



May 10-12, 2017 // The Broadmoor
Colorado Springs, CO

STAR Symposium Report

Strategic Asphalt Research Symposium Report

May 10-12, 2017
The Broadmoor, Colorado Springs, CO

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The mission of the Asphalt Institute Foundation is to conduct strategic research and educational activities that are designed to advance and improve the liquid asphalt industry.

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The logo for ExxonMobil Imperial features the word "ExxonMobil" in red and blue, followed by "Imperial" in blue. Above the "i" in "Imperial" are three blue stars of varying sizes, arranged in a slight arc.

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Executive Summary

The Strategic Asphalt Research (STAR) Symposium was the seminal event fostered by the Asphalt Institute Foundation (AIF) Research Committee to fit within the objectives of the AIF – to conduct strategic research and educational activities that are designed to advance and improve the liquid asphalt industry.

The purpose of the STAR Symposium was to instigate and stimulate conversation about over-the-horizon issues expected to affect the asphalt industry over the next two decades. In this alone, the inaugural symposium was a great success – starting a discussion that is expected to last years into the future, which will grow and branch into new directions.

The objective of this report is to capture the discussion that occurred at the STAR Symposium and its interactive

sessions to create a reference from which further conversations and initiatives can be launched. From these first steps, the AIF Research Committee, in conjunction with the AIF Board of Directors, expects to facilitate the continued discussion and growth of those innovation visions that will drive future strategic research initiatives.

To ensure a successful symposium, one hundred forward-thinking individuals from across North America and Europe – the “STAR 100” – were invited and participated in the inaugural event on May 10-12, 2017, at The Broadmoor Hotel in Colorado Springs, Colorado. Attendees collaborated in interactive breakout sessions on economics, performance, sustainability, and worker issues. At the end of the symposium all the attendees gathered to participate in a final “brainstorming session” to pick up any key ideas that perhaps

did not fit neatly into one of the other sessions.

Before reading further

Consider that the purpose of the STAR Symposium was to start the conversation on “strategic research and educational activities that are designed to advance and improve the liquid asphalt industry.” As part of that conversation, many ideas were presented – some strategic, some less so. Regardless, all the ideas were captured within the pages of this report. To try and briefly summarize the discussion for any given session necessitates isolating what the participants as a whole felt were main themes; this is accomplished in the following paragraphs and is presented to provide a flavor for the symposium. The reader is encouraged to read the whole report as the next great idea could be waiting in the pages that follow.

THE PURPOSE OF THE STAR SYMPOSIUM WAS TO INSTIGATE AND STIMULATE CONVERSATION ABOUT OVER-THE-HORIZON ISSUES EXPECTED TO AFFECT THE ASPHALT INDUSTRY OVER THE NEXT TWO DECADES.

The breakout session on **economics** began with the facilitator asking the attendees to consider the following questions: What impacts the economic viability of asphalt? What does that mean to you, to your business and to this industry? Following discussion, the group identified some common themes that had been discussed and were considered important. They are described below, in no particular order:

- What are the factors that will affect asphalt supply and the quality of crude, and how do we address those threats?
- Important that we map the web (supply, demand, communication, customers, funding) and define the value for each in the web. Also, we should look for new partners.
- Why haven't we been successful with our current agency purchase model (low bid)? What new procurement methods could be used to drive innovation, new technologies and ultimately quality?
- Messaging/communication/ value from all asphalt organizations. Shoot for one message.
- How can we use performance-related specifications and performance measures in asset management to change the economics of asphalt?
- How do we educate local engineers and the public?

The facilitator for the breakout session on **performance** began by noting that the attendees should not necessarily be looking

for answers at this time, even though it could be beneficial. Rather, the issue at question is the need to address the future performance of asphalt and the factors expected to affect it in 10-20 years. Following discussion the group identified some common themes that had been discussed and were considered important:

- How will roads and roofs be used in the future?
- What are the properties of asphalt binder that impact the performance of the end product (i.e., mix)?
- Can we design/engineer a more durable asphalt binder?
- How do we accelerate the innovation and implementation process?
- How do we influence regulators and product specifiers in a better and faster manner?

In the breakout session on **sustainability** the facilitator opened the session by asking the attendees to consider the following question: What does sustainability mean for the asphalt industry (for your business, from your perspective)? Following discussion the group identified some common themes that had been discussed and were considered important:

- Education/Marketing/ Communication – How do we market, educate and promote the sustainability, good science, and good use of asphalt to improve the reputation of asphalt and our industry

(to stakeholders, to the public, to young talent)?

- Ecosystem of others – How do we work with ancillary industries to find best practices to be more sustainable than alternative pavement materials (concrete)?
- Measurement systems – How to participate in standardizing rules on Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA) that provide a level playing field for pavement materials?
- Innovation – How do we maximize the sustainability of asphalt, from cradle to grave, leveraging existing developments and innovations?
- Future – What barriers/ requirements will exist 20-30 years around sustainability and what role do we play?
- Logistics – How can asphalt/ crude oil be moved further and at lower cost with less impact to the environment, and with no impact to quality?

The breakout session on **worker issues** began with the facilitator encouraging the attendees to think about things

that the industry can do now that will have an impact on workers individually and the workforce as a whole in 10-20 years or more. Following discussion the group identified some common themes that had been discussed and were considered important:

- There will be a different workforce in the future. How can we improve the attractiveness of the industry to workers in the future? We need to improve our educational efforts.
- What will the workplace look like 20 years from now? How will that affect the asphalt industry? We need a safe workplace for all workers.
- Can we economically engineer the “bad actors”, like H₂S, out of asphalt?
- How can we increase the public perception of the asphalt industry?
- What are the risks of recycled materials and additives added to asphalt binder and their impact on health effects?

For the final **brainstorming** session, the facilitator challenged

the group to think 10-20 years out and to offer items that did not get addressed or fit into the other four breakout sessions. Following discussion the group identified some common themes that had been discussed and were considered important, as follows:

- International specifications to create greater consistency across borders.
- Dual path scenarios to create multipurpose functions and revenue opportunities.
- Influencing decision makers to create a business environment that is favorable for asphalt.
- Asphalt as an infinite resource – we need to know what is going to happen with it.
- Global trends in other parts of the world to best position the industry to respond to needs.
- Influencing demand growth.
- Research on future paths for demand including a review of trends in transportation, energy and other sectors done by other research institutes to increase asphalt demand growth.

A Message from the 2017 STAR Symposium Chairman

It was a great honor to serve as Chairman of the Asphalt Institute Foundation's Strategic Asphalt Research (STAR) Symposium. This inaugural event served as a unique opportunity to assemble industry experts from across the globe to activate innovative thinking, creating a roadmap for continued industry success 10-20 or more years from now.

It's imperative that we join forces – not with individualized plans – but fostering an environment where we congregate under a big umbrella where transparency builds trust. Some would say that it's easier to walk alone under your own umbrella, however, I would contend that it is much easier to follow one large umbrella, rather than many small umbrellas going in different directions. This is also more economical and you can have the best available experts walk alongside the group for the journey. In this setting, we are not alone but part of a much bigger picture. Under this larger umbrella, we can invite

others along the way, effectively communicate, assign tasks and assume responsibilities that determine a plan of action.

The STAR Symposium is the start of a new roadmap for our industry. Through this initiative, the Asphalt Institute Foundation established a forum in which participants could discuss a vision of where we need to be going, as well as identifying important research areas needed to get us there.

The outcomes of the STAR Symposium will give guidance on strategic research for the Foundation and others. During the three-day event, it gave 118 individuals a new perspective and plenty to further consider. Discussions and insight shared can now serve as a menu of potential areas of study.

While impressed, I was not surprised by the level of active and inspired participation at the inaugural STAR Symposium. I commend the Asphalt Institute

Foundation Board of Directors, Research Committee, and staff for their visionary leadership with this event.

I look forward to following the development of the strategic work and I am sure that in the next symposium we can summarize progress.



Martin Carlson
2017 Chairman
Asphalt Institute Foundation
STAR Symposium
(Nynas, Retired)

A Message from the 2017 AIF Chairman

The origins of the Asphalt Institute Foundation go back almost a decade when the industry was focused on preparations for the International Association for Research on Cancer (IARC) Monograph Review of Asphalt. The entire industry was engaged in this critical issue that had the potential for serious impact on our future. At the time, post an uncertain IARC outcome, visionary industry leaders were asking, “*What are the asphalt industry’s needs for the long haul?*”

The Asphalt Institute, working alongside industry leaders, have a longstanding ability to address current tactical threats and opportunities. The concept of the Asphalt Institute Foundation was born from a need to adequately address the “over the horizon” sustainment of the industry.

Change is a constant for the asphalt industry. Technology is advancing at a rapid pace. Social and economic trends continue to evolve. Increased competition has the asphalt industry squarely in its sights.

A famous quote from a former United States Secretary of Defense reads: “*There are known knowns. These are the things we know we know. There are known unknowns. That is to say, there are things we know we don’t*

know. But there are also unknown unknowns. There are things we don’t know we don’t know.”

The asphalt industry works tirelessly on what **we know we know** and the items **we know we don’t know**.

Thus, the Asphalt Institute Foundation allows our industry to stretch over the horizon and contemplate those things we don’t know, as we work towards sustaining the industry through those uncertainties.

Since its inception in 2014, the Foundation is a 501(c)3 non-profit public charity closely affiliated with the Asphalt Institute. The Foundation’s mission of conducting strategic research and educational activities designed to advance and improve the liquid asphalt industry complements the Institute’s tactical focus.

To accomplish its mission, the Asphalt Institute Foundation is comprised of a board of directors and five committees. The task force of volunteers and staff who assisted in creating the Foundation, as well as serving in key roles, are the heart of the Foundation. Furthermore, the generous individuals and companies who have served as active donors to the Foundation share its vision and embrace

leaving behind a legacy that will support future leaders in the asphalt industry.

I want to commend the leadership of the Asphalt Institute Foundation’s Research Committee members and Greg Malarkey, Malarkey Roofing Products, who serves as the committee’s chairman. Over the past two years, these individuals have worked diligently in planning AIF’s inaugural Strategic Asphalt Research (STAR) Symposium. This event – a first of its kind for our industry – will have ripple effects in the years to come as the Foundation seeks to build upon the ideas in this report to innovate for the future.



Ralph D. Shirts
Chairman
Asphalt Institute Foundation

A brief history of the Asphalt Institute Foundation

THE ROLE OF THE ASPHALT INSTITUTE FOUNDATION IS STRATEGIC IN NATURE – AND PURPOSEFULLY SEEKS TO ADDRESS THE LONG-RANGE NEEDS OF THE LIQUID ASPHALT INDUSTRY AND PROVIDE EDUCATIONAL PROGRAMS.

The Asphalt Institute Foundation (AIF) was formally established as a non-profit public charity on June 4, 2014 under section 501(c)3 of the U.S. Internal Revenue Service tax code following several years of discussions among Asphalt Institute members. Meant to be complimentary to the Asphalt Institute’s mission, the AIF focus is that of Strategic Research and Education. The foundation’s mission statement reads:

“To conduct strategic research and educational activities that are designed to advance and improve the liquid asphalt industry.”

The Asphalt Institute’s areas of strategic focus include, in part, both technical leadership and educational expertise and yet these are purposefully focused on current research, performance improvement, and educational efforts aimed at today’s industry professionals.

However, the role of the Asphalt Institute Foundation is strategic in nature – and purposefully seeks to address the long-range needs of the liquid asphalt industry and provide educational programs which not only improve pathways for professionals to enter the industry but to improve the educational opportunities for professionals seeking an asphalt career.

