Gary Wolf – wrap up Day 2 (August 3, 2016)

First, I would like to remind everyone about Peter Mutton's RCF mapping project and encourage everyone to send in photos and data as Peter has requested. I think this is a very good project that needs our support.

We heard discussion this week about rail milling vs. rail grinding. The questions was raised as whether rail milling will ever get a start in North America, or will it remain mainly in Europe? This is a good question. I think more data is needed on life cycle cost modeling of these two options, and right now folks are struggling to get some relevant data. Certainly milling has some good benefits like working over timber structures where fire hazard is high, but beyond that, there are a considerable number of question marks.

Not meant to be an expressed criticism, but throughout the week, many of the presentations lacked data about the economic benefit or payback for investment in technology. As engineers, we cannot lose sight of the fact that technology is neat, but it must make economic sense. This would apply to Eutectoid steel rails, clean wheels, rail milling, and on and on. Does the increase cost to make these premium components balance out the cost savings over their life cycle. I know sometimes railroads are hesitant to share economic data, and sometimes vendors don't want to display cost information, but as engineers we must insure that good economic decisions are being made when it comes to managing infrastructure. It would also be interesting to find out how most railways view economic payback. Some may use internal rate of return, some may use net present value, and some may use an annual payback number. Sometimes it is easy to quantify maintenance benefits, but it is really difficult to figure out the probability curve on the risk of failure, that's a hard one to get your hands around and know. In derailments, but for the grace of God, we might have a low cost derailment of some gravel cars, but in another similar derailment involving crude oil, there could be a huge economic cost. I think the Lac Megantic derailment in Canada may end up costing 2-3 billion dollars. If that derailment happened in the prairies, cost could have been only several million. So when it comes to preventing catastrophic failure, it is hard to figure out the probability of what that failure could cost. But there are 2 things when we talk about savings. The routine maintenance savings are pretty easy and pretty predictable, but we really have to keep in mind and try to quantify the cost of failure if we don't do some of these practices, if we don't grind, if we don't maintain, if we don't true wheels and we don't search for vertical split rims and things like this.

I think another very interesting topic that Don Eadie started yesterday on is the correlation between broken rails. We saw a couple of good presentations today, the BN data etc. The correlation between broken rails and rolling contact fatigue. I've always felt that there was this correlation. The other interesting correlation that we learned was the correlation between turnouts and road crossings and the predictability of the fact that broken rails may occur within those zones, because we have hard transitions in those areas. Turnouts are a hard spot in the track, road crossings, bridges are hard spots in the track. And I've noticed in my travels and inspections that a lot of times when you come off a road crossing you can see a periodicity to the RCF development because you know the wheel is bouncing at a certain frequency depending on speed and what have you. I think that if we trace that even further we could see a correlation of broken rail development in those areas. So I think that's a very fruitful area for *future research as we move forward, and we should keep working on this modelling of broken rails and the interaction with rolling contact fatigue.*

And then another interesting correlation is the effect of track geometry on both the development of rolling contact fatigue and the curious phenomenon of rolling contact fatigue influence on geometry perturbations. I think it was Brad - did you mention this yesterday about surface roughness inducing geometry perturbations? (Brad agrees that it was in one of his slides). So do we really understand this closeness or this symbiotic relationship between rolling contact fatigue, one feeds the other and the other feeds the first, so we have a total feedback loop there. And that's another very fruitful area I think for continued study and continued data analysis on that. I know I did a paper about 20 years ago, at Gord Bachinsky's WRI conference, where I took a bunch of data he collected on rail wear and then I correlated it against track geometry car run over that same track, and there was a very distinct correlation for several examples where we had geometry perturbations on the track and we could show that that created contact stresses that not only produced RCF but also excessive wear rates in those very localized areas. A big one I'll mention that I've noticed is the influence of alignment defects. You know we all assume that as long as our alignment is within our regulatory standards that everything is fine but I've noticed in unbundling some derailments and things where we've had wide gauge, where we've had an alignment defect in a curve, that increases the curving dynamics, the flanging forces, and it will start to push against the gauge and so again geometry feeds other geometry parameter. Another one is curve elevation. We've all walked curves where we're over elevated and we're running under balance speed we see tremendous RCF development on the low rail and often that leads to broken rails, excessive stresses, pumping and other bad things. We got to keep in mind that geometry and rolling contact fatigue, all this stuff is very, very tightly knit together, and when we assess geometry, we need to assess from the standpoint of its effect on the RCF development.

