



Oregon State
University

VISION FOR OREGON STATE UNIVERSITY ASPHALT MATERIALS AND PAVEMENTS (OSU-AMaP) RESEARCH GROUP

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1. THE PURPOSE OF THIS DOCUMENT

This document summarizes the vision of the Oregon State University Asphalt Materials and Pavements (OSU-AMaP) research group for the next 10-15 years. This document was developed in the light of the [Oregon Research Advisory Committee's priorities](#), the [Strategic Action Plan of the Oregon Department of Transportation \(ODOT\)](#), and discussions with the industry, ODOT, and other stakeholders. The document starts by outlining the research group's mission and fundamental strategic issues of pavement engineering today. Then, the strategy and tasks for solving these fundamental problems are discussed with **general** research and development topics and ideas. Finally, the current capabilities of the OSU-AMaP laboratory and potential future improvements are discussed in the final section. It should be noted that this is a living document, and it will be updated based on the changes in pavement engineering and the economy and feedback received from the industry, ODOT, and other transportation agencies.

2. NOT THE PURPOSE OF THIS DOCUMENT - DISCLAIMER

This document is not a research or teaching proposal to request funds. The research, teaching, and development ideas provided in this document are a part of the general vision of the OSU-AMaP research group led by Erdem Coleri. The contents of this document reflect the views of the OSU-AMaP research group director Erdem Coleri who is solely responsible for the facts and accuracy of the material presented. The contents do not reflect the official views of the Oregon paving industry, the Oregon Department of Transportation, the United States Department of Transportation, or other government agencies.

3. MISSION STATEMENT FOR OSU-AMaP RESEARCH GROUP

The mission of OSU-AMaP research group is to develop and implement methods and technologies to construct transportation infrastructure that is more cost-effective, socially beneficial, and does less damage to the environment while teaching the fundamentals of pavement engineering to K-12 and college students and the public.

4. PROBLEM STATEMENT - STRATEGIC ISSUES IN PAVEMENT ENGINEERING

Pavement engineering has been continuously evolving within the last several decades to address the challenges related to the increasing cost of paving materials, increasing traffic levels and truckloads on roadways, changes in vehicle and vehicle tire technologies, and increasing environmental impact of the transportation sector of the economy. The paving budgets of the state Department of Transportation (DOT), Federal Highway Administration (FHWA), cities, and counties cannot keep up with the current demand for paving. Thus, roads that should be maintained every 15-20 years can only be maintained every 30-40 years. This issue started to become apparent as the aging transportation infrastructure, increasing road user costs (in terms of vehicle maintenance, tires, and fuel consumption), reduced user comfort, and increased damage to the environment from the pavement life-cycle. Pavement research and engineering play a vital role in this equation by developing and implementing methods and technologies to reduce the impact of pavements. To develop solutions that are closest to the most sustainable options, tools, and technologies developed by the pavement researchers should not only target reducing the costs but also address social and environmental needs. In today's world with limited agency budgets, the need for maintaining, rehabilitating, and constructing new roadways to achieve the highest level of mobility and road user satisfaction can only be met by developing and implementing innovative methods and strategies

in pavement engineering. Universities, transportation agencies, and the industry should be working together to identify and address the critical pavement engineering issues. Teaching the importance of pavement research and sustainability to the public by simplifying research findings and contributions and informing them via websites, online meetings, and workshops are also critical to developing public support in order to create the political will for funding development. Achieving all those objectives by considering worker health and safety (by increasing work-zone safety and reducing suicide rates in the paving industry) also has immense importance. The major strategic issues of pavement engineering today from our (OSU-AMaP research group) perspective are discussed in the following sections.

4.1 The aging roadway network and the limited available paving funding in an economic environment with high inflation rates and increasing oil prices

According to the research conducted by the American Society of Civil Engineers (ASCE) [in 2020](#), \$4.59 trillion in infrastructure funding is needed before 2025. Although the budget for some of this required investment is currently available, about \$2 trillion is still unfunded. According to the ASCE's assessment, highways and bridges in the U.S. received an “*ASCE Grade: D*”, which is the lowest rating out of all other infrastructure components (Railroads: Grade **B** and Electrical Grid: **D+**). Traffic delays and high roadway roughness due to inadequate levels of paving are costing the U.S. about \$160 billion annually in wasted fuel, road user time, and vehicle maintenance costs.

