee with 52 such requests received for Fiscal Year 1988 (July, 1987 - June, 1988).

Let’s now look at some examples of the benefits and accomplishments of the IDOH Research Program. Let’s break this down into program benefits and then some specific project benefits.

Some program benefits include an annual research summary of IDOH sponsored research which is published in January of each year. Copies are available from the Division of Research and the Division of Local Assistance. The 1986 Research Summary provides information, findings, and implementation activities on 79 research projects in the areas of

- Bridges
- Construction Management
- Drainage
- Maintenance
- Materials
- Pavement Evaluation Methods
- Pavement Performance
- Pavement Rehabilitation
- Soils
- Traffic

A list of approximately 80 final reports published from 1980-1985 are also included in the report for your use. Final reports on a research project consist of an executive summary, technical report, and implementation suggestions.

The last program benefit I would like to mention is the Highway Research Information Service. The Highway Research Information Service is a national and international tabulation of research being performed in areas of highway research. IDOH pays a flat fee annually for this service. If you have an area of interest and you would like to know what research has been performed in that area, call the Division of Research (232-7510 or area code (317) 463-1521). There is no charge to you for this service.

Let’s now look at a few examples of benefits received from specific projects. Benefits of research in slab stabilization was highlighted in the final report of the Governor’s Efficiency Task Force. A paper was also presented on this research at the January, 1987, Transportation Research
Board Meeting in Washington, D.C. The paper was entitled "Indiana Void Detection and Rigid Pavement Undersealing."

Through research, we have developed a method to determine when and where to underseal rigid pavements to improve subgrade support. In the past, when and where to underseal was not known, consequently, the entire contract was undersealed. Likewise, there was no way to control the amount of asphalt pumped. This lack of knowledge was very costly, resulting in large overruns and good pavement was often damaged by undersealing when it wasn’t required. The research looked at before and after deflections using the Dynaflect, hole spacing and configuration, and slab lifting. A device was also developed to control the amount of asphalt pumped.

Estimated savings resulting from a better undersealed method was $320,000 in 1980; $914,000 in 1981; $2,163,000 in 1982; $2,234,000 in 1983; $10,730,000 in 1984, and $12,000,000 in savings in 1985 and 1986 (See Figure 1). These savings were calculated assuming IDOH was

*Figure 1. Savings Resulting From Dynaflect Research*
undersealing current contracts the old way. This savings actually resulted in more miles of pavement being undersealed for less money. Current contracts requiring undersealing now require this new procedure. This procedure was also highlighted in the August issue of Public Works magazine. These procedures, benefits, and savings are a direct result of research.

Through research, a new technique for locating bridge deck delamination was evaluated utilizing a high resolution infrared camera capable of identifying delaminations and by reading minute temperature differences between sound and delaminated or debonded concrete. It was found the infrared device was, typically, 97 percent accurate in locating delaminated or debonded areas when compared to the actual quantities of patching placed during construction. The speed and cost of testing were also evaluated. It was found the infrared technique would likely benefit IDOH in a bridge management program by prioritizing overall bridge deck condition and by early detection and repair of bridge decks before total deck replacement is required.

Considerable research has been performed in the area of frictional properties of pavements and safety. Benefits from this research have enabled IDOH to develop a Skid Accident Reduction Program. IDOH now performs an annual inventory of roads within the IDOH system to assist the districts in identifying potentially slippery locations and to determine relationships, if any, between pavement friction and accidents that have been occurring at a particular site.

Research has enabled us to identify which surfaces, surface textures, and aggregate types and combinations thereof provide the best frictional resistance on Indiana pavements. Furthermore, research has given us indication into how these surfaces will retain their frictional properties under a given traffic volume. Findings from this research has helped shape IDOH’s resurfacing policy for low, medium, and high volume traffic based on design year directional ADT. If we can find what variables affect pavement friction, we can design our pavements to include these features. One study entitled “Optimizing Indiana Pavements” enabled us to determine seasonal variation of friction numbers for various surface types. Research also is currently underway to evaluate the performance of crushed gravel and dolomite aggregates as less costly substitutes for slag, which is not readily available throughout the state.

Peripheral benefits from the friction research has aided the state in litigation matters and favorable court decisions. In one case, the lawsuit was dropped by the plaintiff when she found out we had friction data at the accident site. The head of the tort section in the Attorney General’s office stated, “The discontinuance of the Skid Accident Reduction Program by IDOH would surely lead to the loss of many lawsuits. Furthermore, it would show negligence on the part of the state by in effect say-
ing we have no concern for the safety of the travelling public.” The benefits of this program are actually benefits from research.

Research has also been performed in the area of pothole repair and fiber mix. In 1978, there was a reported significant increase in repatching of potholes and problems with patching mixtures staying in place. Several studies have been initiated over the years to address these problems. Placement methods for patching materials were developed from evaluating preheating of the WS mix, compaction equipment, methods of applying tack and seal, and hole preparation. It was found that the longest lasting patches were those made from heated mix and compacted to optimum density, which is not surprising today. If the results of the study are used, the need to repatch potholes has shown to reduce dramatically.