Another interesting thing we learned about today was the influence of weather, a number of speakers have talked about the predominance of rail failures and wheel failures. Steve Dedmon brought us up on the whole freeze/thaw cycle on wheels, and how that can develop the crack propagation in wheels in the wintertime and we certainly saw some significant data on the number of broken rails that occurred in Oct, Nov, Dec - the cold winter months, and I guess we will always have the weather to deal with, global warming and some believe it's here but we're still a long way off but we're still going to have winter cycles so I don't think we can rest on that one. The other thing that winter and summer comes back to, thank god our last presentation today actually had a picture of the ballast in the track, we heard the talk yesterday of ballast and I know it's the dirty part, it's the rock and the dirt, nobody wants to talk about the ballast but it is an integral part and we see changes in the ballast modulus in the season and we need to be cognisant of how the seasonal variations affect the vertical modulus of the track structure and again it feeds back into all this stuff so it's not only temperature it's what it's doing to the support elements underneath.

Good comment by Joe (Kalousek), we need more kneelers in our industry. I'm amazed and I thank Joe. If we could put an App on one of these (he holds up his cell phone), these young kids might be able to do it, but you know everybody today walks around with one of these and nobody can get down on their knees and look at the rail and look at the ballast, look at the fasteners, look at the ties and come away with an *understanding of what's going on. First thing I do when I got a derailment, mess of metal piled up, I get down on my knees and I just start crawling along letting the rail speak to me, letting the marks speak to me as to what is going on in this dynamic environment and I think that was a very good comment Joe about the current people, you know our young engineers all they do is sit behind computers. Are they getting out on the railroad and kneeling down and letting the rail speak to them, letting the track structure speak to them, can they do that, and maybe we do need an app to teach them how to look at things on the rail and marks that you've mentioned Joe and teach them how to read this kind of stuff, I thought that was a very good comment.*

Couple of presentations have talked about measurement, of these various parameters and I think we...another fruitful area for research is setting some broad standards for measurement intervals, how often do we need to measure things to be able to come away with a statistical reliability that what we are looking at has significance. Do we need to measure it every foot, like when you do a profile of a rail, or wear on a rail? Is a one foot interval or a ten or twenty foot sufficient? And this might be a good group that could maybe next year or years down the road come up with some ideas on the various parameters whether it's geometry, whether its wear or RCF, whether it's eddy current, whatever it is, what are the appropriate intervals for taking various kinds of data measurements?

A couple speakers have mentioned this topic, both on the wheel and rail side, and that is that tenuous balance between natural wear and mechanical forced wear due to maintenance interventions. In other words when we true a wheel we take metal off versus how much metal is wearing off naturally, and then when we grind or mill rail the same kind of thing. I'm sure it is linked to the magic wear rate, but I think that's another good area of research, is where is that balance between natural wear and man-made wear by intervention? And a lot of things we do obviously removes metal and shortens the life of our assets and where is that intersection there.

This topic came up and it's one near and dear to my heart and it's the advent in our industry of high adhesion locomotives. We've been dealing with these monsters for about 15-20 years now, where adhesion levels are now approaching about 50% on some of the new locomotives the high horse power locomotives (comment by Brad Kerchof – "and that's a locomotive that weighs 430 thousand pounds"). So we've increased the weight to give us better adhesion but General Electric now and maybe EMD (but I haven't heard from them), but I know that GE has got upwards of 50% adhesion. Now what is the effect of that, I think it's profound because we're now concentrating were we used to have 4 SD-40's spread out over 300 feet of track we now may have only 1 or 2 high adhesion locos over 150 feet of track and we're putting a heck of a lot of creep-forces (all these locomotives will naturally creep anywhere from 1 to 2 to 3%) so we know we're putting traction creep in and we're putting lateral creep in trying to maintain adhesion in curves and it's great to have high adhesion locomotives, I'm sure there's big economics behind it but is it impacting what we do as infrastructure maintainers both with wheels and rail in terms of handling these ... One affect I've seen is a big locomotive like that when you concentrate that much traction or braking effort in a small area can start to move that rail around, and I've been involved in a couple of track buckle derailments recently where at the bottom of grades and things we're getting buckles and everyone says well we laid the rail at 95 (°F) but you don't understand when you start pushing that rail with these high adhesion locomotives you can lower the effect of neutral temperature *quite quickly, I'm sure Harold (Harrison) has some data on that. That's another thing that as we cross the world, who has is it? Sweden that has a 15 thousand horse power locomotive (response from audience: 10,000 MW), huge monster so this is something, it's here it's not going away but these things concentrate both a lot of forces at the head of the rail, into the track structure, against the anchoring against the ballast section etc.*