According to the 2020 ODOT Pavement Condition Report, the current ODOT pavement program is significantly underfunded (\$220M is needed while the expected funding for 21-24 STIP is less than \$107M), which is expected to result in a decline in pavement conditions in Oregon within the next five years. According to the report, “*Preservation project mileage programmed in the 21-24 provides an equivalent resurfacing cycle time of 50 years, which is roughly twice as long as pavement lasts.....In the long run, Oregonians will pay more to rehabilitate failing pavement than it would have cost to maintain them in a state of good repair.*” Since these funding projections did not consider the recent increases in oil prices (which directly controls asphalt paving costs) and inflation rates, it is expected that the condition of the Oregon roadway network will even get worse than the 2020 predictions within the next decade. Since timely preventive preservation and maintenance of roads are crucial to reducing the life-cycle cost of paving, reduced paving due to inadequate funding is expected to significantly decrease the percentage of the pavements that are in fair or better condition in Oregon within the next decade. An effective solution to minimize the impact of inadequate paving budgets on the roadway network condition is **research and innovation** to maximize the quality of the paving materials and construction processes and reduce the cost and environmental impact of paving in Oregon and the U.S.

4.2 Wrong interpretation and misuse of the pavement sustainability concept

Some of the state DOTs, counties, and cities started to incorporate sustainability concepts into their pavement operations and management processes. Although it is possible to achieve a more sustainable pavement system by constructing longer-life pavements, stronger/thicker pavements do not always mean less impact on the economy, environment, and society. Similarly, although increasing recycled asphalt pavement content by sacrificing a significant level of pavement performance can reduce the upfront paving costs, this strategy may hurt the environment more in the long run by resulting in more frequent paving due to reduced pavement performance. In addition, just focusing on certain stages of the pavement life-cycle and not considering the entire life-cycle for the development of pavement management strategies can lead to critical mistakes that can discourage the implementation of pavement life-cycle assessment (LCA)

methods in the decision-making. Different industries (or research programs funded by them) can develop methods to calculate the environmental impact of their product based on just one of the life-cycle stages in order to create the most marketing benefit for their industry. This bias can provide misleading information for policymakers and result in long-term issues in pavement engineering. For all these reasons, universities with unbiased and talented researchers should direct agencies, decision-makers, and the industry into a path that will provide the highest level of benefits for the economy, society, and environment by avoiding technical mistakes and misconceptions.

4.3. The increasing complexity of paving materials and risks of implementing new performance-based specifications

Pavement materials are continuously evolving and improving. Several different types of chemical additives, recycled materials, fibers, rubber, plastics, polymers, and several other materials commonly used in today's asphalt and concrete paving mixtures and tack coats (asphaltic emulsions used to bond layers together) are increasing the complexity of the characterization of long-term material performance. For these reasons, outdated mixture and structural design methods that were developed for simpler materials several decades ago do not provide reliable performance estimates for today's more complex paving materials. This problem started to direct researchers to develop balanced mix design and performance-based specifications for asphalt and concrete mixtures all around the nation. Although new experimental procedures for pavement material characterization and design are providing significantly more accurate performance estimates than the existing procedures, their implementation carries a significant level of risk for the state DOTs. A strong relationship between academia, industry, and the DOT should be established in order to eliminate those implementation risks.

4.4. Not having some cities and counties included in the implementation and development game

Although the length of the roadway network managed by cities and counties is always significantly larger than the network managed by the state DOTs (about 5 times larger in Oregon while 4 times larger in California), specifications and quality control procedures are not always followed by all the local governments' public works departments to ensure the construction of high-quality pavement structures. Since the majority of the cities and counties do not have research sections, they do not always follow and implement research and development activities performed by state DOTs and the FHWA. However, training the public works departments of cities and counties to have them follow the most recent specifications and design methods is a vital task to achieve the ultimate state roadway network performance. The City and County Pavement Improvement Center (CCPIC) developed by the University of California Pavement Research Center (UCPRC) is an exemplary effort trying to create communication between academia, the state DOT, and the cities and counties. Establishing this type of platform for Oregon can result in significant improvement in pavement engineering by clearly pointing out the contributions of research and development at the entire roadway network level.

4.5 Reduction in the skilled paving workforce in the U.S.

My experience working with students over the past 15 years made me realize that the only way to attract the attention of younger generations is to show them the innovative and technology-based side of pavement engineering. For this reason, in the courses that I teach, I talk about pavement testing technologies and advanced procedures that are followed to characterize existing pavement performance and predict the long-term performance of pavements. I also have laboratory and field testing sessions in those courses to provide

hands-on experience and further attract the attention of the students. This approach allowed me to recruit the best undergraduate research assistants. Some of those undergraduate students decided to continue as graduate students after getting their undergraduate degrees and now working for the paving industry, ODOT, and some cities and counties in Oregon and California.

