SWITCHED ON

Professor Dorte Juul Jensen on how the **INTELLISWITCH** project will help Rail Net Denmark optimise its services

When metals roll against each other under high loads, damage may occur in the form of plastic deformation, lipping, rolling contact fatigue, etc. This may lead to crack initiation, evolution and finally to the failure of the metal component. This is the situation for components such as gears and bearings in wind turbines and for the rails and wheels of trains.

In a new project called INTELLISWITCH, supported by DKK 12.7m (~€1.7m) from the Innovation Fund Denmark, such challenges are going to be investigated for switches and crossings (S&C) in the Danish rail net.

The co-ordinator of the project, Professor Dorte Juul Jensen, spoke to Pan European Networks about how the project will help Rail Net Denmark optimise its services.

What is the background to the project?

Switches and crossings are critical elements in the whole railway network and are very expensive to maintain (and can require a lot of maintenance), with significant consequences should this maintenance be neglected. Maintaining the switches and crossings is also crucial for the regularity of the traffic. Switches are furthermore composed of several moveable parts, which makes them complicated elements that are difficult to maintain. As such, Rail Net Denmark – which has a great track record in this area – spends a significant amount of money on maintaining its switches and crossings.

Dorte Juul Jensen

The idea behind the project was to develop a maintenance performance indicator which can estimate the need for the maintenance of individual S&Cs, taking into account the loads and dynamic forces as well as the mechanical and metallurgical conditions of the S&Cs. With such an indicator, appropriate maintenance can be predicted in advance, thus avoiding unscheduled repair and delays in railway traffic.
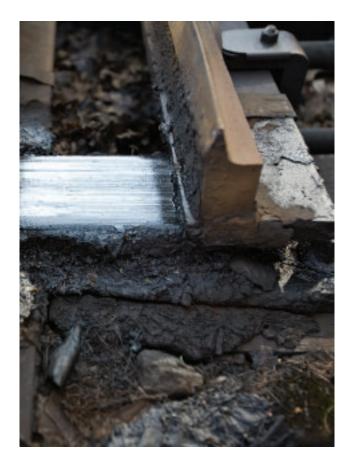
A very holistic approach is taken, which incorporates many different areas and disciplines, from those with expertise in data handling to those with an in-depth knowledge of sensor technologies.

How important is this approach and what are the challenges involved in bringing these different specialists together?

It was clear from the start that a multidisciplinary basis would be fundamental for us to achieve our goals. Indeed, as the project will involve the development of a sensor system which will be mounted on one or more S&Cs – so that it can read the loads, detect the acceleration of trains, etc. at the S&Cs – experts on sensors are involved. We have also recognised the importance of including mechanics because it is necessary to understand the forces that the S&Cs are exposed to and how the ballast, sleepers and rails react to both load and acceleration. Then there are the materials scientists, such as myself, and we investigate how the trains will affect the rails. From our perspective, it is not enough to simply look at the faults; we must try to prevent them from occurring. By understanding what kind of impact has occurred, we can better understand ways to prevent it from happening again.

The final step is to handle all the information being produced. This is very important, and a final group with a background in statistics and data analysis will deal with the big data sets. It will take the sensor input and the mechanics and materials models and develop the maintenance performance indicator. This significant goal has been identified by Rail Net Denmark

as being of particular importance. The indicator will tell us the condition of the S&C, perhaps using a numerical sequence to indicate deterioration. This will enable Rail Net Denmark to optimise its maintenance activities.

Each work package within the project has a leader from the Technical University of Denmark as well as a representative from Rail Net Denmark. This is to make sure that we are always aligned with the practical needs and remain grounded.

The work packages are progressing nicely, and that tends to make things easier for a project leader who perhaps is not entirely familiar with some of the elements that fall outside of their own area of expertise. Furthermore, should an area emerge that, from an academic point of view, is scientifically interesting (and from Rail Net Denmark's perspective is practically important) then we will try to investigate it further. That 'plasticity in approach' requires sound leadership.

Having been awarded funding from the Innovation Fund Denmark, would you like to comment on the availability of finances for research projects of this nature in Denmark – or perhaps the Nordic region more generally?

The way research is funded has changed dramatically over the last 20-30 years from government funding going directly to universities, to researchers now having to apply for finances from different places. Of course, some may argue that this is a positive

change, but it does mean that a lot of good research doesn't receive the money it needs simply because there are not enough resources for everyone (this is certainly my own experience both as a researcher and as a member of the panel at, for example, the European Research Council, where I sit at the other side of the table and have to turn down very good proposals because the finances simply aren't there). Yet, by writing proposals, the researchers are able to mature their thoughts and thus able to properly identify and outline what it is that they really want to do.

The Nordic countries are not so very different from Europe in this sense. There is a trend, which is very clear when it comes to both the Innovation Fund and Horizon 2020, when they are compared to some of the former framework programmes, for instance, in that they are focused on something closer to practical use. Indeed, there is a focus on technology readiness levels in Horizon 2020 that have to be quite high. While this does help to foster innovation and boost growth, there is also the argument that this comes at a cost to blue sky research.

The Innovation Fund allows us to have a significant degree of control over our activities, and Rail Net Denmark is really open to scientific advances. Furthermore, we have four years – while from a scientific point of view this may not be seen as a particularly long time, it is from the industry perspective – which is a good compromise.

The Innovation Fund supports very strong collaboration between industry/infrastructure providers and us, and, in this case, it is working well. The fund also places emphasis on involving young people; we already have three young scientists on-board.

Although the project is still in the early stages, what progress has been made thus far, and where will your priorities lie moving forwards?

Progress thus far is very positive. The first thing we had to do was acquire the sensor systems, which we are now almost ready to install, and after that we will begin to generate data.

INTELLISWITCH

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