

# APPENDIX

## SUMMARY OF MoDOT RESULTS

Year(s)	Innovation/Efficiency	Total MoDOT Savings	Total Customer Savings	Total Additional Funds	Total Lives Saved	Cost-Benefit Details
2007-2011	Practical Design Emphasis	\$ 1,500,000,000	\$ -	\$ -	0	MoDOT saved millions by replacing standard highway practices with practical design concepts. Building without frills allows us to address more customer needs than previously possible.
2011-2020	MoDOT's Bolder Five-Year Direction	\$ 1,235,000,000	\$ -	\$ -	0	By reexamining everything we do, MoDOT achieved substantial savings through the sale of obsolete facilities and equipment and a significant workforce reduction (1,200 employees). We transferred these savings to meet customers' road and bridge expectations. This effort began in 2010. Savings are reinvested in the Missouri highway system.
2007-2020	Paving With Recycled Materials	\$ 351,385,602	\$ -	\$ -	0	As asphalt costs rose in other states, MoDOT's emphasis on asphalt pavement recycling and use of used roofing shingles in pavement mix helped contractors keep the average bid price per ton of asphalt steady in Missouri. The use of recycled asphalt can reduce material costs by \$5-10 per ton. This effort began in 2004 and savings are ongoing.
2007-2020	Alternating Passing Opportunities with Shared 4-Lane Design	\$ 330,463,000	\$ 385,682,215	\$ -	42	A shared 4-lane can be thought of as a 2-lane road featuring a passing lane that alternates every mile or so between opposing traffic. This provides safe opportunities for drivers in both directions to pass slower vehicles. Four Missouri highways use the 4-lane approach, totaling 117 centerline miles. Savings shown here reflect the difference in cost between building traditional 4-lane highways and the shared 4-lane approach. Traveler savings in time and fuel costs are not shown, but are thought to be significant.
2010-2020	Achieving the Improbable With Design-Build Approach	\$ 304,751,000	\$ -	\$ -	6	In the early 2000s, Missouri's legislators authorized MoDOT to use a design-build approach on three projects to demonstrate whether the public sector success of this innovative bid-build approach could be replicated in public works. Since then, MoDOT has delivered 13 Design-Build Projects that were completed 95 months ahead of schedule. MoDOT continues to partner with the public and private sectors to deliver projects that maximize available resources into collaborative solutions that achieve goals. This collaborative effort challenges the way projects are delivered. MoDOT pushes the boundaries to execute projects of different size and complexity using innovative data driven processes and a wide range of public and private partnerships. Concentrating on project goals, innovation, schedule and budget, construction is completed more efficiently, with less impact on travelers.

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2007-2020	Engineering Reviews Enhance Value	\$ 267,950,506	\$ -	\$ -	0	Before design and construction projects can be called complete, consultants or sharp-eyed co-workers review methods and procedures. The ideas they offer often improve project practicality and the bottom line.
2011-2020	Building Slim Shoulders Where None Existed	\$ 261,184,000	\$ 436,358,025	\$ -	41	MoDOT has installed thousands of miles of shoulders and rumble strips on rural highways where there were none. Using a 2-foot standard rather than the 4-foot shoulder required for major roads made this possible. The result - a 30 percent reduction in run-off-road severe crashes. Engineered shoulders helped drivers regain control. The paving cost of a 2-foot versus a 4-foot shoulder saves \$106,000 per mile and reduces the cost to obtain sufficient right-of-way.
2007-2020	Offender Work Crews	\$ 256,777,567	\$ -	\$ -	0	The Missouri Department of Corrections partners with MoDOT to allow offenders to perform labor-intensive work. This allows MoDOT to focus its resources on more skilled tasks.
2007-2020	At-Grade Crossing Conversion to J-Turn	\$ 182,700,000	\$ 336,604,704	\$ -	33	J-Turns, a cost-effective alternative to an overpass, reduce the number and severity of crashes at at-grade highway intersections. Traditional interchanges cost \$5-10 million to build. J-Turns average cost is \$800,000. At locations where J-Turns were installed, crashes are down 25 percent and those incidents result in 88 percent fewer fatalities. This design innovation allows us to address a minimum of six severe crash sites with the same money it would take to build a single traditional overpass. MoDOT's first J-Turn was built in 2007.
2011-2020	Optimizing Pavement Striping Strategies	\$ 144,000,000	\$ -	\$ -	0	Because we found that stripes on low-volume highways show less wear than those on major roads, we chose to extend the duration of the minor route restriping schedule. As a result, we sold 30 percent of our specialized striping equipment and reassigned employees to other needed work. This approach maintains traveler safety and meets customer expectations.
2009-2020	Nation's First Diverging Diamond Interchange	\$ 126,800,000	\$ -	\$ -	0	Springfield, Mo., is the site of the first-in-the-nation diverging-diamond interchange. Initial estimates for traditional interchange improvements at Interstate 44 and Mo. 13 were estimated at \$10 million with up to 2 years to complete. Changing the design to a DDI reduced project costs to \$3.2 million and it was built in 6 months. This innovative and cost-effective interchange design handles high traffic volumes so efficiently that 25 now exist in Missouri. Nearly all other states have followed suit, with at least one DDI of their own.