Not having a similar process established in K-12 education keeps the people who will never get a college degree away from the paving industry. Without having any information about the technologies used during pavement construction, the majority of the high school graduates who could have become skilled workers in the paving industry are choosing to work in other fields. By reaching out to K-12 students and educators, the benefits of working in the paving industry and the technology-based paving procedures in today's world should be clearly conveyed to the younger generations. The suitability of today's paving industry for female workers and engineers should also be emphasized in order to reduce the current gender gap, which will ultimately lead to an increased number of skilled workers in the industry. Increasing work-zone safety and reducing the suicide rates (second highest industry in terms of suicide rates in the U.S. according to the recent CDC report) in the construction and paving industry should be another objective in order to attract more skilled workers.

We should always remember that **construction is the most challenging and critical stage in the pavement life-cycle to achieve long-lasting structures**. Spending millions of dollars for research and development, purchasing the highest quality construction and test systems, recruiting the best pavement engineers, and having the best pavement management systems and strategies can never result in the highest quality pavement systems unless construction is done properly by high-skilled workers. **Without high-quality construction, contributions of advances in pavement engineering will never be visible.**

4.6. Lack of public knowledge regarding the importance of pavement research and sustainability

The major problem of today's democracies is the possible rapid change in public opinion on scientific facts by misleading and politically biased information. The major reason for this problem is the lack of public knowledge on certain issues. Although some people with significant work and life experiences may use critical thinking and reasoning to separate fact from fiction, people without experience and necessary knowledge may be more likely to believe in scientifically unsupported statements about sustainability. For these reasons, universities should be more involved in teaching the concept of sustainability and fundamental environmental issues to K-12 students and the public. This connection between K-12 and universities can be created by invited talks, university laboratory visits, and simplified laboratory experiments conducted by K-12 students related to general sustainability and sustainability in pavement engineering. Details of the process that OSU-AMaP will follow to reach the public and the K-12 are discussed in Section 5.5.2.

4.7. Limited research and strategy development on pavement resiliency

Extreme flood events, storms, wildfires, potential earthquakes, and associated tsunamis are threatening the pavement infrastructure and the post-disaster transportation system. The impact of climate change on the environment and the resulting impact on pavement structures should also be a part of the agency's decision-making processes. Post-disaster transportation system conditions and the following needed rapid construction should be carefully evaluated for the high-risk regions. Although advanced pavement performance prediction and design models and software packages are available in the literature, none of these models were developed and calibrated to address potential pavement condition and performance issues after a disaster. Selecting the most effective pavement recovery strategies (*which range from thin asphalt overlays with thick aggregate base layers to the use of geosynthetics and other interlayers*) after a

disaster has immense importance. A detailed pavement recovery plan (*including communication with plants and the capability to quickly start paving material production after a disaster*) after a disaster needs to be prepared and implemented in order to open those critical lifelines to traffic as soon as possible.

4.8. Lack of communication with researchers from other fields to address today's issues

Pavement engineering has a multi-disciplinary nature due to the components related to: i) numerical modeling; ii) laboratory and field testing; iii) statistical modeling; iv) technology development and systems modeling; and v) life-cycle cost analysis and life-cycle assessment. This multidisciplinary nature requires interaction and collaboration with researchers from other fields (such as statistics, electrical, mechanical and computer engineering, chemistry, environmental sciences, and other areas in civil engineering) to be able to develop permanent solutions to major issues. Solutions for fundamental pavement engineering problems can sometimes be developed at a lower cost with minimal effort by using off-the-shelf products. However, to be able to identify the potential solutions to pavement engineering issues with minimal effort, strong collaborations with different areas are required. Knowing the importance of collaboration with diverse fields of research, my research group and I collaborated with: i) Molecular and cellular biology; ii) Medical engineering; iii) Electrical and computer engineering; iv) Mechanical engineering; v) Forestry; and vi) Toxicology departments within the last 10 years to find solutions to fundamental pavement engineering problems. Developing an online platform to create other collaborations to find solutions to fundamental pavement engineering issues can be effective in the long run (See Section 5.5.4).