The foundation is led by an eight-person board of directors and is tied to that of the Asphalt Institute in several ways. The Chairman of the Board of the foundation is appointed by the board of directors of the Asphalt Institute and the Vice Chairman of the Asphalt Institute serves on the board of the foundation. This leadership alignment ensures support and focus for the foundation long term.

The foundation’s work is accomplished through the efforts of five committees;

two of which are operational committees; Research and Education. The Research Committee for 2017 consisted of the following individuals:

Greg Malarkey, Chairman
Malarkey Roofing Products

Gaylon Baumgardner
Paragon (Ergon Asphalt & Emulsions)

Tom Bertsch
Calumet Specialty Products Partners, L.P.

Steve Buckner
Flint Hills Resources, LP

Brian Wilt
Marathon Petroleum Company LP

John Brownie
Imperial Oil (ExxonMobil)

Laurand Lewandowski
Owens Corning Science & Technology, LLC

Rajesh Ranjan
CertainTeed Corporation

Hassan Tabatabaee
Cargill Industrial Specialties

Rick Holmgreen
Asphalt Institute Emeritus (Shell – retired)

Ralph Shirts, AIF Chairman (Ex-Officio)
ExxonMobil Fuels and Lubricants Marketing

Mike Anderson (Ex-Officio)
Asphalt Institute

Mark Buncher (Ex-Officio)
Asphalt Institute

As a non-profit public charity, the foundation relies fully on financial contributions to achieve its mission. Long-term plans include

building a sufficient endowment to accomplish its goal. In the meantime, contributions and fundraising activities both work toward this objective and enable the foundation to achieve initial success – holding a first STAR Symposium is one example.

Much more about the foundation and opportunities to participate can be found on its website at www.asphaltfoundation.org

Vision for the STAR

Early on, the foundation’s board and research committee saw an acute need for a gathering of key professionals from across the globe to meet and discuss the industry’s long-range challenges and opportunities. Not meant to develop complete research needs statements, nor to solely focus on technical matters, the symposium’s vision from the onset was to create the catalyst for leapfrog thinking for the discussions which would lead to breakthrough ideas and research for an exciting tomorrow in our industry.

The symposium’s title, STRategic Asphalt Research (STAR) Symposium, was meant to capture this vision for participants and the inaugural event was set for May 10-12, 2017 at The Broadmoor Hotel in Colorado Springs, Colorado.

The STAR 100

Gathering a select group of industry professionals from across the globe became an

important element of the STAR’s planning for success. By limiting attendance on an invitational basis, organizers could help ensure industry, government, academia, consultants, associations, and other groups were proportionally represented. Further, the STAR 100, as it was coined, would make the conference manageable in terms of numbers of participants, while certainly adding to the prestigious nature of the event.

To achieve this, the AIF Research Committee invited nominations for consideration to attend the STAR. The “request for nominations” were open, meaning individuals could be nominated by others, or they could self-nominate. The research committee also encouraged allied organizations to submit nominations to attend the STAR. Nominations were sought from all sectors of the industry – and specifically, Asphalt Institute members, Eurobitume, European Asphalt Pavement Association, National Asphalt Pavement Association, Foundation for Pavement Preservation (FP2), Asphalt Emulsion Manufacturers Association, Asphalt Roofing Manufacturers Association, Association of Modified Asphalt Producers, and many universities, public agencies and consultants were among those notified.

Following receipt of nominations, the research committee evaluated the nomination pool and subsequently extended

invitations to register for the STAR Symposium. This was performed on an iterative basis over time until the “STAR 100” was achieved. Asphalt Institute staff and AIF Board and committee volunteers were additive to this number.

Approximately 118 attendees participated in the STAR and were from a cross-section of the world including 32 U.S. states, the District of Columbia, as well as 8 countries including Canada, France, Germany, Mexico, the Netherlands, Spain, Sweden, and the United Kingdom.

The STAR Symposium attendance list including attendee names, titles and organizations they represented are listed beginning on Page 50. As AIF Research Committee Chairman Greg Malarkey stated in his opening remarks: “...this is the Google of asphalt.”

The STAR Symposium Program

The facilitated agenda for the STAR was broken into four separate areas: Economics, Performance, Sustainability, and Worker Issues. A final brainstorming session was also conducted. These are further amplified below.

Economics

What are the economic barriers to successful, long-lasting asphalt materials? How can changes in the funding paradigm

result in longer-lasting, more durable materials? Encouraging thinking beyond the low bid system typically used in the US for building roads. The impacts of environmental regulations on the economics of producing asphalt materials. How might a transition away from fossil fuels affect asphalt?

Performance

Issues impacting long-term performance of asphalt materials – regardless of end use (roofing and paving, principally). Need for durable, long-lasting materials that can resist the effects of weather and traffic loading (paving only). Development and use of better performance prediction tools in the lab that will translate to performance in service.

Sustainability

How can we use/re-use asphalt effectively to produce economical, durable, safe products? What are the impediments to implementation? What is the future of bio-products in asphalt materials?

Worker Issues

This area incorporates health and safety concerns. Also, it considers environmental concerns, such as carbon footprint and greenhouse gas emissions. Can the compounds responsible for health concerns be removed entirely from asphalt products without impacting their performance? How can the carbon footprint of asphalt materials be reduced?

Brainstorming

Brainstorming (or potpourri) captured those issues discussed in a group session on the last day. Ideas for discussion were also generated from attendees using the digital communication tools:

AIF STAR symposium email: Symposium attendees were invited to email ideas, expand on topics discussed or convey thoughts related to a symposium topic prior to arrival, after hours or as they occur during the meeting. Information from these emails was reviewed by AI staff and facilitators in advance of being discussed during relevant breakout sessions, but the senders remained anonymous.

Twitter: For Twitter users, a new STAR-specific address, @AIFSTAR, was established for individuals to follow the work taking place at the STAR Symposium. In addition, attendees were encouraged to use the event hashtag, #AIFSTAR17, to share thoughts, ideas and photos from the meeting.

For the four main breakout sessions (with two running concurrently), STAR participants were asked to go where they would have the most to share or where they were most interested. There was no pre-set assignment based on participants’ background or other rationale. Performance and Sustainability breakouts had the greatest general attendance but all sessions were fully viable in terms of participation.

“THIS IS THE GOOGLE OF ASPHALT.”

- GREG MALARKEY

The STAR Symposium agenda is contained on Page 55 of this report.

Facilitation

An important element of the program was its facilitation by Bill McGinnis, CFA and President, Professional Meeting Facilitator, LLC out of Milwaukee, Wisconsin. He was accompanied by Matthew Rochte, LEED, AP, and Director of Opportunity Sustainability. Mr. Rochte is also from Milwaukee and additionally served as the lunch speaker on sustainability on May 11. Having two facilitators enabled the STAR program to accommodate two simultaneous breakout sessions. Neither facilitator was from the asphalt industry nor had any previous experience with the Asphalt Institute or the foundation. This was by design to avoid any familiarity bias.

Mr. McGinnis made good use of a few Technology, Entertainment, and Design talks (TED Talks) – short video segments which amplified a particular message or theme throughout the STAR. TED talks originated with a conference in 1984 themed “Ideas Worth Spreading.”

One example was the use of the talk: “Where do good ideas come from?” TED talk presenter Steven Johnson spoke about the concept of the coffee house in idea generation and sharing. He also introduced the notion of “The Slow Hunch” – how thinking about an idea or problem over time and sharing it with others

often leads to solutions. Mr. McGinnis welcomed STAR Symposium participants to the “AIF STAR Café” for the duration of the symposium. The process of nomination and then selection to attend the STAR was purposeful and signals the importance each participant’s contribution to this event.

Keynote Address

The symposium’s keynote address was delivered by Michael Rogers, Practical Futurist®. His long resume includes service for two years as the “Futurist-in-Residence” for the New York Times. He had also worked with many large companies including FedEx, Boeing, NBC Universal, Microsoft, Pfizer, Siemens, Lucas Film and Apple. Mr. Rogers studied physics and creative writing at Stanford University, launched Newsweek’s technology column, and served ten years as the Vice President of the Washington Post Company’s New Media Division.

Mr. Rogers opened with the observation that it is quite unusual for an industry to spend time thinking about the future and subsequently doing something about it. He applauded the foundation for the vision of the STAR Symposium.

Challenging the audience, “The futurist in the room gives you permission to think well into the future” without worrying about tomorrow or the next quarter.

ALL THE INNOVATION IN TECHNOLOGY PLACES HIGHER DEMANDS ON HUMAN-TO-HUMAN COMMUNICATION SKILLS.

He urged our industry to consider three important trends:

- The virtualization of the world
- Sustainability, resilience, and climate change
- Demographics; what our customers and employees will be like

Virtualization of the world

How we shop, how we do our business, how we meet our mates, is all moving into the internet, the cybersphere. It has just begun. We're creating a virtual layer on top of the real world and those in the future that will do best are those that understand both of these and how to connect them.

A perspective on change: 10 years ago the iPhone was created and not doing so well. Facebook just started to accept people who were not college students. It was doing okay and just introduced the news feed. Twitter started 10 years ago. Today, iPhone is on its 8th version, is a wristwatch and the world's most popular camera. Today, Facebook has a user list greater than the population of China. Twitter not only caught on but is a central part of American democracy – for better or worse. These are some great examples of how quickly things have changed.

Change is fast. He gave two examples: Moore's law refers to an observation made by Intel co-founder Gordon Moore in 1965 which states that the

number of transistors per square inch on integrated circuits had doubled every year since their invention. Holding true. The second is Metcalfe's law which states that the value of a telecommunications network is proportional to the square of the number of connected users to the system (n^2). Mr. Rogers gave an example of the network effect by describing that just two years ago, there were the same number of Uber cars in New York City as yellow cabs. Today there are seven times as many and importantly, shut down the push from the cab industry by networking their riders and drivers to lobby the Mayor's office.

In the virtual world, every person will be connected to the internet all the time in many ways. Consciously and unconsciously, connections will change our lives; online will be the norm. Mr. Rogers discussed the proliferation of smart sensors and enumerated upon the types of data collection that they are being used for.

Artificial intelligence over the last 10 years has changed rapidly and is starting to replace a lot of white-collar functions. Coupled with robotics, this will change the workplace. Cow milking robots are common in Europe today as an example.

The future of autonomous vehicles has been followed closely by Mr. Rogers. By 2030 all cars are predicted to be electric and not owned. He calls this "mistaking a clear view

for a short distance.” In other words, the pieces are likely true, but the timeline unlikely. With the average age of a car approaching 12 years, there will remain a legacy of “dumb” cars out there. The insurance industry is an important part of this predicted change. Not about the economics of the self-driving car, it is its insurability. The insurance industry is looking at this phenomenon closely. More likely is the idea of smart car lanes to separate them from human drivers. Platooning lanes for trucks could work well with trucks connected through a network. Density, speed and safety could all be improved.

The ultimate vision for smart vehicles could result in it becoming illegal to drive a vehicle on the highway because it is too dangerous. Autonomous vehicles could one day drive without emotion or inattention resulting in much safer travel.

Sustainability and resilience

More important in the 2020's than we might expect.

He also pointed out another important impact as a result of the insurance industry; having incident data makes them even more so the regulator. An example is the inability to obtain insurance in flood-prone areas – in a way inhibiting building in a flood zone. Hurricane Sandy in New York is one example where new zoning is addressing this concept.

