5 breakthrough innovations and technologies that will shape the future of railway maintenance
Introduction

We are living in a time of innovation and massive technological advancement, and it is clear that the ever-increasing pace of technological advancement will be a major driver of change in the rail industry in the coming months and years.

What’s more, the history of technology teaches us that technological progress is not just linear, but exponential. Today, we are witnessing huge advances in the fields of nanotechnology, biotechnology, information technology, and the cognitive sciences (known as the NBIC fields). Developments in nanotechnology and material science are leading us towards lighter, stronger, and greener materials, while innovations such as 3D printing are set to transform the supply chain, drastically reducing the need for mass-produced manufacturing, transportation and storage.

The implications of such developments for the railway industry are significant. In this paper, we present just five of the ways that recent developments will shape the future of railway maintenance.
Traditional vehicle inspections to monitor the condition of trains and their components are labour-intensive, time consuming, and costly. This long and difficult process is prone to human error. Moreover, some components are difficult to reach, and some are difficult to measure.

Automatic vehicle inspection is changing all this, as more and more companies turn toward advanced inspection technologies. These technologies can reliably offer repeatable and accurate inspections of key risk areas, such as wheel profiles, brake pads and blocks, and pantograph carbon, raising an alarm when these components reach a minimum size.

Besides already existing recent technologies in this area, there is further potential for the development of x-ray and radio technology to inspect components that are hidden or difficult to reach. The release of such technology is not far-off.
2. Drone technology

Railway lines can cover thousands of miles over the countryside, miles away from the nearest town. In many parts of the world, we find railway lines crossing all kinds of terrains and climates. This poses significant challenges for maintenance, for in extreme climates, tracks need to be inspected at least once a week. This makes for a labour-intensive and expensive process.

The problem of track maintenance in isolated places and extreme climates is now being tackled with drone technology by a number of innovative and forward-thinking companies. Drones were first used in the industry in Germany to tackle the expensive problem of vandalism. A number of US rail operators are now beginning to turn to drones to monitor and inspect track in the far-reaches of the country.
3. Condition-Based Maintenance

We live in the age of Big Data, with ever-increasing amounts of potentially useful data being produced. In the rail industry this data is now being increasingly harnessed to improve safety, reliability, and operational efficiency.

Within rail maintenance, Big Data is being harnessed for what maintenance experts call Condition-Based Maintenance (CBS). Through Streaming Data Analysis (SDA) of Big Data Streams (BDS), rail assets can be monitored so closely that deterioration can be detected before it leads to major issues such as failures in the system, and costly resulting service disruptions. By harnessing the power of data, CBS is a cutting-edge field of current research that is set to revolutionise rail maintenance.
4. Additive manufacturing for product maintenance

Additive manufacturing enables the manufacturing of parts whenever they are needed, without the need to deal with supply chain and inventory carrying costs. Advanced manufacturing techniques, such as 3D printing, laser sintering, and stereo lithography mean that it is possible to simply buy a license from a manufacturer over a cloud-based service to build whatever part is needed. Additive manufacturing can offer rail maintenance teams of the future flexibility, control of their own supply, and the freedom not to hold on to thousands of spare parts that are risk of obsolescence.
5. Laser scanning systems

The four common issues that cause problems with rail tracks incorrect track geometry, incorrect relation of gauges, instability of subgrades, and instability of ballast. For some time now, laser technology has been used to measure track geometry. But laser technology can also be used to quickly and accurately address the three other common safety issues. As well as for the measuring track geometry, some companies are using laser technology to accurately measure gauges (the distance between the track and other objects that might get in the way of the train), subgrade instability (such as that caused by a landslide), and ballast instability resulting from insufficient ballast depth. High density point clouds – an ever newer technology – can also be used to make these measurements. Yet, arguably, laser technology is just as effective, and significantly more cost-effective.
References:

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