5. STRATEGY AND TASKS FOR ADDRESSING THE FUNDAMENTAL PROBLEMS OF PAVEMENT ENGINEERING

The major objective of OSU-AMaP research group has always been addressing pavement-related issues by not only considering the cost but also incorporating the social and environmental factors. Our research has been focusing on diverse areas in pavement engineering, including technology development for QA, laboratory, field, and accelerated pavement testing, numerical modeling, life-cycle cost analysis, environmental impact assessment, and development of a path for the implementation of all our research findings. In my future career as the director of the OSU-AMaP research group, I am planning to develop a procedure that incorporates all these components in one design and strategy selection process. My general plan with critical research and development components is summarized in Figure 1 below on a pavement life-cycle that includes designing the pavement structure and material followed by material production, construction, use, maintenance, and end of life phases. The strategy and tasks described in this section for addressing the problems described in the previous section (Section 4) are shown in a diagram in Figure 2.

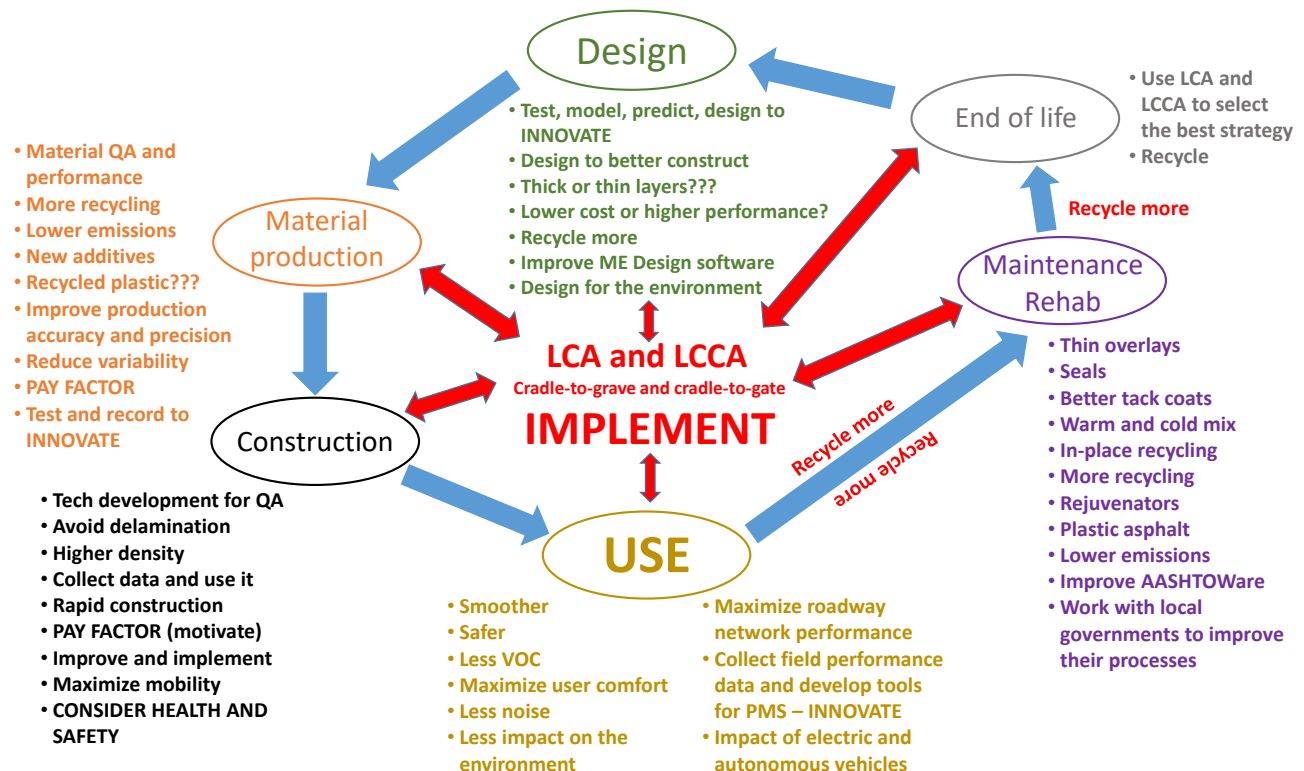


Figure 1. Pavement life-cycle with potential research and development areas and ideas