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2007-2020	Innovative Finance	\$ 107,127,154	\$ -	\$ -	0	MoDOT refinanced and paid off some bond debt years early, allowing millions to be directed to Missouri's roads and bridges. Since October 2003, the alternate bidding process in MO has resulted in the average number of bidders per project rising to 5.5. The three-year average asphalt price/ton for alternate paving projects is 5.1% below that for non-alternate projects, and the three-year average concrete price/CY for alternate paving projects is 8.6 percent below that for non-alternate projects. Overall, it shows a decrease in asphalt prices on alternate bid projects.
2007-2018	Alternate Pavements	\$ 44,701,609	\$ -	\$ -	0	When contractor bids come in above initial estimates, MoDOT takes another look. Often we discuss cost-saving adjustments with industry, such as eliminating unnecessary contractor risk, then release the proposal for new, nearly always lower-cost bids.
2007-2020	Rethinking Over-Estimate Contractor Bids	\$ 29,883,302	\$ -	\$ -	0	Though other states have shuttered rest areas in an attempt to save money, Missouri converted obsolete and expensive-to-maintain rest areas and weigh stations to basic truck parking areas. The costs of decommissioning these sites is quickly recouped. When converted, there is no need for building cleaning services, site maintenance or water. Electricity costs are slashed. Motor carriers praise Missouri. The conversions increased the number of publicly provided truck parking spaces in the state, making it easier to find a safe place to sleep. Rested drivers are safer drivers.
2009-2020	Converting Roadside Assets to Truck Parking	\$ 17,649,421	\$ 1,657,796	\$ -	0	By scrutinizing every aspect of traffic signal design and operation, we found efficiencies and now save more than \$1.5 million that can be used on road and bridge work each year. We shared our discoveries with Missouri cities, counties and developers. As a result, the savings opportunities stretch beyond MoDOT alone.
2009-2019	Efficient Traffic Signal Design	\$ 16,500,000	\$ -	\$ -	0	

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2007-2020	Acceptance of Alternate Technical Concepts	\$ 15,250,000	\$ -	\$ -	0	<p>Bidders sometimes propose an alternative technical concept when presented with a MoDOT-supplied base design configuration, project scope, design criteria or construction criteria. ATCs often provide solutions equal or better to the original bid requirement.</p> <p>ATCs provide flexibility to the bidders in order to enhance innovation and achieve efficiency.</p> <p>ATCs have been used on multiple projects since 2007, including the Stan Musial Veterans Memorial Bridge in St. Louis. ATCs resulted in \$7.5 million in savings on the \$229 million dollar project.</p>
2011-2020	Mowing Smart	\$ 15,000,000	\$ -	\$ -	0	<p>Starting in 2011, MoDOT adjusted our mowing schedule on low-volume highways to shift more of the budget to Missouri's roads and bridges each year. On odd years, two passes are required to make sure no substantial growth occurs in the clear recovery zone and on even years, only one pass is required on the final mowout to assure there are no sight distance issues.</p>
2007-2019	Converting Signals to LED Lighting	\$ 12,988,046	\$ -	\$ -	0	<p>Replacing incandescent signal bulbs with LED bulbs results in remarkable energy savings. Also, because LEDs last longer, they are changed less often, resulting in lower labor costs. MoDOT's LED efforts earned an AASHTO Sweet Sixteen award and is emulated by other states.</p>
2007-2020	Fighting Snow with Beet Juice and Salt Brine	\$ 11,578,784	\$ -	\$ -	0	<p>Salt brine, a liquid solution, soaks into pavement. It is used to pretreat roads for expected storms because rock salt is scattered by passing traffic. Beet juice is a waste product of sugar production. The sticky substance helps rock salt adhere to pavement, increasing the effectiveness of MoDOT's winter storm activity. Both innovations reduce MoDOT's salt usage.</p>
2015-2020	Building on a Strong Base - Intelligent Compaction	\$ 9,514,050	\$ -	\$ -	0	<p>Improvements to soil and aggregate compaction under the highway increase pavement service life and decrease maintenance costs for MoDOT. The approach also saves considerable time and labor costs for contractors.</p>
2012-2017	Sign and Post Inventory Reduction	\$ 9,003,162	\$ -	\$ -	0	<p>As MoDOT reduced the number of maintenance buildings, we reevaluated the quantity of signs and posts kept in inventory. Materials are drawn from supplies on hand until we reach the new, lower reorder point.</p>
2011-2019	Achieving Savings Through Research	\$ 8,290,000	\$ -	\$ -	0	<p>MoDOT actively pursues academic and other research to discover new methods to drill bridge support shafts. Methods derived from spread footing geotechnical research conducted in 2011, for example, will save \$100,000 in a typical year.</p>