Limiting carbon is more an intellectual concept today – likely to become a much more emotional one in the future. Countries experiencing massive and recent droughts such as Australia and Russia became emotionally involved resulting in real action directly attributed to the extreme weather phenomenon. These included physical and political changes. As these transform to a millennial generation problem, we can expect a growing distinction between carbon as a waste product and the use of petrochemicals as an important feedstock for manufacturers.

Demographics

How will the next generation affect the living space? This generation will have a unique connection between the virtual and real worlds. Mr. Rogers feels that the increasing reliance on the virtual world will amplify the importance of maintaining relationships in this virtual environment.

The effect this will have on the business landscape will be more important. Economic reasons will drive some of this, for example working from a home office, or a midpoint via a telepresence center equipped with hi-resolution monitors and video conferencing. Ambient telepresence is being experimented with today in a business environment. A mix of all three of these work experiences is likely to play in future workplace expectations.

A broad perspective

While acknowledging that even if you see where you want to go, there is often something in the way. Obstacles inevitably will be overcome along the way.

He drew many parallels for the asphalt industry from others including those in the technology world, specifically the technology transformation of media.

Mr. Rogers emphasized collaboration with other industries. Their perspective on virtualization and connection with the virtual world, robotization, etc. will help define our industry's initiatives and responses. An example: privatization of infrastructure is a trend in our industry yet the role of governments in ownership remains a debatable item. This trend introduces new partners but can also bring new solutions. Another example is the involvement of the insurance industry and using performance and claims data to require a change in standards setting, zoning, or building codes.

He sees U.S. populations continuing to spread out over time away from cities for cost of living and quality of life purposes which limit widespread use of car sharing programs but take advantage of improving telecommuting systems.

Solutions to burgeoning data from smart sensors will be the incorporation of artificial intelligence. This trend drives changes in needed skill sets from

OUR INDUSTRY REUSED OVER 100 MILLION TONS OF MATERIAL LAST YEAR.

future workers. All the innovation in technology places higher demands on human-to-human communication skills and he sees a big growth in the value of this skill set. What are the key success elements for both our and worker future? Collaboration, communication, and open-ended problem solving will serve us well.

Sustainability Presentation Summary – Mr. Matthew Rochte

Mr. Rochte's presentation at the AIF STAR Symposium on Thursday was delivered not from the "feel good" environmental side of sustainability, but from one of a business imperative, by choice.

His background in business led him to the eventual launch of the Milwaukee Sustainability Roundtable to bring together business leaders and environmentalists focusing on strategy and business resilience. Companies are looking for ways to adapt and remain creative in a complex environment. Specifically, he used the Interface Company as an example of one which embraced sustainability as part of their core strategy.

Mr. Rochte set the stage by discussing five myths of sustainability.

First. *No one knows what sustainability is.* He offered a good definition of sustainability: Meeting present needs without

compromising the needs of future generations.

Second. *Sustainability is just about the environment.* It really is a holistic approach to what we do. Look at the entire value chain. Ethics, social justice, employees, reduction of waste and innovation. All of these contribute to sustainability.

Third. *Sustainability is just about feel-good actions like recycling and earth day.* Smart companies are well beyond this notion of "green washing" and are incorporating sustainability into everyday actions.

Fourth. *It is expensive.* It is the opposite. The costs of setting up a process to incorporate reusable items are where most of the costs are.

Fifth. *Sustainability is really a population problem.* This is not a myth. Today's world population is approximately 7.3 billion people but estimated by 2030 to reach 8.5 billion; a 16 percent increase. An example, Syria's problems can be traced back to a water crisis caused by population growth.

By 2030, several studies indicate that the middle class will more than double in size. This sector of society demands a high-intensity consumption of goods. Population is a real issue.

Turning to positive things

Ray Anderson of Interface, the world's largest manufacturer of indoor carpet tiles, realized

one day that his company was toxic. It was his so-called “spear in the heart” moment. He refocused the company, their stakeholders and in some cases their customers around the importance of achieving sustainability. He sought to eliminate waste, achieve benign emissions, use renewable energy, close the product loop (recycle), be more efficient at transport, sensitize all stakeholders to sustainability, and re-design commerce to ensure product loop achievement.

In 10 years, Interface is now a signature example of a company making change in this realm.

Mr. Rochte urged us to watch Ray Anderson’s TED talk for more on this theme.

Sustainability is about making smart business decisions. How can we mitigate the risks? Start with a sustainability mindset.

The World Economic Forum asks companies about key risks. Sustainability was identified as this year’s risk area.

Trust is another risk barometer. The majority of the population rejects almost all established authority. The last bastion of hope lies in companies. The implications of this to our companies are huge.

Asphalt actually has a lot of positive advantages. Our industry reused over 100 million tons of

material last year. Industry has also made huge strides in the reduction of greenhouse gasses in the production of asphalt. Asphalt has safety advantages by reduction of hydroplaning and fuel efficiency increases by improving smoothness of roads. These all add to the sustainability of our product.

Reuse of material is far better than recycling. Recycling is typically for a new purpose and is very energy intensive.

Sustainability is a mindset, not a program. He briefly discussed three well know companies who are leaders in the sustainability world. Walmart, Unilever, and M&S (UK’s Marks and Spencer) were all given as examples. Mr. Rochte urged us to visit their websites to learn what they are working on and to see how/what they are doing and how it could apply to our companies, our industry.

The STAR Symposium Report

Four breakout sessions (with two running concurrently), and a fifth session “Brainstorming,” utilizing two separate facilitators, 118 very active participants merged with an external social media and email audience makes for a lot of conversation and idea generation over the three-day program. Each of the main and breakout sessions were audio recorded for the sole purpose of helping write this report. Similarly, and for the same purpose, some of the

main sessions were also video recorded. Separately, Asphalt Institute staff were assigned to each breakout to make notes of the main discussion points. Further, at the end of each session, the facilitators attempted to have each group prioritize the main points utilizing large flip-charts. It is important to understand that through this prioritization process, the context and even meaning of these main points were often diluted beyond their original intent. Nonetheless, they can serve of some value in this report.

While there are many ways to record the results of the STAR Symposium, here is an outline of the approach we utilized:

A senior Asphalt Institute staff person was assigned each of the main breakout areas. This person functioned as the principal author for what would become a chapter in this report. That author had access to all the recorded media, staff notes, and the flip-chart materials used for that session.

Each breakout session randomly discussed many themes in a short period of time, and often returned to a related topic at a later point in the session. This occurred in all sessions and several times over. In the writing of this report, we attempted to unite thematic elements of each breakout session for the benefit of the reader. Themes from different sessions were not combined. We kept each

FUNDING FOR RESEARCH INITIATIVES DEVELOPED AS AN OUTCOME OF THE STAR SYMPOSIUM DISCUSSIONS ARE BOTH ENCOURAGED BY THE AIF BOARD AND HIGHLY DESIRED.

breakout discussion together in a single chapter. It is believed that this effort will make the report more readable and useful in its final form.

Efforts were also made to capture the prioritization discussions at the end of each session (including the Potpourri session on the last day). The reader is however cautioned about the validity of the ranking and the thought or concept which the attendees were trying to prioritize.

This report contains a chapter for each session held at the STAR Symposium:

- Economics – Chapter 2
- Performance – Chapter 3
- Sustainability – Chapter 4
- Worker Issues – Chapter 5
- Brainstorming (or Potpourri) – Chapter 6
- External input captured via email or social media – Chapter 7

Desired outcomes

With the fundamental desire of the STAR Symposium to launch the many conversations concerning the strategic future of the industry along with its challenges and opportunities, the AIF Board also had a clear vision for the outcome. It starts with the STAR Symposium report.

The report is available in both eBook, portable document format (PDF) form, and print to enable the widest distribution. Visit the store at asphaltinstitute.org to obtain your copy.

As previously mentioned, the report is not a collection of research needs statements, but does lend to their generation in many ways. First, some of the concepts discussed and reported in subsequent chapters of this report are sufficient to succinctly develop a comprehensive research needs statement – perhaps by conjoining with other material already developed. In many cases, some smaller scale scoping research may need to be conducted to narrow the research focus on a particular topic. This is not an uncommon approach to research development today.

Academic and governmental funding for research initiatives developed as an outcome of the STAR Symposium discussions are both encouraged by the AIF Board and highly desired to help advance these ideas to reality. The foundation itself will review various research needs and may pursue some of these on their own accord. It may also participate in limited initial research to further develop specific research needs which ultimately will require a larger funding source.

As research gets underway, regardless of the origin, the AIF Board welcomes the opportunity to showcase the research and progress at another venue such as a future STAR Symposium event.

Lastly, the conversations held in Colorado Springs provide invaluable insight into the future of our industry. As such, these conversations, as outlined in this report, provide an opportunity for further presentation and discussion at industry events. The (U.S.) Transportation Research Board annual meeting in Washington, DC, Association of Asphalt Paving Technologists annual meetings, Canadian Technical Asphalt Association annual meetings, American Society of Civil Engineer meetings, Western Research Institute's annual Petersen Conference and the E&E Event Berlin 2018 are but a few examples for consideration.

As this report goes to press, plans are already underway for another STAR Symposium. Details will be made available on the Asphalt Institute Foundation's website and widely made known throughout the industry. Consider how you or your organization could participate to continue this valuable conversation for the future of our industry.

A Word of Thanks

It took the vision of the Asphalt Institute Foundation Board and the hard work of the AIF Research Committee to turn this signature idea into the valuable reality it became. A unique event like this has financial risk which was greatly mitigated by the financial support of the STAR Symposium sponsors. The AIF board extends a debt of sincere gratitude to these companies for

their generous financial support from the onset of the concept of this landmark event. Their logos are also listed on Page 54 in this report.

Every event of this magnitude needs a champion and we couldn't have found a better one than Mr. Greg Malarkey of Malarkey Roofing Products. His tireless energy and infectious enthusiasm simply willed this event to reality in a very short period of time. His service as the Chairman of the Research Committee remains exemplary and defines service, dedication and commitment. The AIF board sincerely appreciates both the support and leadership of Mr. Malarkey and that of Malarkey Roofing Products.

Finally, the leadership and support of the staff who worked behind the scenes to support countless volunteers in the making of the STAR Symposium's inaugural event were invaluable in every way. Contracting the many speakers and facilitators, making all hotel arrangements, managing registration details, perfecting the agenda and executing the STAR Symposium in May 2017 are some of the highlights. A special thanks is extended to AIF Program and Development Manager Susan S. Tanner for her efforts to help coordinate all Asphalt Institute staff actions on this project.

Chapter 02

Economics

LOCAL AGENCIES (CITIES AND COUNTIES) ARE DEMONSTRATING A WILLINGNESS TO TRY NEW THINGS.

The moderator for this two-hour breakout session, Matthew Rochte, welcomed everyone and set the stage by asking the group: What impacts the economic viability of asphalt? What does that mean to you, to your business and to this industry? Open discussion ensued. The following narrative is intended to capture the essence of that discussion.

From an owner perspective, it means making sure asphalt remains profitable enough to continue making and still meets performance requirements.

How do we create economic viability to keep producing asphalt, and keep it “purchasable?” Today, we don’t identify the various profit levels of different types of asphalt sources. Perhaps we should. Not all crudes make equally profitable asphalt.

Is the issue how to make asphalt less costly, or to create a larger market for asphalt? How do we increase the size of the transportation funding pie? It was stated that we are two percent of the federal budget. Recycling certainly will play a big factor in our future economic viability.

How do we demonstrate the value of our asphalt products to society? The public’s perception, real or not, is that our industry is not a good steward of taxpayers’ money. How do we overcome that? The problem is not necessarily poor material being used, but rather the entire process of building roads. Poor in-place compaction was cited by several as a common problem.