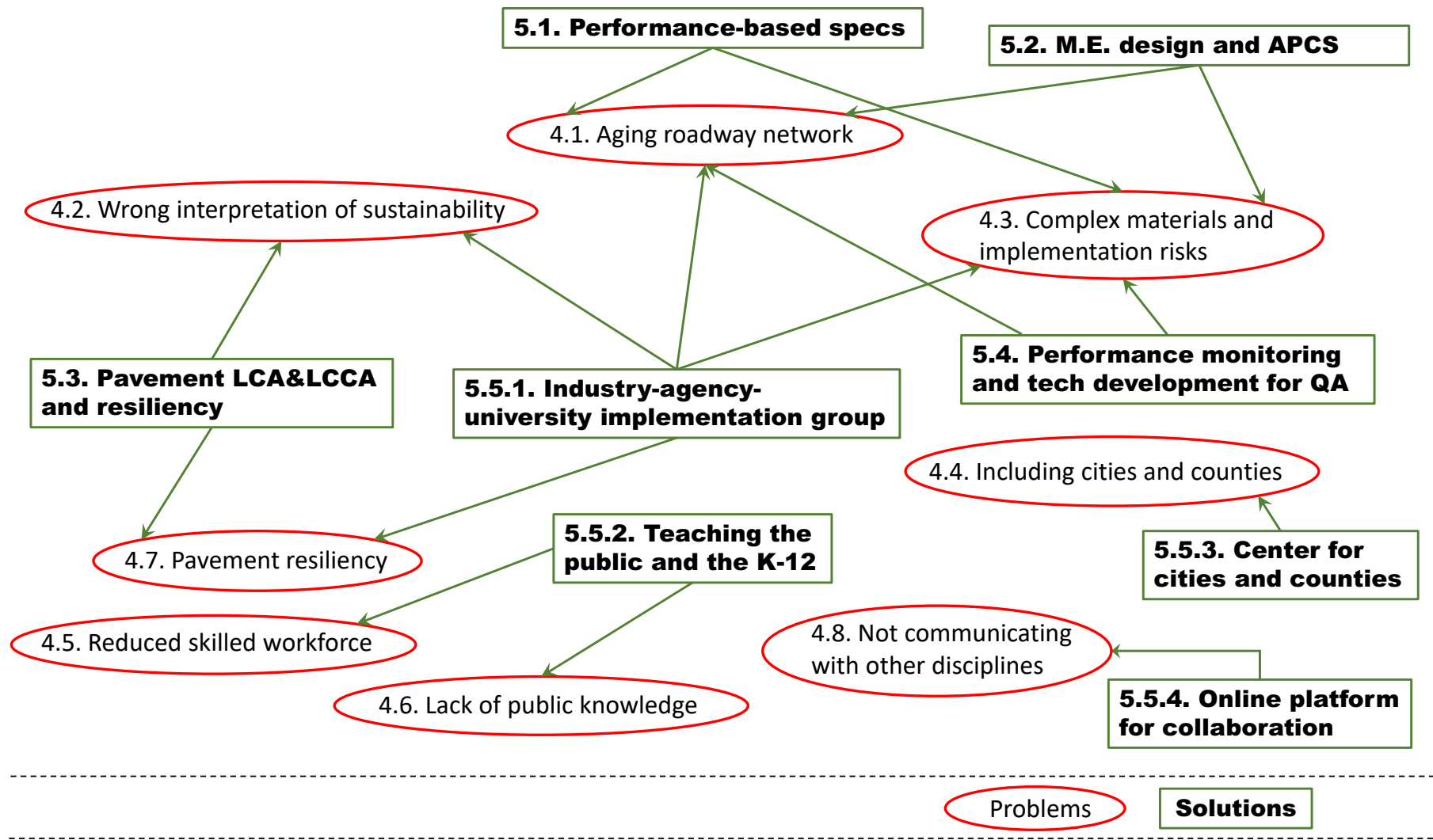


Figure 2. Strategic issues in pavement engineering (described in Section 4) and tasks for addressing them (described in this section - Section 5)

5.1. Development of performance-based specifications and a comprehensive materials database

To reduce cost and improve long-term performance, several new chemical additives, polymers, rubbers, fibers, and high-quality binder and cement types are incorporated into the paving mixtures today. Current concrete and asphalt mixture testing and design methods are not capable of capturing the pros and cons of using all these new technologies for long-term performance. Furthermore, the interactions of cementing materials with recycled materials and chemical additives are still not well understood. Due to all these complications related to the more complex structure of today's pavement materials, simple volumetric evaluations to maximize in-situ performance may not result in reliable material designs. For all these reasons, procedures to incorporate performance tests into the current material design and quality assurance (QA) methods should be developed. Using the test results from complex asphalt and concrete mixtures, comprehensive material databases with several mixture and performance parameters should be developed. New methods to increase recycled materials (including rubber, asphalt, and plastics) in pavement materials should also be developed by using innovative methods and field, laboratory, and accelerated pavement testing.