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2012-2020	Streamlining Survey Costs with Light Detection and Ranging (LiDAR) Technology	\$ 7,973,879	\$ -	\$ -	-	LiDAR instruments measure distance to a target by illuminating it with a laser light. Adopting this technology reduced the cost of survey design. An ACEC Engineering Excellence Grand Award winner two consecutive years.
2007-2020	Bridge Redecking Template	\$ 7,726,800	\$ -	\$ -	-	When bridge supports are in good shape, MoDOT redecks older bridges rather than replacing the entire structure. MoDOT uses a standard template for the design of bridge redecking projects to save design time and costs. Travelers enjoy the design time savings and Missourians benefit from cost savings.
2007-2018	TowPlow - Missouri-Made Snow Fighter	\$ 5,224,338	\$ -	\$ -	-	The TowPlow was created by a former MoDOT employee. The TowPlow blade swings out to the side of a snow plow-equipped truck to help clear more lane miles with fewer trucks and operators. MoDOT includes 81 TowPlows in its snow-fighting arsenal. Many other four-season states investigated our success and obtained TowPlows for their own fleets.
2011-2020	Sign Design Modifications	\$ 5,000,000	\$ -	\$ -	-	MoDOT designs as many signs as possible to fit on existing posts, resulting in significant savings.
2007-2018	Durable, Informative Emergency Reference Makers	\$ 3,120,000	\$ -	\$ -	-	The federal standard calls for a single mile marker sign with nine reflective delineators spaced evenly between each sign. MoDOT sought and received permission for the variation. The five signs per mile prove much more durable than the nine reflective delineators. MoDOT recouped the cost of the signs realizing savings in materials and maintenance costs. MoDOT enjoys the overwhelming support of EMS personnel and 911 operators for the decision. Interstate travelers can now provide more accurate location information to dispatchers when they call for emergency services, speeding response time.
2014-2019	Modifying Chevron Sign Spacing	\$ 2,806,002	\$ -	\$ -	-	MoDOT adopted federal standard spacing for installation of chevron signs in curves, eliminating the need for an engineer's field visit. The change also reduced the need for an average of two signs per curve, a savings of \$720 on each.
2010-2019	Achieving Efficiency with Bridge Analysis Software	\$ 2,756,927	\$ -	\$ -	-	New LARSBridge software helps bridge engineers more quickly and accurately conduct structural analysis for the movement of specially-permitted super-heavy truckloads. The quicker response and more accurate restrictions save motor carriers time and money while reducing the need for staff resources and improving bridge preservation efforts.
2016 - 2020	Choosing the Most Cost-Effective Sign Posts	\$ 2,000,000	\$ -	\$ -	-	By changing its one-size-fits-all sign post philosophy, MoDOT saves by choosing the smallest post for the job at hand and avoids costs associated with well-intentioned over-building.