Education is very important: to the public, to both big and small government agencies, and to our own industry (for improving quality). How can we help provide solutions to the owners, and educate them on how to

extend the lifecycle by using preservation techniques? Local agencies (cities and counties) are demonstrating a willingness to try new things, sometimes more quickly than a state DOT. We need to change the culture among agencies to design and construct longer life, or perpetual pavements.

Our industry is not doomed by electric cars because the need for smooth roads will continue. How does the production of asphalt change when the demand for gas drops because of electric cars?

Are we naive about our stance in the industry? We need to consider the total cost of our product versus others. We need to address HS&E issues.

Do we have a sales problem for our product, or are we relying on our historical market position with the assumption that we will continue to dominate? Our roads, both concrete and asphalt, are deteriorating much too quickly in many cases. Have we become too comfortable? There is a trend among state agencies to move towards alternate bidding (asphalt versus concrete) for pavement projects in an effort to get better value. This means that we need to do a better job of quantifying the value of asphalt pavement.

Asphalt is a byproduct of one material and used with other materials. We are not a true standalone material. There is a need for us to map the web of source and use. What other industries do we need to partner

with to see how asphalt fits into the roads of the future? Are there other, non-traditional partners we haven't thought of? This will provide insight on how we make liquid asphalt viable with future automation.

We should look at the supply side of crude. The quality of feed stocks predicated the quality of the asphalt produced. How do we incentivize the refiners to go after the better crudes to get better asphalt?

Roads are a tremendous value to the public, yet are drastically underfunded. If funding was more appropriate to what is actually needed, performance would follow. We have demonstrated that we know how to build long-term performance with the few long-term warranty projects that have occurred. We should pursue alternatives to the low bid system to move to higher performing pavements. In a low bid system, the specifications get tighter and tighter to assure performance. Long-term warranties will shift innovation and risk to the builder. A current obstacle for having more long-term warranty pavement projects is lack of willing bond companies. Perhaps we could do a study involving other economic partners that looks at how public agencies could do project procurement with better risk sharing and better financial diversity to get better performance and allow our industry to be innovative.

How do we encourage owners to look at pavements from an

asset management perspective to preserve the system, versus letting it deteriorate to the point of needing rehabilitation? There are many local governments that understand this. The public understands the huge backlog of necessary road improvements needed, but 45 percent of that public think that backlog is a result of our industry not being smart. Need to communicate the need for steady sustainable funding and the need for funding pavement preservation. There has been lots of progress in the area of pavement preservation and specifically around education.

Educating the entirety of our industry on best practices and not just the DOTs. An example is how often cold-patch gets thrown into a pothole full of water. Lots of best practice information is already available, but we are not getting it to the right people, especially at the local level. Suggest looking at the pavement preservation community, specifically FP2, and the success they have had with their recent educational initiatives targeted at the local level.

Need dedicated corridor system exclusively for trucks. China did this effectively.

Finding the mechanism(s) to get our value message to the right people who have the right influence on funding. That value message needs to be carefully articulated to the public and decision-makers. We need to understand the barriers to getting asphalt's message out.

ROADS ARE A TREMENDOUS VALUE TO THE PUBLIC, YET ARE DRASTICALLY UNDERFUNDED.

Conversation around value is critical. We need to improve our image, brand and our message. Explain how important our roads are. We are not reaching the local policy-makers. Educating the public on how potholes occur is valuable in this regard.

We also need to show the value of asphalt to the refiners so that they will see the benefit of continuing to produce asphalt. How do we create value and profitability for the asphalt producer?

Agencies are too risk adverse, which inhibits innovation. How can they be motivated to be more innovative, allowing the industry to be as well? Perhaps the answer is to get away from the low-bid system. It was important to get performance measures into MAP-21. We should conduct research on different project delivery approaches to allow for more innovation, finding a way the government can transfer the risk to the contractor.

How to keep gas tax revenue going to roads? How do we revisit the funding and building of roads? We need to do a better job of showing value to decision makers.

How do we prepare for future disruptive technologies or events that may occur, such as changing crude sources, declining demand for gas, electric cars, new economics, etc.?

What new markets might we explore for asphalt outside of

what we currently pursue?
How do potholes affect driverless cars? Not good.
Needs to be a public message.
How can asphalt play into the city of the future, improving the quality of life?

Following a break, the session reconvened with the moderator asking the group to turn all these ideas into very specific questions for the AIF to move the industry forward. The following questions and suggestions were formulated by the group:

What information do we need to provide exploration companies and refiners that would motivate them to go after the better crudes for asphalt and maybe deeper sources?

Research asphalt chemistry/additives to maintain or improve the quality of binders.

Research synthetic asphalts and combinations.

What would the petroleum industry do without the asphalt industry?

What if asphalt became more of a specialty product outside of the historical refining world? Is it viable?

Do performance-related specifications drive us to better roads? As an example, not all PGs give the same fatigue performance even though they are the same grade. Could performance-related specs

better incentivize quality for producers?

Do we need a white paper on history and future of crude sources and how feed stocks affect asphalt quality?

What is the best set of contractual documents to enable (incentivize) innovation for highest total value in a road?

Can we collaborate with a business school, or other credible organization, to quantify the benefit of longer lasting roads? This could help in getting proper funding. Along the same lines, could we do a similar study showing refiners the value of producing asphalt?

What potential research partners (i.e. insurance institute for highway safety) could we work with to identify needs and build the web? Map the web!

Why can't industry replace agencies in the transportation business and provide the road networks?

What is smart asphalt and what value can we add?

What other funding partners might there be to invest in roads? Are there other funding models? Could we attract third-party investors? In Denver, there is a new interstate lane called a "managed lane." This is the new term for toll roads.

We need to shift away from the low-bid system. We need to look at new procurement models that drive innovation and ultimately quality. What performance measures for agencies are working, and how can they be improved?

How do we demonstrate the value of road infrastructure versus subsidized mass transit such as light rail?

What are the factors that will affect the future supply or availability of asphalt?

What is the value of including asphalt and road preservation into formal civil engineering curriculum?

How will sustainability have a role in the future economics of our industry?

Is there a product looming that could replace asphalt as the binder in mixtures?

How do we continue to position asphalt as a strategic product and not a residual material for refiners?

How do we position asphalt as a strategic asset to our government?

What do we do if asphalt is classified as a carcinogen by a future IARC review?

At this point, the moderator asked the group to narrow

these questions down to about five. The following top themes emerged:

What are the factors that will affect asphalt supply and the quality of crude, and how do we address those threats?

Important that we map the web (supply, demand, communication, customers, funding) and define the value for each in the web. Also, we should look for new partners.

Why haven't we been successful with our current agency purchase model (low bid)? What new procurement methods could be used to drive innovation, new technologies and ultimately quality?

Messaging/communication/value from all asphalt organizations. Shoot for one message.

How can we use performance-related specifications and performance measures in asset management to change the economics of asphalt?

How do we educate local engineers and the public?

Chapter 03

Performance

The moderator for the breakout session, Bill McGinnis, welcomed everyone and set the stage by noting that the group would be talking about performance. He noted that the group should not necessarily be looking for answers at this time, even though it could be beneficial. The issue at question is the need to address the future performance of asphalt and the factors expected to affect it in 10-20 years.

Open discussion began. The following narrative is intended to capture the essence of that discussion.

How can we reduce aging in asphalt?

In order to achieve long-term or near-term performance of asphalt materials we have to know the composition of the asphalt (i.e., chemistry)

We have to define what the asphalt of the future will be by looking at what asphalt looked like as it was produced 20-50 years ago. The types of the materials used in asphalt today are not the same as were used 20-50 years ago and will not be the same as what may be used in 20-50 years. We have to begin thinking about asphalt as a composite of materials – not all of which will come from the refinery. Recycled materials and re-refined pig manure are a couple of examples of other materials that could make this a composite.

Refiners have an incentive to make asphalt harder, taking out the lighter ends for other products. Users have a need for softer asphalt, particularly as recycling increases and asphalt is used in colder climates. Where do we go for fluxes that soften the asphalt and still provide good paving materials?

In the future will we be specifying materials or end performance?

We need to question the use of asphalt in the future. It is essentially an adhesive for aggregate/rocks in a mix. In the future, that adhesive will be an engineered binder, and asphalt may or may not be a component.

How do we expect to do research in a timely manner to keep up with the technologies of today and how do we move fast enough?

How do we define the performance of asphalt and what do we expect? We don't have a common indicator of performance used by agencies.

What will specifications look like in the future to define asphalt products? We need to understand why the products work in the field right now. There is too much emphasis

MORE EFFORT SHOULD BE PLACED ON EXAMINING WHAT PRODUCTS ARE WORKING TO LEAD TO BETTER SPECIFICATIONS.

on forensics looking back to see why products failed. More effort should be placed on examining what products are working to lead to better specifications.

What will the requirements need to be in the future for performance?

How do we address “over-specification” and “under-specification”?

Asphalt binders are currently specified using mechanical properties, trying to get to performance-based specifications. While it is a good goal, we have seen that it doesn’t always work so well. Should we consider composition specifications or guidelines in the future?

Can we improve the performance of asphalt with various additives such as ground tire rubber? How can we improve the structure or wearability of our roads through multi-layer systems?

What are roads and vehicles going to look like in the future in regard to occupancy, weight, and speed? Under what conditions will the asphalt have to perform?

What will be the demands on energy conservation in the future? What will the expectation be to use bio-components in asphalt?

The asphalt paving industry, including the specifying

agencies, typically designs the lowest cost pavement. Sometimes we look to make better products for the longer term and that usually works; those products perform well. But we don’t do that on a regular basis, instead defaulting to the lowest cost. We need to change fundamentally how we think.

As the asphalt products evolve and technology evolves should we also be considering health as a performance standard?

Instead of always benchmarking our performance of new mix designs and modified mixtures, we should spend more time benchmarking the performance (life) of standard, low-bid designs that are economically feasible in the areas in which they are being placed. Without that, it will be difficult to get a good estimate of the return on investment (ROI) offered by the newer and/or modified mixtures.

What is the industry doing to look at how technology is changing road usage (e.g., through Google Maps and Waze) by shifting traffic to secondary and tertiary roads that were not designed to handle the loads, thus resulting in accelerated failures on those roads? Is there room for industry or the community to communicate with mapping companies about the issue this creates?

Environmentally, we need to understand how we want our product to perform. How does the performance of our

HOW DOES THE PERFORMANCE OF OUR PRODUCTS INTERACT WITH THE NEW TECHNOLOGIES?

products interact with the new technologies? What are the requirements of our product in new technologies?

What will the roofing industry look like in the future? Currently, asphalt shingles make up 80 percent of the market. Will that continue or could new products take that market share? For roofing, we look at 25-year performance, so even longer aging should be considered in understanding how to reduce aging of asphalt products.

No two asphalts are exactly alike in terms of quality and performance. How can we create specifications that will optimize performance based on selection of the quality of the asphalt? In that way, refiners that produce asphalt that have better performance qualities can get paid more for the quality product than refiners who produce the exact same grade but doesn't have the performance qualities. We are one of the few, if not only, industries that sell a high-quality product at the same price as a low-quality product because it is a low-bid system under which the industry operates and there is no incentive to differentiate quality.

As an industry, we are only permitted to operate because society gives us a license to operate. They (others than those in the asphalt industry) have a very different view of what we need to deliver than we (the asphalt industry) do. We need to find a way of engaging

with the broader society and understanding their expectations of performance.

