Closing Remarks 2016 SIRWEC
The Challenges for the Next Two Years

Rick Nelson, P.E., F.ASCE

First of all, I want to take just a moment to thank our colleague and SIRWEC past president Pertti Nurmi for the contributions he's made during his career and wish him the best in his retirement.

I can say that this conference provided a very well rounded program of presentations and posters covering the 5 main topics. Thinking about the knowledge tree Max mentioned in his opening remarks, the past one and a half days has covered that spectrum of data, information, knowledge, and wisdom.

I'd like to see a show of hands – how many here were in this winter maintenance business in 1984? I think that everyone would agree that the work you pioneered has laid a solid foundation for the work to follow. It's encouraging to see the number of younger members here today.

I have a couple of observations regarding the path we've taken so far. First, I had the privilege to attend the SIRWEC conference in 1992 in Minneapolis and it strikes me that the presentations were largely focused on RWIS and the models for making the pavement temperature forecasts. Looking at this program – we've come a long way.

When I made my escape from University of Colorado just down the road from here in the early 80's as a civil engineer, I took a brief detour as an environmental engineer before I came to my senses and took my first post as a maintenance engineer for the Nevada DOT in the western region in 1989. I've had the opportunity to see a lot of the change that Max talked about in his opening remarks. I didn't have a Macintosh then but I did get one of the first IBM PC's with its state of the art 10-megabyte hard drive. I remember when I started in the region my boss told me that in the back of the maintenance yard there were pieces of hardware for this new technology called RWIS that he scavenged from another district. They tried to get it to work and gave up so grabbed on to it before they could throw it away. Maintenance workers never throw anything away! He wasn't sure all the pieces were there but after a few months time we had our first operating RWIS site.

Those first slides of Lee Chapman's presentation on Low Cost Road Surface Temperature Sensing outlined the path we took as we began building the RWIS system to a tee.

Developing better, faster, inexpensive, more reliable communication pathways is one of the cornerstone elements that will open new horizons. The WIFI network available in smart cities, Digital Short-Range Communications being utilized in connected vehicle applications, fiber optics, and microwave technologies set a solid foundation for all the work to follow.

Communication strategies also include communicating with users. Using the user as a data gathering platform has many benefits by making them feel part of the solution and more eager to believe the data from their peers and take more responsible decisions about their travel in inclement weather. As a fellow Wazer I'm more inclined to make route choices based on the information from fellow Wazers.

Thinking back to early erector set RWIS we cobbled together north of Reno, this technology positioned us participate in one of the seminal anti-icing research projects that was part of the first Strategic Highway Research Program here in the US. In order to evaluate the performance of the RWIS pavement temperature forecasts and the effectiveness of using liquids we installed a video camera capable of

recording time lapse video and hooked it to a VHS recorder to "see" the difference in road condition between the test and control sections. How many have a VHS recorder?

It's really amazing to me to see the advancements in mobile and optical sensors available to classify road conditions. As we saw in an earlier presentation, these sensors do a remarkable job.

Thinking about the sensor technologies utilized to gather data and the post processing to turn it into information, many of the barriers that were holding back future development are falling away. For example, the availability of communication bandwidth, the mobile computing power making new sensor technologies available, and the computer resources to deal with big data are eliminating roadblocks to future development.

These aren't the only barriers falling. Remember that VHS camera I mounted on an overhead sign? When the public saw that camera they were convinced it was there to catch speeders, or read their license plates, or see who else was in their car. We made the news for a week. I think society, as a whole, is becoming a more becoming more comfortable and even reliant on applications that track their location and preferences that allow them to see where their friends are and when the get close to stores that sell their favorite stuff and alert them to sales. I have an app on my iPhone here that shows me that my daughter in Reno is where she's supposed to be, and my daughter in the bay area is where she's supposed to be, and the same for my wife in Minden. Of course they can also that I'm where I'm supposed to be too! The same will be true with their transportation experience and we will play a big role in enhancing their mobility and safety.

There were several presentations that talked about these applications. Systems that provide warnings of poor road condition, high winds, poor visibility, and provide advise in routing options will become the norm and in fact expected. These will become more important as the connected and automated vehicle programs gain momentum. Think those are a long way off? Wilf Nixon in his session on emerging issues during the TRB conference this week told us that some 30 major companies are working on this right now. Apple, Google, Volvo, Audi, and many others are spending money to develop and roll out these technologies. And even if you're like me and drive your car until the wheels fall off, there will be apps for smart phones and aftermarket products that will get us into the game. I challenge you to consider this developing landscape as you work on your various projects.