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2007-2012	Using Innovation to Mitigate Impacts to Streams- Stream Mitigation Banks	\$ 1,342,521	\$ -	\$ -	0	MoDOT replaced several low water crossings with environmentally friendly bridges, earning stream bank mitigation credits to offset impacts to streams elsewhere. MoDOT also uses the Stream Stewardship Trust Fund to mitigate stream impacts to reduce long term maintenance costs.
2016-2020	Energy Saving Lighting	\$ 983,000	\$ -	\$ -	0	When existing bulbs for overhead and task lighting burn out, MoDOT replaces them exclusively with LED lamps. LEDs consume much less energy and last far longer, saving both electricity and labor costs. The effort expands beyond offices and maintenance areas. The Rock Port, Mo., welcome center earned LEED Silver certification in part because of its use of LED lighting.
2016-2020	Reassessing Road Sign Needs	\$ 750,000	\$ -	\$ -	0	MoDOT looked at every type of sign and learned some were not essential to safe roadways. These are not replaced when they deteriorate.
2013-2020	Paperless Contract Storage	\$ 582,000	\$ -	\$ -	0	By using electronic storage, MoDOT reduces its long term document storage costs. Contracts and bonds prepared for road and bridge work average well over 100 pages each. Creating, modifying and delivering them electronically for approval cuts processing time from 30 days to 3 days. MoDOT's other agreements, such as reciprocal agreements and memorandums of understanding are stored and often produced paperlessly. This expedites the research, review and handling of such documents, saving staff time and other costs.
2016-2020	Merging Operations Software	\$ 375,000	\$ -	\$ -	0	By merging multiple software contracts into one we found efficiencies for our system.
2012-2020	Remapping Snow Plow Routes	\$ 342,000	\$ -	\$ -	0	MoDOT's St. Louis District reexamined the routes its snowplow operators drive, discovering changes that resulted in a savings of 10 minutes per cycle. Pavement is treated faster, saving \$9,400 per storm and making the way safer for the millions of travelers in the region in less time.
2019-2020	Converting Roadway Lighting to LED	\$ 180,259	\$ -	\$ -	0	Replacing high pressure sodium highway lights with LED lighting results in remarkable energy savings. Also, because LEDs last longer, they are changed less often, resulting in lower labor costs.

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2014-2016	Using Research to Challenge Culvert Load Standards Saves Cost and Motorist Inconvenience	\$ 100,000	\$ -	\$ -	0	MoDOT took an innovative approach to research the load capacity of concrete box culvert bridges. By proving that soil fill helps distribute the truck traffic weight carried by this type of bridge, we are able to reduce the number of detailed structural analysis studies needed and avoided placing unnecessary weight restrictions on 3,150 culverts statewide. The effort earned an AASHTO Sweet Sixteen award and other states are using our research results to fine tune their approach for structural analysis on box culvert bridges.
2007-2020	Reducing Crossover Crashes with Median Guard Cable	\$ -	\$ 5,190,619,195	\$ -	512	Missouri's median guard cable is successful in slowing and guiding wayward vehicles from crossing into opposing lanes. Guard cable is used on portions of all Missouri interstates and other major routes. It drastically reduces the number of median crossover crashes which can be devastating, often fatal.
2007-2020	Making Highways Smoother and Safer, Sooner	\$ -	\$ 1,424,146,056	\$ -	120	The Smooth Roads Initiative and Better Roads, Brighter Future program were back-to-back efforts that improved 5,600 miles of highways. Completed earlier than scheduled, the efforts delivered smoother pavement, brighter striping, rumble stripes and other safety improvements to the highways that carry 80 percent of Missouri's traffic. These improvements have resulted in over \$1 billion of safety benefits to the customers since 2007.
2007-2020	Electronic Truck Pre-Screening at Weigh Stations	\$ -	\$ 255,458,905	\$ -	0	Electronic pre-screening using weigh-in-motion scales and other technology helps identify the "good players" among commercial truck traffic in Missouri. Transponder-equipped trucks found in good standing are allowed to bypass weigh stations so Missouri State Highway Patrol Commercial Vehicle officers' inspection efforts are more efficient. Motor carriers who participate in the voluntary service save time, fuel and money while Missouri uses the same resources to process an increasing number of trucks.
2007-2020	Web-Based Motor Carrier Credentialing	\$ -	\$ 106,695,470	\$ -	0	Motor Carrier Express, an online business portal, allows trucking companies to conduct business with MoDOT anytime and drastically reduces the need to speak with an agent. Customers transact more than 125,000 actions each year on their own and receive most required credentials electronically rather than by mail or shipment. Since 2007, Missouri motor carriers realized significant time savings through electronic credential delivery. Trucks get on the road - making money - faster.