Will we even have asphalt specifications in the future? We may be moving towards a specialty product where we don't have a specification that the refiner has to meet, but rather we may see a paving or mix specification. An example of this is in New Jersey where they have a specification on a mix that does not consider the asphalt binder – just requires that the mix has to meet certain performance-based criteria.

We have a brand image or public relations problem. We do not do a very good job at communicating asphalt benefits outside of the industry. We are not telling the performance story to regulators, influencers, legislators, or consumers. How can we do a better job in understanding how to educate them?

Why are we using asphalt as opposed to another material in the manufacture of roads and roofing products? If there are certain values, how do we maximize those? If there are certain drawbacks, how do we minimize or eliminate those?

What will be the performance expectations in 20 years and will those needs be met?

Who is going to be financially responsible for our roads in 10-20 years? We have no one like Elon Musk in government. If we

expect that most roads will be privately owned/operated, then we can consider game-changing technologies. If we expect that we will continue to have government management of roads, then we have to gear our research to small advancements, pursued at a cautious pace.

How do we get smarter in how we build roads? Are we going to build roads differently in the future and is asphalt going to continue to be the product of choice?

What is the negative impact of recycled materials in asphalt? Is the asphalt industry considering the future growth of the bio-industry (e.g., bio-asphalt and bio-polymers)?

We still do not have specifications where performance is part of the contract for asphalt roads. How do we make performance part of the specification for asphalt mixtures and then drive towards performance? It is the difference between “pushing the technology forward” and “pulling the technology forward”. If you can change the rules of the game, you can bring industry to performance instead of trying to push the industry towards it.

What is bitumen? It is a fundamental question that we have yet to answer on a chemical level. It is a valid discussion when we talk about performance and performance properties and

what is measured, but we need that basic understanding on a chemical level. An analogy might be a customer saying that we want a drought-resistant wheat, yet we don't know what DNA is. We can't hope to engineer that product without that fundamental understanding.

What will be the demands for our roofs and roads that go beyond its primary use today? What will society demand for our infrastructure?

Dissenting some from the discussion regarding the fundamental understanding of asphalt chemistry: if we can set the standard of performance that we are trying to achieve then the research will be able to zero in more productively on engineering the product and understanding the important building blocks.

Is the future going to be that we don't have asphalt specifications or will we simply be shifting the burden of proof? The roofing industry is an example. They do not have national specifications, but they have individual purchase specifications that the supplier needs to meet. Would the future shift the responsibility of assuring on-spec material to the contractor/supplier as opposed to the agency?

We have to define to whom we are telling the story about asphalt performance; is it the government or the homeowner? Who is the audience and what story do we need to tell?

We are really lacking in recycled materials research. We continue to recycle more, thinking we're saving money and praising ourselves for recycling 95 percent of our materials. While there have been some good things done, there are contractors who are using 30 percent binder replacement from RAS and 30 percent binder replacement from RAP in the same mix and those mixes are cracking. One particular project cracked in four months and is now a matter for the courts – resulting in legal costs as well as material and construction costs. We don't need that as an industry. We don't have good specifications on our recycled materials. How do we specify the final product, including the recycled materials, instead of just the asphalt binder as it is added?

What are we doing, or what can we do, to integrate technology into our systems and structures? Examples include data lines, sensors, the ability to capture energy from the roadway surface, and deicing.

While we're talking about performance as an issue in 10-30 years from today, with the low-bid system we have in the United States it can be argued that we have a crisis now. The push from the FHWA in this age of sustainability is to use recycled material. We are not set up to make a good road in some cases. The FHWA guideline is to use as much recycled material as practical that will not reduce

the life cycle of the road. In addition to thinking long-term, we need to address the issue with the low-bid system and the push to use recycled materials without proper protocols. How do you monitor the performance of these materials without the proper controls? There is a potential issue with re-recycling.

Do we have an issue with binder performance or do we have an issue with the additives/products that we put into the binder and the performance of the end product?

What can the asphalt industry be doing to promote better safety for the traveling public in the future?

We define performance for today, but we may find that it is not really performance. We need to define what the real performance is. The performance specifications that we have now are not really performance-related.

Whenever we have a private contract or a public contract that allows for alternative technical concepts, the asphalt industry innovates in amazing ways. But we don't always capture those benefits. In the future, agencies will be asking for a product that lasts for a certain amount of time that has certain properties. With that openness, how can the industry respond to that future so that the industry benefits from shared successes and is able to produce materials that perform immediately?

How can the asphalt industry catch up to the ingenuity of private industry? The current specifications are empirically based on traditional materials. Private industry is ingenious enough to meet the specifications with different materials even though those specifications do not necessarily relate to performance.

Performance is a vague term. Is it the end product? We need to benchmark where we are now. What aspects of performance are not meeting the expectations of the public?

The process of understanding failure or poor performance of asphalt roads is not well done. It is a time-consuming process that often results in answers that do not provide a clear understanding of what caused the failure. The process of forensic investigations needs to be improved.

New innovations take years to get implemented if they get adopted at all. The only innovation that can be tried in the current climate is one which will also reduce cost. What mechanisms do we need in place in order to create incentives for private and public customers to try new innovative products that are not just improvement in performance at a lower cost?

Binder becomes the asphalt and whatever else is added. Like it or not, we are stuck with the

performance of that combination. If we are going to innovate, we need to challenge ourselves to find failures in innovation. The limits of performance of many innovative products have not been obtained. It is left to others to find the limits of those products in the lab or the field.

How do we sustain our technical knowledge? How do we learn from our past mistakes so that they aren't repeated every 20-30 years when a newer generation comes along?

Sometimes innovation in the private sector doesn't work. A company built and warranted large private highways 20 years ago. It didn't work for a number of reasons, but it really died because of barriers like finance (insurance and bonding) and local politics. Those types of barriers kill innovation. We have to clear the path of those barriers in order to properly innovate.

How do we share knowledge and move collectively towards performance? How do we educate everyone involved in the asphalt industry from the supplier to the road owner?

How can technology, autonomous equipment, smart sensors, and accelerated construction improve worker safety and the quality of our product? What does the whole process look like? How can we shorten that? Owners will pay for speed.

WHAT ASPECTS OF PERFORMANCE ARE NOT MEETING THE EXPECTATIONS OF THE PUBLIC?

Measuring performance in the future may come from sensors in our smartphones that can capture/monitor the performance of the product in real-time. It is up to us to figure out how to use that information.

Many of the challenges are the same in North America as in Europe. How can we share our experiences? Will performance be based on local demands or will the influence of shared knowledge affect those performance standards?

An end-product performance specification is likely the way agencies will specify materials in the future. That is probably the right thing to do. Having a pure binder specification is important for the suppliers because the suppliers still need to have a way to transact the barrel.

We have a base specification for the “glue” used in the roadways, but it doesn’t predict the performance of the product with all of the additives that are used. We need a specification that truly predicts the performance of the asphalt, regardless of the additives used.

Much of the binder comes from sources other than the asphalt supplier, like RAP and RAS. Even if we try to elevate the purchase specifications for the asphalt binder it still will fall short because more and more it is becoming just one of many components in the “glue” and control doesn’t just rest with the

supplier anymore. We are being forced to have performance assessment occurring downstream on the final product.

When considering performance we have to have something related to an article of commerce – some metric which can be exchanged. The composition of a road or shingle will have constituents that will be commercially purchased. What we miss is the next step – the interaction of the composition related to performance. We need very good measurements of the performance of the system. Integrated performance of the final system is important.

We have used specifications to cap risk as an industry, whether it is the owner, supplier, or contractor. This has led to a race to the bottom for the lowest cost. We need to consider what is really important to the user. Safety is important – no rutting, no deterioration due to moisture susceptibility, no splash/spray, and reduced noise. Those are the concepts we need to consider.

We have no durability test for our asphalt pavements. While we are hung up on a better specification for asphalt it is important to understand that the public only cares about the road. We need to look to the construction industry. They measure performance properties initially, then follow with an accelerated durability test and get a retention of the original properties. This gives the customer a relative

HOW WILL THE ROAD OF THE FUTURE BE FUNDED AND OWNED?

measure of the performance of the innovative product. We should copy this approach in the asphalt paving industry.

We need some kind of specification so that the contractor knows what he is buying. What are those specifications? Maybe the mistake is trying to relate those specifications to failure on the roadway. Don't try to get a direct relationship.

Barriers that we face currently are that specifications differ depending on the user agency. We are wasting time fixing the same product a little bit just to meet the demands of different agencies.

We need to consider the affordability of our products. The current road funding system has not been changed in many years. How will the road of the future be funded and owned? Can society afford it?

How important is road noise? Do we need speed specifications to limit noise?

Renewable roads may be used in the future in which metal fibers are used and reheated 5-years after placement.

Can we do a fast rebuild of roads? When we have a washout of a road can we quickly get it back in operation?

Climate specifications have not been changed in a number of

years. When is that going to occur and what will the impact be? What will be the impact of climate change on roads?

What is the future of enhanced roads having electrical generating properties (e.g., roads that light up)?

Marketing to regulators is important in addition to marketing to the public.

We are all end users. If things need to be done – in the form of construction or preservation – one of the things that end users want to see is that things get done quickly. What is the equipment going to look like in the future to provide a better application process for our products on the ground or roof?

How do we reduce research “in silos”? There are dozens of entities conducting asphalt research. They either ignore each other or compete with each other. It is unproductive. How can we have a collaborative entity that can advance science?

Road owners are state agencies, and they are setting the specifications, therefore there might not be a possibility of having a national standard. There are European specifications in progress, and the driver to this process is the political idea of an internal market; no barriers to trade.

Without the leadership by the researchers and FHWA that was

evidenced after the Strategic Highway Research Program (SHRP), entropy ensued and now everyone is back to writing their own specifications. National standards are a matter of the right leadership and research money leading to new things that everyone wants to learn about that creates the environment for standardization.

We need to consider the road as a whole – maybe down to the chemical level – and understand how recycled materials can be used to make the road whole again.

Does performance only mean technical performance or does it include environmental performance as well? Without knowing what has been used in the road previously, from a composition point of view, how do you know what you get from reclaimed materials?

There is a need for a bridge between North America and Europe to share knowledge. We don't need to reinvent the wheel.

Public-Private Partnership (PPP) represents 15-20 percent overall of the federal road network in Germany. PPP models can set the time frame of performance (20-30 years), but it is the responsibility of the contractor to guarantee defined performance for that period, including maintenance and traffic. Low-cost models are not necessarily the first choice.

PPP models – which open performance more easily – are not popular in the United States because of concerns about the return on investment (ROI). To implement, you have to incentivize how to get the private funding to flow in.

How can we take advantage of big data and machine learning; the “internet of things”? Everything comes back to considering performance as a whole – the end product. Can we demand that producers of the main component (asphalt binder) provide products that best serve the whole of humanity instead of just focusing on making money?

We need to improve the communication between supplier and agency. The only time they meet is to discuss when there is a failure.

PPP may be low-bid depending on agency requirements on purchasing decisions. In most cases, this is not true.

In the future, we may be talking about specifications that are individualized for the specific project.

Some group ultimately has to be held accountable for the performance of the road. Who should be held accountable for the performance of the final product on the road?

How do we get our product

to be more of a manufactured product that has low variability?

We should be able to leverage data from vehicles to collect ride data. Can we use cameras on vehicles to collect cracking information for free? We can then be reactive to where the needs are on the road.

We often forget the past research on asphalt materials. We need to capture and make use of all our existing knowledge by building a repository of information and tying it into information from other industries with which we can connect in terms of material performance. We should not think of asphalt as “asphalt”, but simply another material.

As we move into the future how can we incentivize the people that will be in charge of our roads in the future?