5.2. Mechanistic-Empirical pavement design and Automated Pavement Condition Surveys (APCS)

Predicting the long-term performance of pavement structures by advanced mechanistic-empirical design methods and using time series analysis based on the past performance data from Pavement Management Systems (PMS) has been a major objective of our past research. Performance outputs can be used to develop long-term and short-term plans and strategies. Accuracy of the predicted long-term performance and the associated service lives also have immense importance to be able to achieve reliable predictions from life-cycle assessment (LCA) and life-cycle cost analysis (LCCA). AASHTOWare software (*a software package with several tools and models to predict pavement performance by considering climate, traffic, and material properties*) and the associated design procedures have been one of the most powerful methods for long-term pavement performance prediction and decision-making. Advancing the capabilities of AASHTOWare by increasing field calibrations using the APCS data to achieve more accurate performance predictions is expected to result in a more effective decision-making process. Using the advanced materials database (from Section 5.1 above), performance and service life prediction precision and accuracy at the material and structural level can also be significantly improved.

5.3. Pavement LCA and LCCA for decision making and policy design and resiliency

Pavement LCA and LCCA have been long-neglected components in pavement engineering. In collaboration with other faculty members and researchers, our research group's goal is to develop methods and implement them to incorporate those two important concepts into the decision- and policy-making processes. By integrating the findings and models from Sections 5.1 and 5.2 above with the developed LCA and LCCA tools, it is possible to achieve the design and decision-making processes that actually balance economic, environmental, and social factors in a sustainability-based framework.

Several environmental issues related to climate change, such as droughts, wildfires, heatwaves, and storms, started to control our daily lives. We strongly believe that by following and implementing scientific principles, it is still possible to mitigate these issues by collectively working together to turn it into a success story similar to the "preservation of the ozone layer" movement back in the 80s and 90s (although climate change is a more complicated problem). However, in addition to the scientific revolution to improve environmental efficiency, a permanent solution to this complex issue also requires significant changes to our lifestyles, education system, and a reduction in our personal energy use and carbon footprint.

Considering the current impact of climate change on the environment, enhancing the resilience of pavement structures to extreme events has immense importance. The impact of climate change (changes in

temperatures and the frequency of flood events) on pavement performance and life-cycle should be modeled by using mechanistic-empirical design methods. Pavements should be designed by considering changing conditions. The vulnerability of existing structures to future events should be modeled to develop an action plan in the event of an environmental change (such as the extreme heatwave that happened in Oregon in 2021) or a disaster. The development of rapid pavement construction and planning tools to be used in the event of a natural disaster to quickly open critical roadway sections (“lifelines” of cities) to traffic is another critical research item.

5.4. Long-term performance monitoring and technology development for construction and material production QA and planning

Quality assurance at the material production and construction stages directly controls the long-term performance of pavements. Implementing the best material and structural design methods does not always provide the highest long-term performance when there are issues at the material production and construction stages. For this reason, we would like to continue developing methods and technologies (*such as the OreTack technology series for construction QA and the performance-based plant QA process developed for asphalt mixtures*) to address the need for QA at those stages. Implementing our tack coat and pavement material testing technologies and procedures at the national and international levels is one of our major goals. Developing a practical but effective QA test for asphalt and concrete materials’ performance quantification during construction is another major objective of our future research. Improving and implementing the construction planning software tools (such as the CA4PRS tool) to analyze pavement rehabilitation strategies and select the best alternatives will be another integral part of our research program. Implementing all those methods, software packages, and test technologies in a pay factor analysis approach to reward or penalize producers and contractors for maximizing construction and material production performance can be a game-changer for the agencies.