When I went to work for the Nevada DOT, I had two predictions. The first was that to make surface transportation really safe we had to get the driver out from behind the wheel, and that before I retired the only highway maintenance required would be to keep the guidance wire intact and the brush cut so the vehicles could levitate over them. We've made a lot of progress in this area. Cars these days are compensating for a lot of poor drivers. You don't have to look to far in the future before the human interface becomes obsolete and the vehicle itself is the user. We heard a presentation that showed how combining many sensors together can paint a more complete picture of road conditions that could be used for autonomous vehicles. I'm curious, how many here can drive a car with a manual gearbox? A growing lost skill - How many generations do you think it will take before driving itself will be a lost skill? This is something to be thinking about as you continue your work in this arena.

I might have missed the mark about the guidance wire, but we'll certainly have to keep the stripe fresh for the autonomous vehicle to follow and we'll definitely have to keep the pavements in good shape for the foreseeable future.

So long as there are pavements in the form of sidewalks, bikeways, roadways, and runways there will be a need of accurate forecasts and decision support systems. The advancements in this area have been amazing as demonstrated in the presentations this afternoon. We are gaining a better understanding of the complex relationships that exist.   We have to remember that this world we live in is a dynamic

organism and we need to be thinking about the changes we're seeing in climate and how those changes are going to affect our work.

One of the central themes Max talked about in his opening remarks was the Knowledge tree. How data leads to information that leads to knowledge that ultimately leads to wisdom. As I listened to the presentations I caught myself wondering if the was model isn't necessarily a linear one. All the pieces are important and they fit together to make a system of things. Advances are necessary in each of those areas and it's not a bad thing to collect data, or to transform it to knowledge or make it actionable as wisdom. There are important works to be done in all areas. The other thing to remember is that all those pieces are necessary and important to provide for safe mobility during inclement weather. That's why were here.

This business is operating in a very dynamic time. What, with this climate change, connected vehicles and connected users, autonomous vehicles, advancements in sensor technology, and so on - Just when you thought you knew the rules, they change the game.

When it comes to the pace of Technology, you all have heard of Moore's Law? Gordon Moore was a co-founder of Intel and Fairchild Semiconductor. In 1965 he wrote a paper that said the number of components per integrated circuit would double every year and that rate would continue for a decade. This became known as Moore's Law. In 1975 he revised his prediction to a doubling every two years. Here you can see the growth in the number of transistors in an integrated circuit. This has followed a nice logarithmic path and the latest installment in 2012 the 65 core Xeon Phi processor has 5 billion transistors in this processor. Since the development of the 14- nanometer processor makes them even smaller in their footprint. Moore was right, and the pace of invention continues at a rapid rate.

There have been lots of variations of Moore's Law with respect to technology. Cost of memory, speed of processing, and so on. And, pretty much this has been a good forecast for many years. But what happens when the rules change?

There are quantum jumps ahead - leaps forward in orders of magnitude. What happens when we are no longer bound by the physical size of a single electron, when computing is accomplished by photon instead of electrons? When the news reported on quantum entanglement or what Einstein called "spooky action at a distance" where entangled particles remain connected, even when separated by distance – mind blown. How does this relate to our situation here in winter maintenance? Maybe not today or tomorrow, but certainty it will in the future.

So I really haven't done much in the way of adding much definition to the challenges for the next two years, as the program suggested would be the topic of my remarks. But I can leave you with one piece of advice.

To follow on with Max's baseball theme, when you come to a fork in the road, take it. There are many new opportunities lurking just over the horizon and we have to be ready to respond. Is this sun in the photo setting or rising? Being with all of you these past few days makes me believe that when it comes to these opportunities waiting for us in the future, your hard work will lead to great progress in providing safe mobility for commerce and private trips in all weather environments. So for me, this sun is rising…

So as we wrap up this conference I want to take this opportunity to recognize some folks who, without their dedication and effort this conference would not have been possible.

1. The presenters
2. The presiding officers

3. The organizing committee – call out Wilf and Katherine especially for the organizing the food menu.
4. The hotel and staff – thanks to the Wyoming DOT for the PC
5. The sponsors and their generous support: Boschung, Vaisala, Foreca, Lufft, and Teconer
6. Finally, my thanks to you for your attendance and participation