Moderator Bill McGinnis then asked the group to work together to condense the discussion into several large categories. The discussions allowed the group to narrow the issues discussed to the following categories as follows:

General Categories Related to Performance

- Buyers and Buyer Issues
- Performance Standards for Components, End Product, and Users
- Incentives for Innovation

- Incentives for Performance
- Product Delivery Systems
- Binder Composition
- Regulators
- Transfer of Knowledge and Sharing of Research
- Digital Technologies
- Re-Recycling and Recycling
- Environmental Performance Standards
- Future Road Requirements
- Benchmarking of Performance
- A World with Less Refining?
- Sustainability
- Implication of Others' Technologies on our Products
- How do we define performance?
- Marketing and PR
- Specialized Roadways (e.g., smart cars, dedicated truck lanes)

McGinnis asked the group to consider the previous discussion and the large, general categories to ask, "What questions could we pose to a research team that we would like to see answered?" We need to consider where we can have the most impact by being proactive now. The ensuing discussion led to the following questions and top themes.

Macro trends will impact our industry. What do we need to know now to anticipate the increasing requirements on road and roof performance? What are the drivers that will impact performance needs in the future? How will roads/roofs be used in 30 years? How can we use them in the smartest way to serve the

customer? Who do we need to partner with to make sure asphalt is a product of choice for performance in the future?

How can the Asphalt Institute Foundation (AIF) serve as a repository of new research information? Can we build a performance database that will allow us to know what does and does not work well?

Asphalt durability controls so much. Can we design/engineer an asphalt binder that does not age or change properties with time and is UV-resistant? Can we make better use of accelerated aging to assess durability?

How can we move from research to implementation faster? How do we speed our innovation process? How can we learn faster from the experiences of other countries? How can we demonstrate to the end user that an improved product means reduced liability for performance? As an industry how do we best address policy issues versus technical issues?

Can we develop a better correlation between asphalt binder properties and road performance that will allow us to develop a better performance-based specification? What are the contributions of the asphalt binder alone to pavement performance?

How do we take the product that is produced at the refinery and meet the future needs of the industry?

How can we understand the performance of the end product better so that the asphalt binder industry has clarity on how to make a product that will meet those needs? Should we be funding accelerated asphalt mix testing implementation? What are properties of the asphalt binder that are driving mix performance?

How can we assess asphalt performance containing recycled materials? How much asphalt can we replace in the mix or the roof and still have a good product? Can we develop a new PG binder specification specifically for mixtures containing high amounts of recycled materials?

Top Themes:

- How will roads and roofs be used in the future?
- What are the properties of asphalt binder that impact the performance of the end product (i.e., mix)?
- Can we design/engineer a more durable asphalt binder?
- How do we accelerate the innovation and implementation process?
- How do we influence regulators and product specifiers in a better and faster manner?

Chapter 04

Sustainability

The moderator for this 2-hour breakout session, Matthew Rochte, welcomed everyone and set the stage by asking the group: What does sustainability mean for the asphalt industry (for your business, from your perspective)?

Open discussion ensued. Bullet points were written by AI staff on large pieces of paper and displayed around the room. The following narrative is intended to capture the essence of the discussion.

How do we recycle our own materials, and how do we make asphalt and restore the aged materials to its "original" form? We have moved to more and more RAP. Bio materials offer alternatives to our traditional product. How do we become more sustainable and still improve performance? We must maintain control over our

material and how they are used.

Can we reduce mix temperatures farther? Is there a need for a measurement tool? Can we reduce exposure for paving crews?

How do we strategically use asphalt with a diminishing supply? For instance, can we place it in thinner lifts?

When will sustainability be mandated and are we prepared for that? Are we ahead of the curve or behind the curve in how we recycle?

How do we reduce our impacts across the entire lifecycle of a pavement? This includes the use and reuse (and reuse) of our product. If we can get it to last twice as long, we reduce the environmental impact by 50 percent.

How do we get the owners (agencies) to allow for more

recycling? This becomes a technical and education issue on understanding how to recycle effectively. We need recycling to perform well so owners are not reluctant to do it.

Determine what's most important for the stakeholders in terms of being sustainable. Is it performance or recycling? Both deliver sustainability.

Where else can RAP or RAS be used outside of asphalt mixes? Is there a more effective place to use it?

How can we do a better job during the construction process to improve our footprint? For instance, we currently lay mixes way to hot. We also can do a better job with initial construction so it lasts longer.

We need to understand the chemistry of recycling agents, and how to optimally select to best recycling agent based on

WHAT DOES SUSTAINABILITY MEAN FOR THE ASPHALT INDUSTRY?

the chemistry of a particular asphalt and the RAP and/or RAS. In other words, it's all about the chemistry.

What aspects of our industry do we need to identify to become proactive as it relates to sustainability, and to move us to greater sustainability? Are there constraints to making asphalt more sustainable? Where is the talent for the future of our industry going to come from?

We need to better understand RAP, to include how it's processed. Are we characterizing it the way we should so we are utilizing it most effectively?

How do we ensure a level playing field for agencies evaluating sustainability among competing industries? We need to look at the product category rules. How do we increase our involvement in the process that creates these rules? The Netherlands has had a system in place the past 10 years to evaluate lifecycle assessment for a particular project, which can also allow us to evaluate if recycling is the most sustainable. There are new ISO standards being established in this regard.

What performance data do we need to show that new materials, technologies and rehab alternatives are viable options to make asphalt more sustainable thru improved performance?

Improved longevity and performance is critical to sustainability.

We need to be the one writing our LCA, PCR and EPDs. It was pointed out that we are doing that. AI is in the middle of an LCA on binders, and NAPA has a new PCR and EPD on asphalt mix.

Regarding recycling, it's critical that we incentivize contractors or agencies on what needs to be done for a high recycle job to do it well. Need improved guidance for highly recycled content, including improved characterization of RAP. How do we do this better for in-place recycling? This gets back to understanding the chemistry better.

The next IARC monograph will be coming and how are we going to address this? Will the lowering of temperatures effectively help with this?

How to preserve pavements better?

How do the AIF, the AI and their members work with NAPA and the contractor community to look at the overall benefit of recycling, past saving initial dollars, to include performance?

How do the concepts of perpetual pavements (with renewable surfaces) and pavement preservation tie into sustainability? Look at all the preservation techniques being used and identify the most effective ones in terms of performance and sustainability.

ARE THERE CONSTRAINTS TO MAKING ASPHALT MORE SUSTAINABLE?

How do we utilize smart sensors to make our process better and recycle smarter? Using sensors to get real-time data on pavements and to make improved maintenance and preservation choices.

What additives add value to our pavements?

Look at the cost of moving asphalt. Moving asphalt further at less cost makes asphalt more sustainable.

How far are we willing to go with recycling and still be sustainable? As performance deteriorates, we lose sustainability. Tear-off RAS is an example. Repurposing these materials into other industries/products is our responsibility.

The perpetual pavement concept really supports asphalt improving its sustainability position. Recyclability and performance are mutually dependent on each other. Recyclability and sustainability are not the same. More recycling doesn't mean more sustainable. We need to develop a methodology/test to determine the performance of mixtures. This will help ensure performance and maintain sustainability.

We have systems and tools to evaluate sustainability. These allow us to evaluate perpetual pavements, preservation systems, etc.

Look for uses of higher modulus materials in locations where that makes sense.

Can we develop or modify binders that will be more recyclable?

How many times can we recycle a given pavement and still be effective? What to do when we have reached that number? What new products can be made from "used up" pavement?

The PCC industry is ahead of the game in claiming the science such as the albedo credit, green building codes, etc. Where do we as an industry need to be more proactive in this area? We are underrepresented in this area. Credits are being implemented that favor concrete that are not based on science. Urban heat island effect is an example. It's all about the material life cycle. Building energy use is irrelevant. How do we become more sustainable than concrete?

What other industries can we align with?

Need to research the winter deicing benefits for asphalt versus concrete.

Need to quantify the economic benefits of speed of construction for asphalt versus concrete.

Need to change the mindset around heat energy from attributional to consequential.

Can we explore the organic generation of crude oil to increase its occurrence?

Can we look at innovations from our materials? One example may be salvaging energy from the pavement. Can we generate energy from our roads?

Vehicles use way more energy than do the roads. Take a visionary look at the future of roads and see if we can better optimize the geometrics (i.e. lane widths)?

What ancillary industries are impacted by our product and how can we assist them? Map out the ecosystem of asphalt. Are there ecosystem options to reduce our impact? The biggest wins in sustainability come from partnerships. Mutual opportunities.

Define the life cycle of a pavement to better identify a LCA or LCCA. Develop best practices in data mining and utilization of PMS data.

Work with the auto industry over the long term to improve PVI (fuel efficiency).

Identify the barriers that keep us from developing a more sustainable product. Learn from other industries and what they did.

Gather input from the younger generations on our product's sustainability, pulling in millennials.

How do we improve the reputation of our industry? Promote what we are already doing that makes us sustainable and getting this message out. Make it fun. Communicate our message to the public and to agencies that we are the better choice. www.driveasphalt.org Word of caution on legislative/mandated "solutions" to real or perceived problems. We don't want to hitch our wagon to an idea before the science is done. These can create more problems than they solve. Doing this can significantly hurt the trust that agencies have for our industry, something we never want to risk.

Following a break, the session reconvened with the moderator asking the group to identify overarching topics that captured all the earlier discussion points. The notes that were written on large pieces of paper around the room were heavily utilized in this exercise. The following four topical themes were identified by the moderator and group as capturing most of the discussion points. An associated "wide-casting" question was then formulated by the group and is shown below each theme.

Education/Marketing/Communication

- How do we market, educate and promote the sustainability, good science, and good use of asphalt to improve the reputation of asphalt and our industry (to stakeholders, to the public, to young talent)?

Ecosystem of Others

- How do we work with ancillary industries to find best practices to be more sustainable than alternative pavement materials (concrete)?

Measurement Systems

- How to participate in standardizing rules on Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA) that provide a level playing field for pavement materials?

Innovation

- How do we maximize the sustainability of asphalt, from cradle to grave, leveraging existing developments and innovations?

These last two topical themes had only a single comment around each and were included by the moderator.

Future

- What barriers/requirements will exist 20-30 years around sustainability and what role do we play?

Logistics

- How can asphalt/crude oil be moved further and at lower cost with less impact to the environment, and with no impact to quality?

Chapter 05

Worker Issues

HOW DO WE TRAIN THE WORKERS OF THE FUTURE FOR THE NEW TECHNOLOGIES THAT WILL BE AVAILABLE?

The moderator for the breakout session, Bill McGinnis, welcomed everyone back after lunch and set the stage by noting that the group would be talking about worker issues and noted that the intent was to be very broad to capture issues affecting workers at all levels of the industry.

Bill recognized that there could be overlap with some of the ideas and issues in other breakout sessions, but encouraged the attendees to think freely – even if there was overlap with one of the other four main topic areas. Bill further encouraged the attendees to think about things that the industry can do now that will have an impact on workers individually and the workforce as a whole in 10-20 years or more.

Open discussion ensued. The following narrative is intended to capture the essence of that discussion.

Liquid asphalt suppliers make a product that is placed into commerce. Manufacturers provide good guidelines for the safe use of their product, but users – sometimes a whole industry – may take those guidelines and use the product as they see fit. We hope to change that practice to prevent future injuries and loss of life. An example of this is the mastic industry in Germany

The asphalt industry gets judged by the worst that might be out there. We know that temperature is a huge factor; if we lower the temperature, the exposures drop very rapidly. In 15-20 years, the International Agency for Research on Cancer (IARC) will again review asphalt. The asphalt industry shouldn't

be improperly judged based on a smaller cohort such as the mastic asphalt group – a niche market in Europe. Things that can be done to help reduce exposures in that small group could be very important to the industry as a whole.