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2013-2020	Keeping Cars on the Road with High Friction Surface Treatment	\$ -	\$ 99,819,331	\$ -	0	MoDOT achieved a 20 percent reduction in run-off-road crashes in areas with high rates of ROR incidents by installing high-grip surface treatments. Ideally, the alignment of those road sections would be corrected, but until that is possible, the pavement 0 helps hold vehicles on the driving lanes, reducing skidding.
2009-2020	Earning Competitive Federal TIGER Grants	\$ -	\$ -	\$ 56,703,000	0	The federal TIGER Discretionary Grant program supports innovative projects and collaborative approaches to difficult transportation issues nationwide. This program allows Missouri 0 to address transportation system needs using federal funds.
2009-2020	Realty to Roads Property Sales Program	\$ -	\$ -	\$ 58,252,319	0	MoDOT sells state-owned property no longer needed for transportation purposes. The proceeds from this program are reinvested into the road fund. In 2010, MoDOT's Right of Way Division earned the 2010 FHWA Excellence in Right of Way Technical Specialty Award for the team's aggressive approach 0 and rationale in selling excess property.
2013-2020	Realizing Revenue Through Recycling	\$ -	\$ -	\$ 2,771,859	0	Recycling paper, plastic, ink cartridges and more is second nature for MoDOT office employees. Field staff routinely collect scrap metal, tires, anti-freeze and the like. All of the items are sold with the revenue invested in Missouri's highway system.
2016-2018	Outsourcing Sign Production	\$ -	\$ -	\$ 1,800,000	0	Renegotiating the terms and renewing the contract between MoDOT and the vendor that manages business and tourist directional signs on highway right-of-way guarantees MoDOT an additional \$600,000 in revenue annually. The terms also shifted responsibility for sign production and installation to the vendor, 0 freeing MoDOT employees for other work.
2007-2020	Cost Share and Cost Participation Programs	\$ -	\$ -	\$ 1,416,268,000	0	Communities contribute to state highway projects to receive needed upgrades faster. Revenues from local tax initiatives 0 often provide the local portion in Cost Share Program projects.
2007-2020	Encouraging Economic Opportunity and Competition Using Federal Funds	\$ -	\$ -	\$ 7,281,217	0	MoDOT uses Federal Highway Administration funds to administer programs that expand business opportunities for historically disadvantaged groups. By educating business owners how to pursue opportunities with the state and by providing real-world experiences through apprenticeships, MoDOT benefits from an expanded pool of competitive vendors 0 and increased numbers of skilled laborers.
2019-2020	Revenue Generated from Leasing Property	\$ -	\$ -	\$ 8,720,866	0	MoDOT leases Commission owned property when it does not interfere with the operation of the system and benefits the public. Areas leased are utilized for agriculture purposes, parking facilities, highway patrol regional sites to list a few. The 0 additional revenue is reinvested in Missouri's highways.



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2020	5339 Rural Transit Facilities Competitive Grant	\$ -	\$ -	\$ 5,120,000	0	MoDOT successfully secured federal funds to construct two storage and maintenance facilities for rural transit providers. These facilities will save operational costs, add efficiencies and help keep transit buses in a state of good repair.
2020	FAA Airport Improvement Program Competitive Supplemental Appropriation Funding	\$ -	\$ -	\$ 10,000,000	0	Helping small airports that may not compete well for other competitive discretionary funding. MoDOT received funding for four projects at three small airports to improve runways, taxiways and aprons.
2020	CARES Act Funding - Transit	\$ -	\$ -	\$ 61,770,760	0	Taking advantage of the CARES Act monies offered, MoDOT secured much needed federal funds, with no match requirement, for operating and capital assistance for rural transit providers to continue services during the COVID-19 pandemic.
2020	FAA - Competitive Discretionary Funding	\$ -	\$ -	\$ 18,700,000	0	Funds intended for high-scoring projects using FAA's project prioritization formula; projects seeking discretionary funding to compete against other projects in FAA Central Region.
2020	CARES Act Funding - Aviation	\$ -	\$ -	\$ 8,490,464	0	MoDOT successfully secured CARES Act federal funds, which required no matching funds, to help airports cover regular airport operation and maintenance costs during the COVID-19 pandemic.
<b>TOTAL:</b>		<b>\$5,299,759,928</b>	<b>\$8,237,041,697</b>	<b>\$1,655,878,485</b>	<b>754</b>	