Fiber mix research on I-65 and US-52 has shown that the addition of fibers in asphalt patching mixtures have produced a dramatic improvement in stability and resistance to rutting of the patch. Furthermore, the patching material is easier to use and lasts longer than patching material without fibers. This has resulted in the addition of fibers to our current cold mix patching materials. This improved patching procedure and improved patching material are benefits resulting from research.

Research has also been performed in the area of pavement roughness. Yesterday afternoon an award was given to the contractor who constructed the smoothest bituminous overlay in the state last year. Research has helped us to identify what parameters affect pavement roughness and how these can be measured. Testing that allows us to recognize good construction is performed primarily to establish an objective measure of pavement condition. What really is of prime importance is finding the roughest roads rather than the smoothest roads. Every mile of pavement in the state system is tested annually to determine its current level of service to the public. This is called present serviceability index (PSI). Indiana has conducted research for the last 10 years in the area of pavement roughness to determine the relationships between pavement roughness and user (driver) opinions on the acceptability of pavements. The serviceability index can be used to compare pavement condition between pavements and to help managers decide which pavements should be rehabilitated and in what priority. By analyzing serviceability index over time we can forecast the number of miles of pavement that will become unacceptable at some point in time. These projections will help facilitate the planning and program development functions of the department. Again, these benefits would not be available to the department had it not been for research.

Research is being performed in the area of Weigh-in-Motion (WIM). In the past, truck weights have been estimated from data collected at permanent static weigh stations around the state. Unfortunately, permanent weigh stations are expensive to build and to operate. Furthermore, truck
weighing currently is time consuming, causing long backups, delays at some locations, and overweight trucks can easily avoid open permanent weigh stations through the use of CB radios. In recent years, devices allowing for the weighing of heavy trucks at highway speeds have become available. These devices utilize a small mat or tube to determine the weight of each axle and a pair of inductance loops to measure vehicle length, speed, and to assign the proper axle weights to each vehicle’s total weight. Some of these devices are portable and may be easily moved from site to site, others are permanently embedded in the pavement. These WIM systems appear capable of measuring the weight of vehicles within 5-10 percent of their static weight and are inexpensive compared to static scale installations.

This combination theoretically makes it possible to obtain axle weight distributions on a much larger sample of pavements than previously possible. Testing is performed at highway speeds and truckers, typically, don’t realize they are being weighed. We are currently researching a portable WIM system to determine cost and feasibility of collecting the data for the biannual truck weight study required by FHWA. The research will also look into establishing axle weight distributions on the various functional classes of highways.

Research need not be terribly complicated to have a significant payback. While some areas of study require a long study period with much data collection, in order to produce meaningful results, some problems lend themselves to a much more expedient solution. An example is a research project performed by Professor Jeff Wright of Purdue entitled, "Microcomputer Implementation of SANTA: A Personnel Management Model." SANTA stands for Systematic Analysis of Noninferior Transfer Assignments. The problem was in order to effectively attack the winter snow removal problem, it is necessary to reassign some workers for the winter months. These are workers who normally work in other areas of IDOH, such as construction and reassignment can result in a large expense to IDOH if not performed efficiently.

For this project, a Personnel Management Model was developed and implemented for a microcomputer. The model was developed and tested over a two-year period for the LaPorte District. The strategy of the model was to minimize the total travel distance to the work unit for all employees and also to minimize the maximum travel distance of any employee. A further constraint was to minimize the number of vehicles assigned to workers. A worker is entitled to a vehicle if assigned to a unit other than the closest to his home, or if the unit is farther than 15 miles from his home.

The model was tested and compared to the current ‘‘by hand’’ method. The overall savings to IDOH was approximately 92,000 person miles during one season and a dollar savings for this one district alone
of about $100,000. The average travel distance was also reduced from 36 to 15 miles.

Time does not permit one to tell of the many benefits received from research on small hand compactors which has enabled maintenance departments to buy the right equipment for the right job, or research on snow plow spinner spreaders versus drop spreaders, nor when stockpile prewetting of rock salt with calcium chloride solution is preferable over truck prewetting, and how stockpiles should be prewetted. Neither is there time to speak of the benefits of research from research into pipe coatings, which enabled IDOH designers to select the right types of pipe for strong acidic or alkali locations, or to elaborate on the results of research on Bridge Deck Protection Systems, looking at latex modified concretes, LSDC concrete, corrosion inhibitors and membranes, some of which work, others which should be avoided. Or thin bonded concrete overlays which improve friction characteristics of smooth concrete pavement, such as the thin bonded concrete overlays on SR-37 near Martinsville, Indiana. Nor is there time to discuss the findings coming from the unbonded concrete overlay project on I-69 or the Concrete Pavement Restoration (CPR) project on I-65, or for that matter, time to discuss benefits from research in a dozen other areas. Suffice it to say, we would not have the benefit of considerable knowledge were it not for this research.

President Reagan stated in 1985, for our country to remain strong, we must strongly support basic research in the United States. Would this not also be true in a $40 billion a year industry? Past experience verifies that research does reap considerable benefits in this large and evolving highway industry and it takes people like you to recognize this and to allow research to address your problems. You are in turn the ones who reap the benefits.