In the asphalt roofing industry there aren't enough workers now to do what is needed, so how are you going to attract them? A related question – how do we train the workers of the future for the new technologies that will be available? Should we look to design shingles that could be placed without human workers?

The asphalt industry should look to research ways to permanently eliminate hydrogen sulfide (H₂S) from asphalt. This likely a long-term project that addresses a definite safety problem for workers.

Federal Highway Administration (FHWA) along with the Associated General Contractors (AGC) and American Association of State Highway and Transportation Officials (AASHTO) has a workforce initiative, partnered with the U.S. Department of Labor, to identify next-generation workers at all levels, not just engineering. We need to get information on the industry down to the primary and secondary education levels (i.e., K-12). Part of the initiative is also looking at the ways that people learn. The millennial generation accesses and processes information differently because of the available technology than older

generations. Educational efforts need to be cognizant of the way that all generations learn.

Self-driving cars are becoming more of a reality. Does that technology translate eventually to road construction (e.g., automated compactors) eliminating the need for human workers?

What is the workforce going to look like in 20 years? Will it be partially or wholly robotic? How much training will be necessary and should we start now?

It is becoming more apparent based on the discussions that the asphalt industry is going to need a different workforce for the future. Today, the asphalt industry has civil engineers and chemical engineers. In the future, the industry may have more computer or software engineers. How do we attract the best graduates for our industry?

The asphalt industry spent considerable time with the National Institute for Occupational Safety and Health (NIOSH) during the preparation for the recent IARC review discussing human health effects research and some of the discussion centered on the question: Can we get the “bad actors” out of asphalt through engineering? It is a refinery and post-refinery issue. When the next IARC review is conducted will they find that asphalt is a carcinogen, harming the workforce regardless of the end use of the product?

Demonstrating that we can engineer the “bad actors” out of asphalt before it gets to the use phase takes the concern of harming the workforce off the table. If we cannot get the “bad actors” out, can we engineer the potential exposures to an even lower level? For example, automating paving operations would make it so there is no exposure to humans.

How are we going to engineer jobs so that people have the opportunity to work in the future? The automated process is the future. Although there are going to be jobs and hazards, the future could remove workers further from asphalt production/distribution thus lowering the hazard. The jobs will be more restricted to things that a machine cannot do.

Regarding the potential long-term health risk – is it prudent to consider now the possibility of future class action lawsuits and involve the insurance agencies proactively? It is a tricky situation, but if the liability is there then product stewardship dictates that we should not ignore it and should do something about the potential liability.

We have to be aware not only what the process is for developing the product, but also the processes for the product use and its end of life. Ethical manufacturers want to run a company that is functioning at a high ethical level now and in the future. The lowest liability path is to understand all future

potential risks and try to mitigate those future risks through good product stewardship practices today.

Technicians, researchers, salespersons, and other business persons do not think of the asphalt industry in the same manner as a technology company like Google. We need to find how to make the industry more attractive to top talent.

From the perspective of health effects, what data should we be collecting now in anticipation of what we will need 20 years from now?

We are recycling more today than in the past. That increased recycling introduces a set of risks that may not exist when we are just using virgin materials that are controlled. We need to manage and better understand those risks.

Along those same lines, are the additives that we may be adding to the asphalt binder increasing health risks? We have looked at the process for some additives, but we have not investigated many of them.

Do re-recycling and re-re-recycling result in some unintended behavior in the asphalt materials – particularly from a health effects standpoint?

For the size of our industry, the number of schools that teach about asphalt materials is way too small. Just about every developed civil engineering

program teaches concrete materials. There is a built-in bias from the schools towards other products, where asphalt is often viewed as a secondary material to concrete. It is not at all, but that may be the perception. We need to do better at overcoming that perception. It is a long-term, generational effort, but if we don't start it will never happen.

It was suggested that 95 percent of graduating civil engineers do not know about asphalt. Even more dangerous is the fact that those same engineers are writing specifications for the industry. Similarly, construction crew supervisors may have also come from schools without a robust asphalt education. Their lack of knowledge could result in poorer products in place. We need to educate better!

Post-college, FHWA may sponsor state engineers to go to the National Center for Asphalt Technology to learn more about asphalt. While that may be helpful, the pre-college pipeline suffers from the challenge of the Science, Technology, Engineering, and Math (STEM) Program – more students are exposed to advanced technology and end up wanting to do work with robotics and not civil engineering. “Project Lead the Way” is an opportunity to have an impact. It is a general engineering curriculum at the high school level (secondary education). The curriculum incorporates design challenges, one of which is transportation

– albeit often looking at sustainability. There is an opportunity for material sciences to be brought in. However, teacher resources on asphalt materials are unfortunately lacking.

A standardized protocol needs to be developed for testing asphalt products and blends for carcinogenicity.

The image of asphalt in Europe is partly affected by the name of the product. The term “tarmac” is still used, which is problematic since “tar” is in the name and it is associated with cancer. Is there an opportunity to partner with other industries who are respected in new technologies – like F1 Racing – to elevate the asphalt industry so that it has a place in a future dependent on new technology?

How do we influence professional engineering (P.E.) exams around the world so that there are at least optional, if not required, problems on asphalt pavement design and asphalt mix design? Given the product market share – 90 percent of pavements in the United States are asphalt pavements – this seems reasonable. This gives incentive to the curriculum at engineering schools and their students to spend more effort on asphalt.

The AIF internship program is underway. It started by going to career fairs and noting what types of companies are recruiting

WHAT IS THE WORKFORCE GOING TO LOOK LIKE IN 20 YEARS?

engineers. Smaller companies are working to attract talent for a two-way look, both for the student to evaluate the company and have summer employment and the company to get the benefits of a young engineer who they might be able to later entice to work with them on a full-time basis. Our industry needs to follow this model to get excited about exposure to the asphalt business. Internship programs, industry-wide, could be a pathway to that exposure.

What will work look like in 20 years? We need highly-skilled employees, but the challenges offered by one company may not be enough. Could we see a future where multiple businesses share the same employees working on similar projects with remote work locations? The educational battle is at the high school level – how will we teach them?

We need to have a future path for workers who are not going to college or will not get a P.E. Having a path out of high school (maybe a trade school) for potential workers to build skills like maintenance and troubleshooting will be critical to workers – particularly as there may be an increased risk of losing jobs due to automation.

Workers are getting older and union halls are increasingly empty. They (unions) may be good partners as we consider the blue-collar workforce of the future.

Our industry gets judged by our product, therefore the proper

application is imperative and the maintenance workers are the ones that are more critical than ever in affecting the perception in our industry. Developing those workers, particularly at a younger age, and keeping them in our industry is critical.

This next generation of talent is a different breed than what has been seen in the past. They are more technologically savvy. We have to continue to challenge them by pushing down responsibility. We can't lose sight of the need to continue to challenge the people that we have – particularly those without degrees – so that they can continue to be excited about the work.

The push towards social acceptability means that we have to remove the smell from asphalt, not just the H₂S.

We need to raise the image of the road worker so users understand the value of the product and the service it provides to the community.

What should our workplaces look like to encourage workers to join and stay within the industry?

As an industry, we cannot forget the lessons of the American automobile industry in the 1980s who lost significant market share to the Japanese automobile industry due to the perceived lack of quality in the American autos. They had to change the mentality of how they built products to stay in business.

HOW CAN WE INCREASE THE PUBLIC PERCEPTION OF THE ASPHALT INDUSTRY?

It is now all about quality, with the lowest worker on the line authorized to stop the line over any defect. Although we may be concerned about automation, modern manufacturing is all about automating whatever can be automated because the quality improves. How do we engineer the variability out of the process and put the talent where we absolutely have to have judgment – which a human does best?

One of the challenges of attracting and keeping skilled people is the seasonal nature of the work. Extending the paving/roofing seasons to make the workplace more continuous may help us get/retain better people and maintain their skills.

As we shift the workforce from physical work to technology-based work we have to understand that worker safety will now encompass different risks like blue light, ergonomics, and the harm of a more sedentary lifestyle. We need to consider how to mitigate those risks to keep our employees healthy.

What are we looking at 15-20 years down the road when people don't want to breathe anything other than pure air? It isn't a question of whether the asphalt gives off any fumes and whether they are harmful; the worker of the future will not want to breathe any of it. We need to consider how to eliminate all fumes from the workplace.

Moderator Bill McGinnis then asked the group to transition to a focus on items that would most likely fall within the 10-20-year time frame. The ensuing discussions allowed the group to narrow the issues down to several top themes:

There will be a different workforce in the future. How can we improve the attractiveness of the industry to workers in the future? We need to improve our educational efforts.

What will the workplace look like 20 years from now? How will that affect the asphalt industry? We need a safe workplace for all workers.

Can we economically engineer the “bad actors”, like H₂S, out of asphalt?

How can we increase the public perception of the asphalt industry?

What are the risks of recycled materials and additives added to asphalt binder and their impact on health effects?

Brainstorming Session

WHAT DO INFRASTRUCTURE MATERIALS LOOK LIKE IN THE FUTURE?

Bill McGinnis served as the moderator for the brainstorming session of the STAR symposium. He set the stage with a TED talk video of the Director of Healthcare Logistic for UPS. His talk focused on moving toward a three-dimensional transportation system which includes subsurface and aerial options, away from our current two-dimensional surface, and on innovative and automated solutions for today's traffic and congestion issues. Bill challenged the group to think 10-20 years out and to offer items that did not get addressed or fit into the other four sessions.

What follows are the ideas that sprang from this session.

The foundation should conduct a survey of other organizations so that we have an ongoing look forward and we can keep an eye on the progress. Develop a white

paper survey of the estimates of future vehicles. An autonomous vehicle convention is happening this summer. The foundation should talk to them about pavements and sensors. It was also asked what the logistics are going to look like in the future, i.e. rail, etc. Transportation is going through changes if we could take 90 percent of the trucks off the road via automated trucks and dedicated lanes. Existing infrastructure with autonomous vehicles can replace mass transit. Self-driving trucks can make troughs in asphalt pavements unless wander is programed to occur.

It was suggested that asphalt might be an infinite resource in the future. What do infrastructure materials look like in the future and what bio-sources, biopolymers of the future will sequester CO2 – carbon credits? There could be National Science Foundation help available if we seek their help.

Historically, implementation of new technologies is slow. What can the foundation do to increase acceptance and speed the process?

In 10-20 years, what threats to our supply are there going to be? Future supply will depend heavily on coker activities. The development of paths to track what the trends are, i.e., refiners making softer asphalt that could increase the use of RAP/RAS, and do we need to track was discussed. We also don't know about future technology to extract crude. Moreover, the industry saw the lowest demand for asphalt since 2005-2007. How can we influence demand for asphalt with a value proposition or advocacy? And refinery closures in Europe which could affect prices as it affects global supply availability were mentioned. Determining the internal and external factors within the industry was an area that was seen to need exploration. Also, what does the aggregate supply look like in the future which could affect asphalt mixture production capabilities?

Similarly, it was stated that shale oil is lighter with no asphalt content. Therefore, in the United States, there might develop a need to increase importation of asphalt. Should the foundation therefore promote or develop a global specification? Risk and opportunity, identifying who are our current allies in our (petroleum) industry and the impact we could have on them could be a focus for the foundation.

