Research is an extremely dynamic process. As time passes, certain areas of research become more salient, while others require less attention. As a tenured Associate Professor at the University of Arkansas, my research currently focuses on three primary areas: asphalt emulsion, pavement maintenance and rehabilitation, and sustainability.

My first area of research is asphalt emulsions. Within asphalt emulsions, I strive to increase overall knowledge of soap solution fabrication, asphalt emulsion milling, and performance properties of asphalt emulsion both in the lab and in the field. Asphalt emulsions are often thought of as more of an art than a science, but I believe that with proper analysis of each component of asphalt emulsion, along with robust control of parameters during the manufacturing process, movement can be made to understand fundamental asphalt emulsion properties. A critical perspective of asphalt emulsions is the milling process. The asphalt binder, soap solution, and any additives are joined together immediately before the mill, and after passing through the mill, the asphalt binder becomes suspended in the soap solution with the help of the emulsifiers. By using our lab bench-top scale Herbert Rink asphalt emulsion mill, we are able to manufacture asphalt emulsion and then test it using a Cannon DPV (digital paddle viscometer) and a Beckman Coulter Multisizer (for particle size distribution). Moving toward performance based specifications (such as particle size) and away from empirical tests (such as demulsibility or penetration) is critical for a deeper understanding of asphalt emulsions.

Another important area of asphalt emulsion research is performance properties in the lab and in the field. Current asphalt emulsion specifications are empirical, and not tied to actual field performance. Therefore, the development of performance-based specifications, which can be run in the lab before placement in the field, would be beneficial for the Civil Engineering community. These concepts of performance-based specifications can be extended into the soap solution production as well. When making a soap solution for asphalt emulsion, the only parameter recorded is the pH and the temperature. However, it would be beneficial to better understand the characteristics of the soap solution before the manufacturing of the asphalt emulsion. Perhaps a better control of viscosity would increase the performance of the final asphalt emulsion, or a molecular analysis on the soap solution residue. There has been very little research done in this area, which provides an opportunity for development.

My second area of research is pavement maintenance and rehabilitation. This is a wide field, but I am interested in focusing on exploring the fundamental behavior of the different pavement maintenance and rehabilitation products. Research in my group has focused on developing a return to traffic testing device for Full Depth Reclamation (FDR), reducing the quantity of material needed for lab testing of Cold In-place Recycling (CIR), exploring FDR as a semi-stabilized layer in pavement structural design, and studying compaction behavior of both CIR and FDR. In addition, collaborative work with other universities has investigated the influence of asphalt emulsion on aged asphalt concrete stiffness. All of these research studies are an attempt to not only understand fundamental behavior, but also begin moving toward implementing innovative test methods and analysis techniques both in the lab and the field for pavement maintenance and rehabilitation products.

In addition to exploring innovative test methods and analysis techniques, my group's pavement maintenance and rehabilitation research has explored asphalt emulsion and aggregate interaction. While the understanding of soap solution and asphalt emulsion are critical, at the end of the day, the majority of asphalt emulsion applications are combined with an aggregate. Whether an aggregate dropped on the surface of an asphalt emulsion in a chip seal or an aggregate mixed with asphalt emulsion in a slurry seal, CIR, or FDR (three types of asphalt emulsion mix applications), understanding the aggregate and asphalt emulsion interaction is essential in understanding pavement maintenance and rehabilitation products. The University of Arkansas has many tests available for quantifying the performance of asphalt emulsion mix applications, including:

- Wet track abrasion
- Superpave Indirect Tension
- Creep compliance
- Dynamic modulus (uniaxial, indirect, and shear torsion bar)
- Fracture testing.

For asphalt emulsion residue, when the water has left the asphalt emulsion, the Dynamic Hybrid Rheometer captures G*, sin δ, and $J_{nr}$, while the Brookfield Rotational Viscometer measures viscosity. This wide range of testing capabilities in our lab allows for a deep understanding of the fundamental material properties of asphalt emulsion mix applications and asphalt emulsion residue. This research is critical as it been shown that spending $1 to maintain a good road can save $6-10 of future reconstruction costs.

My third area of research, sustainability, crosses all disciplines of Civil Engineering. As described in my textbook "Fundamentals of Sustainability in Civil Engineering" (CRC Press, 2017) there are three pillars of sustainably: economic, environmental, and social. Metrics have been developed in each of these areas. For example, under the economic pillar of sustainability, there is Life Cycle Cost analysis, and under the environmental pillar, Life Cycle Analysis. However, there are very few metrics for the social pillar of sustainability. There are two different levels of social metrics for sustainability: the level of the developing world and that of the developed world. In the developing world, metrics are centered around clean drinking water or access to education, whereas in the developed world, metrics could include government services access by mass transit or the utilization of locally sourced materials in construction. As I continue to learn and apply more of these sustainable metrics toward transportation applications of Civil Engineering, I dialogue with other faculty in different departments and colleges in order to share and transfer knowledge of sustainability potential into their disciplines and projects.

In summary, as a tenured Associate Professor in Civil Engineering at the University of Arkansas, my three areas of research include asphalt emulsion, pavement maintenance and rehabilitation, and sustainability. My research is enhanced by local, regional, national, and global collaboration with other researchers, and is complimented by the incorporation of real-world applications of engineering research into the undergraduate and graduate classrooms at the University of Arkansas.