Another good thing I heard today is, which is I came from the Southern Railway back in the Southeast and we had a rule, believe it or not, that you would never use the automatic air brake, and I was told at a young age that anytime you touched the Westinghouse air brake, 6 things happen and 5 of them are bad. I think that was reinforced today with some of your comments about tread temperatures and the effect of that and how heat into a wheel can actually deflect the wheel and change the rolling radii characteristics of that wheel, some important stuff. We always thought that certainly we could get flat spots and we could get overheated wheels but there's a lot more refinement to that and we're beginning to get an understanding on the effects of high heat and as we've gone to longer trains, bigger trains, and the demand on the brake systems has increased proportionately so you know we have to have be more cognisance of what air braking is doing if we use air braking and the brake horse power going into the wheels and the effect of that on the metallurgy and transition of the wheels etc. And it gets back to temperature, heat and cold, the effects on steel.

Throughout the presentations and the last one was a good example, or our second to last one: the difficulty in controlling experiments. A number of presenters would get up and say well we did this and that, we only has 28 samples or we had 50 samples or whatever it was and the question comes back is when is an experiment statistically significant, and I think again as engineers we have to touch into the statistically significant realms, we just can't take data or make predictions. We have to know whether those predictions are statistically significant and I think we're a long ways off from being able to know when an experiment is good or bad and how to control experiments, whether we're doing full scale laboratory test rigs as our second to last presenter was talking about today or are we doing experiments out on the track and getting data out in the real world and god knows it's hard to control the variable so there's that tenuous balance between simulation work, between laboratory experimental work and between real world data and we have to continue to keep in mind the relevance of those three things, they all have a point or a position in what we do or a place certainly, but we have to understand the limitations of each of those methods. Simulation is great because you can control a lot of variables but then you have to make pretty good assumptions and estimations on some things, laboratory testing has a place and certainly the field is out there as our experimental data base as well, but it is very hard to control things in the field, I think all of us have found that out and many presenters have mentioned it. But it would be good if maybe this group thinks about what are some of the standards that ought to apply to field testing, to laboratory testing and simulation work, kind of what should be our parameters to reach a valid conclusion from those methods.

It's really amazing too, my final point here is how much data we are collecting as an industry across all the boundaries, Europe, America, South America, wherever. The number of detectors out there today, the amount of data being collected on a daily basis with automated machine vision systems for track inspection, for wheels, for wheel profiling, and are we really managing that and how do we manage and *use all that data and there's probably a lot of data being collected that is not being properly utilized, everybody in this room has data squirreled away somewhere in some of their test files and things that would be valuable to everybody, but are we really using this data? Sometimes I fear we strictly use this data to protect ourselves from regulatory intervention and once we get that off our back we're not using the data to really optimize the operation. You know I've seen some of this in the track geometry, oh we take geometry readings to satisfy the FRA, no offense Ali (Tajaddini FRA) and you know once that's done I don't care what else it can tell me, you know I'm not going to use it for anything else other than insuring I meet the FRA standards in our country, or Transport Canada in Canada, and I think that is a very short sided approach. Track geometry data is loaded with nuggets of information if you want to use it in an more advanced method and not only that but wayside detectors out there give us a lot of information on the health of our fleet, of our wagons, our wheels and again are we just using it for regulatory compliance or are we using it as engineers to reach a truly optimal state of railroading?*