5.5. Listen, Understand, Innovate, Solve, and Implement - Working closely with the industry, FHWA, DOTs, local governments, and other researchers

Connecting with the industry and government agencies, understanding their needs, and addressing their problems with innovative research products have been our major objectives. We think that the key to addressing their issues is to first carefully listen and understand the problems with all components and potential complications. Developing innovative solutions (such as the OreTack technology series that we developed to address the pavement delamination issues in Oregon) to solve the problem will follow. Developed innovative solutions and technologies should be tested in the actual process to quantify their effectiveness. Something working very well in a laboratory or theoretical setting may not work when it is implemented. For this reason, deploying the developed processes and technologies in the problem areas and monitoring their effectiveness before implementation is critical. After performing modifications, the developed process can be confidently implemented. Identifying the risks, costs, and benefits of the developed process is another important step to achieving a successful implementation by also satisfying the needs of the industry and government agencies. To be able to achieve the most effective policy and process implementations, it is absolutely critical to creating strong communications with the industry, FHWA, DOTs, and local governments.

5.5.1 Forming an industry-agency-university implementation group

Developing a useful product or process does not always mean that it will provide the highest levels of benefits for all stakeholders. Issues and disagreements throughout the implementation stage can easily lower the positive contributions of the final implemented product or process. For this reason, more research effort, time, and resources must be spent on the implementation stage to harvest the maximum level of benefits and minimize risks for all stakeholders. A strong relationship between

academia, industry, and the DOT should be established in order to eliminate those implementation risks. If one of these three entities is not contributing enough to the implementation process, it is likely that successful implementation cannot be achieved. It should be noted that even minor failures at the early implementation stages may quickly discourage the implementation of important pavement quality control/assurance and design procedures. For this reason, specification implementation stages should be carefully analyzed by all three entities, and implementation should occur in a controlled manner by reducing the risk of failure at the early stages. For this reason, an industry-agency-university implementation group should be created to facilitate productive discussions before research work moves into the implementation phase. However, it is important to note that the major objective of this advisory group would be to inform the Agency's decisions, but it would not have decision-making authority on behalf of any agency or entity.

5.5.2 Forming an “instructor team” to teach the importance of pavements and OSU’s pavement research to the public and the K-12 students

To address the issues described in Sections 4.5 and 4.6, an instructor team will be formed from the members of OSU-AMaP and interested ODOT and industry members to teach the importance of pavements and pavement-related research to the public and the K-12 students. The instructor team will organize OSU facility visits for K-12 students. Students will also be invited to the accelerated pavement test sections that are planned to be constructed during the summer of 2023. The instructor team will also visit K-12 schools to talk to the students about the importance of pavements and pavement engineering. During those visits, the technology-based side of pavement engineering will be demonstrated by performing the Falling Weight Deflectometer (FWD), the 3D Transverse Profiler (which will be purchased this year), and other field tests in front of the students. By reaching out to K-12 students and educators, the benefits of working in the paving industry and the technology-based paving procedures in today's world can be clearly conveyed to the younger generations. The suitability of today's paving industry for female workers will also be emphasized by including current female workers and pavement engineers in the process. In the long run, this approach is expected to reduce the negative impact of the skilled worker shortage issue on the paving industry by creating more interest in joining the paving workforce. Ultimately, this approach is also expected to create a more skilled and diverse workforce for the OSU-AMaP and other government agencies.

OSU-AMaP is also planning to reach out to the general public via websites, webinars, and in-person talks (at almost no cost). Social media tools will be used to publicize those events. In this way, a positive public opinion about pavement research and sustainability is expected to be created. This “inspired” positive opinion can be a “game-changer” for the transportation agencies and the paving industry by increasing public support for tax laws. Showing the public that *“the savings in vehicle operating costs created by improving pavement performance can be higher than the current gasoline taxes”* can reduce the rejection of critical paving tax laws by the voters. Increased public support is also expected to trigger more political will to improve the condition of the pavements in Oregon. Making the public understand the positive impact of pavement engineering and research on environmental issues would be another major contribution.

5.5.3 Developing an improvement center for cities and counties in Oregon

A city and county pavement improvement center (similar to the one developed by UCPRC in California) will be developed for Oregon. The center will have members from academia, industry, and government agencies, including ODOT. OSU-AMaP research group will develop a website with current performance and method specifications followed by ODOT. Online training courses will also be developed and provided for the city and county public works to facilitate the implementation of those specifications. In-person training sessions, workshops, and talks will also be organized

periodically (which can be provided by OSU and the paving industry) to help cities and counties implement the current methods followed by ODOT and FHWA. Best practice documents and technical briefs will also be provided for the local governments through the developed website and other online platforms. Successful implementation of the most effective method and performance specifications for the design, construction, and material production stages are expected to create major performance improvements on roadways managed by the cities and counties in Oregon.

