Railways are an essential means of transportation in Japan. The East Japan Railway Company approached PARC about employing condition-based maintenance to help improve train efficiency and safety for their more than 6 billion yearly passengers.

**OBJECTIVE**
*Improve train efficiency and safety*

In recent years, the East Japan Railway Company, or JR East, has faced the challenges of an aging infrastructure, reduction in the number of new train maintenance specialists due to the decreasing population, and rising costs alongside shrinking budgets. JR East was in search of an innovative solution to address these problems and ensure their trains continue to run reliably each and every day for their passengers.

**WHY PARC?**
*PARC’s condition-based maintenance technologies*

Condition-based maintenance (CBM) is a concept in which maintenance of machinery is performed when the need arises, as opposed to traditional practices of time-based maintenance (TBM) and reactive “fail and fix” or planned maintenance, which can be costly, prone to human error, and in worst case lead to downtime or accidents. JR East turned to PARC to deploy PARC’s CBM technology suite, which employs model-based algorithms that enable 90% or higher accuracy and low false alarm rates, and need only minimal data sets in some cases. Together with their open innovation model and breadth of interdisciplinary expertise in system sciences and materials, PARC was the perfect choice for JR East.
“Now the knowledge normally obtained and accumulated among train maintenance workers through their work can be revealed with IoT technology.”

- Atsushi Yokoyama, Head of Technology Planning, JR East

**SOLUTION**

Customized fault detection and diagnosis software

With PARC's partner Nomura Research Institute (NRI), PARC interviewed JR East engineers, R&D teams and maintenance technicians to understand the problem and discover how the CBM technology could be used. After gaining an understanding of the available data to train the machine-learning algorithm, as well as the need for data-driven versus first-principle or hybrid models, PARC suggested an analytics approach to JR East. PARC then created dashboard mock-ups, gathered feedback from JR East end users, and began rapid iterations of algorithm and software development. The end solution? PARC developed customized fault detection and diagnosis pilot software, leveraging advanced machine-learning and model-based system analyses approaches, to test an initial CBM pilot for JR East focusing on train door and railway track maintenance. Dashboards were also developed for JR East engineers to visualize and better understand the obtained data. PARC and NRI are now working with JR East Technical Center teams to test and implement these solutions on some of the most heavily used train lines in Japan.

**RESULTS**

High true positive rates, low false positive rates

Initial tests for both the railway fault detection and train door detection indicated very high true positive rates and very low false positive rates. Further tests are currently being conducted to validate findings and prepare for field implementation. Once installed, the CBM dashboards would enable JR East to detect and repair upcoming train failures before they happened—all with remarkable confidence. This would allow JR East to improve efficiency, cost-effectiveness and most importantly, keep trains running safely, optimally, and on time. Condition-based maintenance technology has great potential in transportation and many other industries like energy storage and smart manufacturing, and is one step toward PARC's broader quest to enable self-aware, self-adaptive systems.