Do we need to do research on the concrete industry, or do we need to investigate regulations in the HSE arena? In the short-term, how do MARPOL restrictions, especially with regards to sulfur, affect the asphalt industry? A discussion about having a "first voice" at the table and the implications that regulations can have on our industry was encouraged. Doing so helps to direct the discussion, making us a leading voice.

Dual purpose pavements, such as electrical generating pavements to charge the batteries of electric cars while in route or for external usage, tolls, to melt snow, or other purposes, could increase the use of asphalt.

It was noted that railroads are moving to asphalt concrete bases, especially for high-speed trains. It was encouraging to look for other places to implement asphalt in future technologies such as autonomous vehicles. Also, building dedicated truck lanes, which will help congestion and it could be self-funding was stated. As asphalt pavements are flexible we could potentially increase the speed of movement. Car life is typically 10-15 years and therefore the roads will not change drastically quickly because a transition time that is needed.

It was further stated that electric cars might increase by 50% over time, affecting the traditional revenue generating stream – gas taxes. Economics plays a critical

role in the bigger picture for the future of asphalt.

What other new areas that could use asphalt beyond roads and roofs that can be explored?

Population growth and how it affects climate change in third world countries could affect migration and how we get food throughout the world. Building roads in remote places and the inherent difficulty therein, how can the industry help to expand access? What are the technological, logistical tools that are needed to do this efficiently? International transportation legislation affects how and the ability to get resources from other parts of the world. This too was seen as an area that needed to be explored.

Where does our future talent come from – we need to sell it the undergraduates and graduate programs. Promoting of innovations with asphalt, make asphalt sexy to appeal to the younger generations, was called for. A student hot mix asphalt design competition similar to the concrete canoe or steel bridge competitions to help make asphalt more fun was offered. The American Society of Civil Engineers sponsors the other competitions and could be partnered with for such a contest for civil engineering students. How do we make people, current and future personnel, more passionate about asphalt? It was also stated that the industry would benefit by having more women in its ranks.

ECONOMICS PLAYS A CRITICAL ROLE IN THE BIGGER PICTURE FOR THE FUTURE OF ASPHALT.

How can we change the viscosity of asphalt without the use of heat which would eliminate fumes? Warm mix asphalt in Europe is used primarily to reduce the temperature of the mix, how will that affect performance and durability long-term?

Customers, stakeholders, and partners are changing, how proactive is the foundation going to be with stakeholders and the decision makers to influence these people, was asked. It was similarly suggested that the asphalt industry could be more proactive in pushing solutions forward to the right partners and stakeholders.

Asphalt and tar are commonly confused with one another. A media fact sheet to understand the difference between the two might be beneficial.

Asphalt is competing in stormwater retention and making an asphalt carpet as an urban hardscape is under attack.

Research global trends to determine key factors for future production, demographic shifts, new and existing market trends, and changing materials.

Roads could accept trash making them more practical to the public as a secondary use for the road.

As had been done with the previous four breakout sessions, the best ideas from the brainstorming session were determined. The top ideas, in no particular order, from it were seen as:

- International specifications to create greater consistency across borders.
- Dual path scenarios to create multipurpose functions and revenue opportunities.
- Influencing decision makers to create a business environment that is favorable for asphalt.
- Asphalt as an infinite resource – we need to know what is going to happen with it.
- Global trends in other parts of the world to best position the industry to respond to needs.
- Influencing demand growth.
- Of these, research on future paths for demand including a review of trends in transportation, energy and other sectors done by other research institutes to increase asphalt demand growth was seen as the top priority.

The final task of the symposium was to create a list from all breakout sessions of the top overall ideas. Nine items rose to populate the following list, again in not in an order of importance:

- Innovate and implement faster
- One message for the entire asphalt industry
- Map out the interdependencies of the asphalt industry value chain
- Influence regulators and specifiers
- Maximize sustainability cradle to grave
- Workforce/workplace of the future and educate
- Influence public perception/branding
- Worker health risk
- Future demand paths

External Input

REFINE THE DEFINITION OF PERPETUAL PAVEMENTS AND PROVIDE IMPROVED GUIDANCE.

A variety of input was provided before the STAR symposium. These pieces arrived via email and through social media. Much of what came in reflected consistent themes as was expressed at the event. The volume was not as great as was offered in Colorado. The following comments were received prior to the symposium:

The need for a unified, consistent voice for the asphalt industry was desired. A total of 16 national organizations were recognized currently by the individual.

Two emails were submitted where the respondents chose to offer suggestions for the primer questions that all invitees received before the event. They suggested that positive impacts to the industry term of sustainability could occur over the next 10-20 years. Aspects that were offered included a

partnership between academia, industry, and government to pursue sustainable technologies; look to improve the recycle life of bitumen and use plastic residues in roadways and demonstrate that cement is a short-term view of road infrastructure and that it is extremely hard to recycle. Another idea was offered on demonstrating that bitumen is safe for workers and the environment. And lastly, encouragement was offered to develop international cooperation to share technologies, raw materials, and to seek future market needs.

With regards to potential negative changes or events over the same timeframe of 10-20 years, six suggestions were offered. One respondent noted government corruption, a loss of good supervision, and lack or scarcity of petroleum resources were seen as potential issues. Another person suggests high

crude prices, the toxicity of bitumen, and accidents involving asphalt workers and/or exposure to H₂S were seen as potential issues.

The third primer question was to look at how the industry can proactively embark on making itself stronger and potentially more profitable in the 10-20-year timeframe. Ideas expressed in response to this primer were to look at the previously offered health and safety issues (H₂S, toxicity, etc.) and to find solutions for them. Additional input was received that suggested that the industry investigate potential synergy of technologies which could further utilize pavements to produce secondary benefits such as the generation of electricity. Looking further into the use of recycled or repurposed materials within the asphaltic materials. And finally, explore various bio-technologies for modifiers, especially polymers, and bio-asphalts.

Another respondent broke their looming potential issued into long- and short-term areas. For long-term they suggested (with edits):

Supply, Logistics, and Demand

– These three were put together as they are interwoven. Available crude sources and the amount and quality of asphalt from refiners will be asked to meet demands for the product. Movement of raw materials and product to the refineries and then the customers will require proper support. The responder posed

the question of whether the industry has the capabilities to support worldwide growth and demand.

Economics – Understand the costs to produce with relevance to usage and supply for the long-term.

Economy – Is the economy growing and future trends (where) and focus on USA, North America but also the world.

Infrastructure Funding – Federal and state funding through gas taxes, highway bills, and recognition of trends throughout the country. Also, private-public partnerships for the future.

Value-added asphalts – Polymers and their proper usage.

Quality – How do we address?

Maintenance Asphalts – Emulsions and thin overlays, is this the future?

Types of asphalt – Current grading systems and validation of them.

Concrete – Assessment of the threat and how to combat it.

Research – What types of research is required for the future? Look to NAPA and AI for direction.

For short-term issues, only one was offered. It was with MARPOL regulations. The question was offered about if and how this may affect

asphalt production and thus supply and economics.

Another pre-symposium response sought to move outside the box and they suggested the following (quoted):

May I suggest we have a breakout session topic of the impact on crude refining and resultantly asphalt production (or asphalt at what price) from the emergence and replacement of petroleum-derived fuels by:

- electric vehicles
- reduced need for fossil fuels for electric power generation caused by evolving solar and wind energy and improved battery technologies and costs,
- the reduced need for personal vehicles due to the evolution of self-driving vehicles,
- the impacts on road construction of self-driving vehicles.

Another breakout session was suggested to address a means to accelerate research and adoption of improved performance asphalts. How to circumnavigate or break down the impenetrable bureaucratic systems now in place.

- How to pierce the veil of misperception that today's asphalt is a homogenous, uniform singular type of material by the agencies
- How to accelerate the use of pavement preservation products / technologies

EXPLORE FUTURE PUBLIC-PRIVATE PARTNERSHIPS.

- We simply do not have the time or reason to continue with how we conduct research (2-3 years to fund + 5 years to conduct + 2-5 years to adopt).

A final responder focused on more of the technical or engineering aspects of roadways. They had the five following items which they thought should be discussed during the symposium.

- Desired a move away from “recipe” specifications and towards performance specifications.
- Develop a better understanding of “good” to “excellent” performance. Utilize forensics for more than just “bad” projects. This was seen to be an issue for hot or warm mixes as well as recycled technologies (hot in-place, cold in-place, full-depth reclamation) and pavement preservation techniques, too.
- Refine the definition of perpetual pavements and provide improved guidance on how to achieve it.
- Look further into air voids and their effect on moisture sensitivity performance. Mentioned the positive performance that is commonly seen with in-place recycled and open-graded pavements with high air voids but excellent performance.
- Explore future public-private partnerships especially in the arena of pavement preservation. Not looking at toll roads, but rather sharing of responsibilities and costs on roads, especially those with the highest volumes.

Following the symposium, as had been encouraged, participants provided additional input via email. It is anticipated that even more comments may continue to trickle in. This information was shared with the AIF Research Committee for their consideration.

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Agenda

Wednesday, May 10

10:00 AM	Registration	(West Ballroom Foyer)
1:00 PM	STAR Symposium Welcome - Pete Grass, Asphalt Institute President	(West Ballroom CD)
	Facilitator's Welcome & Introduction of AIF Leadership - Bill McGinnis, CFA	
	STAR Symposium Chair Remarks - Martin Carlson, STAR Symposium Chairman	
	Introduction to the Asphalt Institute Foundation - Ralph Shirts, AIF Chairman	
	Research Committee Perspective - Greg Malarkey, AIF Research Committee Chairman	
	Introduction of Keynote Speaker - Bill McGinnis	
	Keynote Presentation - Michael Rogers, Practical Futurist®	
	Break	
	Expectations for Symposium - Bill McGinnis	
6:00 PM	Reception (Concludes at 7:00 PM)	(Pompeian & Main Ballroom)

Thursday, May 11

7:00 AM	Registration	(West Ballroom Foyer)
8:00 AM	Setting the Stage for the Breakout Sessions - Bill McGinnis	(West Ballroom CD)
8:45 AM	Breakout Sessions Economics – I; Performance – II	(Divide I & Divide II)
10:45 AM	Break	
11:15 AM	Reassemble & Report - Bill McGinnis and Matthew Rochte	(West Ballroom CD)
12:00 PM	Lunch - Matthew Rochte, "Sustainability: Business Resilience"	(West Ballroom AB)
1:30 PM	Setting the Stage for the Breakout Sessions - Bill McGinnis	(West Ballroom CD)
1:45 PM	Breakout Sessions Sustainability – I; Worker – II	(Divide I & Divide II)
3:45 PM	Break	
4:15 PM	Reassemble & Report - Bill McGinnis and Matthew Rochte	(West Ballroom CD)
6:00 PM	Reception (Concludes at 8:00 PM)	(Mountain View Terrace)

Friday, May 12

7:00 AM	Breakfast	(West Ballroom AB)
8:00 AM	Setting the Stage for the Session - Bill McGinnis	(West Ballroom CD)
	Brainstorming and Prioritization Session	
	STAR Symposium Reporting & Next Steps - Greg Malarkey	
	Special Presentation - Ralph Shirts and Bob Sedon, Asphalt Institute Chairman	
	Closing Remarks - Martin Carlson	
11:15 AM	STAR Symposium Send-Off - Bill McGinnis	

2017 STAR Symposium Highlights



Ralph Shirts, AIF Chairman, presents an award to AIF Research Committee Chairman Greg Malarkey recognizing his commitment to the inaugural STAR Symposium.





Bob Sedon, AI Chairman, presents AIF STAR Symposium Chairman Martin Carlson with the Asphalt Institute Emeritus Award.





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