5.5.4 Creating an online platform to increase collaboration with researchers from other fields

An online platform will be developed to connect researchers from several different disciplines for solving today's fundamental issues. Due to the multi-disciplinary nature of pavement engineering, OSU-AMaP research group has already been collaborating with several research groups in and out of OSU (See Section 4.8). First, those existing collaborators will be invited to initiate the online platform. The platform is expected to expand rapidly by reaching out to several other potential collaborators and also the collaborators of the existing members. A newsletter will be released every 6 months to report the successful collaborations created by the platform (with brief stories) to encourage the enrollment of more members. Collaborators from this platform will also be encouraged to give talks for K-12 students and participate in the "instructor team" described in Section 5.5.2.

6. CURRENT CAPABILITIES OF OSU-AMaP LABORATORY AND POTENTIAL FUTURE IMPROVEMENTS

OSU-AMaP laboratory is equipped to conduct modeling and testing in several areas of pavement technology, including asphalt binder and mixture characterization, aggregate characterization, asphalt mix and structural design, advanced numerical modeling, mechanistic-empirical design and service life prediction, life-cycle cost analysis, environmental impact analysis and pavement life-cycle assessment, field and laboratory testing for implementation, and development of construction quality control technologies and systems.

Research conducted at OSU-AMaP laboratory encourages the use of more sustainable pavement materials, such as permeable pavements, rubber asphalt, warm-mix asphalt technologies, rejuvenators, recycled asphalt pavements, and other sustainable technologies. The laboratory is also equipped with computational modeling tools to investigate possible applications of pavement design strategies that can have a considerable impact on fuel consumption, vehicle maintenance costs, greenhouse gas (GHG) emissions, and life-cycle costs. The laboratory and the field test systems enable researchers to develop research programs to study pavement materials at both the applied and basic research levels.

The only major missing capability of the OSU-AMaP research group is the full-scale Accelerated Pavement Testing (APT). Most APT systems cost several million dollars and require significant funding to keep them operational (about \$1,000 to \$3,000/day). Due to the current funding limitations, the AMaP research group is planning to build a lower-cost portable APT system that will require only one person to operate and collect data. The developed system is expected to cost less than \$200,000 and will just require a fraction of the operating cost of full-scale APT systems. Test sections are expected to be constructed at the exit of different asphalt plants, and constructed pavement will be loaded with the developed low-cost APT system and the truck traffic (loaded) exiting the plants. A 3D Transverse Profiler system will be purchased to periodically collect rutting, cracking, and roughness data from the test sections to quantify the damage created under vehicular loads. Truck weight data will be collected at the static weigh stations available at the exit of plants. Axle configurations of all passing vehicles will be determined by installing electronic vehicle classification systems available in the market. A portable climate station will also be placed near the test sections to collect temperature, rainfall, wind speed, solar radiation, and other required information to determine the impact of climate on pavement performance. [Strain and pressure gauges](#), accelerometers,

and [several other wired and wireless sensor systems](#) will also be installed on the test sections to monitor the performance of the pavement under applied vehicular loading to quantify the long-term performance of the pavement materials and structures. **With the recent financial support received from OSU**, the AMaP research group started the process of acquiring all the required technologies to make this portable APT system available for research soon. With the funding from the ODOT Research Project - [SPR 852](#), an experimental section for the developed low-cost APT will be constructed during the summer of 2023. By comparing the results from the APT tests to the measured field performance, the effectiveness of the low-cost APT system will be validated.

This low-cost APT system and the associated process are expected to revolutionize the current full-scale pavement test methods by providing an alternative to the current multi-million dollar APT systems available in the market. This system and the process will also **help develop a more inclusive environment for the competitive national research grant applications** for research groups with limited research and development budgets by providing a full-scale test system that can be developed and operated at a fraction of the cost of the current systems.

OSU-AMaP research group recently received additional space from OSU to expand the current laboratory. This space expansion is expected to improve the productivity of the research laboratory by providing additional space to build a second asphalt mixture preparation, oven aging, and compaction area. In addition, new space will be used to house a second hydraulic test system to improve the testing capabilities and the productivity of OSU-AMaP laboratory. Additional space is also expected to help create a more suitable environment for dust and fume control in the research laboratory to provide a more suitable environment for students and researchers. Once this additional space is acquired and move-in completed, a 3D Virtual Tour of the laboratory will be prepared and shared with the industry and government agencies (including cities and counties in Oregon and ODOT). The updated laboratory will also be used for teaching and outreach by organizing visits from K-12 schools, other universities, the asphalt industry, cities, counties, and other stakeholders.