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Improve Haul Truck Availability by Braking System Failure Prediction Using Advanced Data Analytics

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The aim of this article is introducing a haul truck availability improvement multi-objective computer model developed by using Artificial Intelligence Methods (AIMs) to complete predictive analytics for the haul trucks braking system. This model will be developed as an on-line service or a software package working with existing data collecting and analysing systems to predict serious and catastrophic failures in haul trucks' braking system. This model makes a priority list for future maintenance activities to reduce unscheduled events, avoid catastrophic failures, and provide a platform for ongoing proactive maintenance. All recommendations created by the model will be filtered and sent to operators, supervisors and mine managers for making better decisions (See Figure 1).

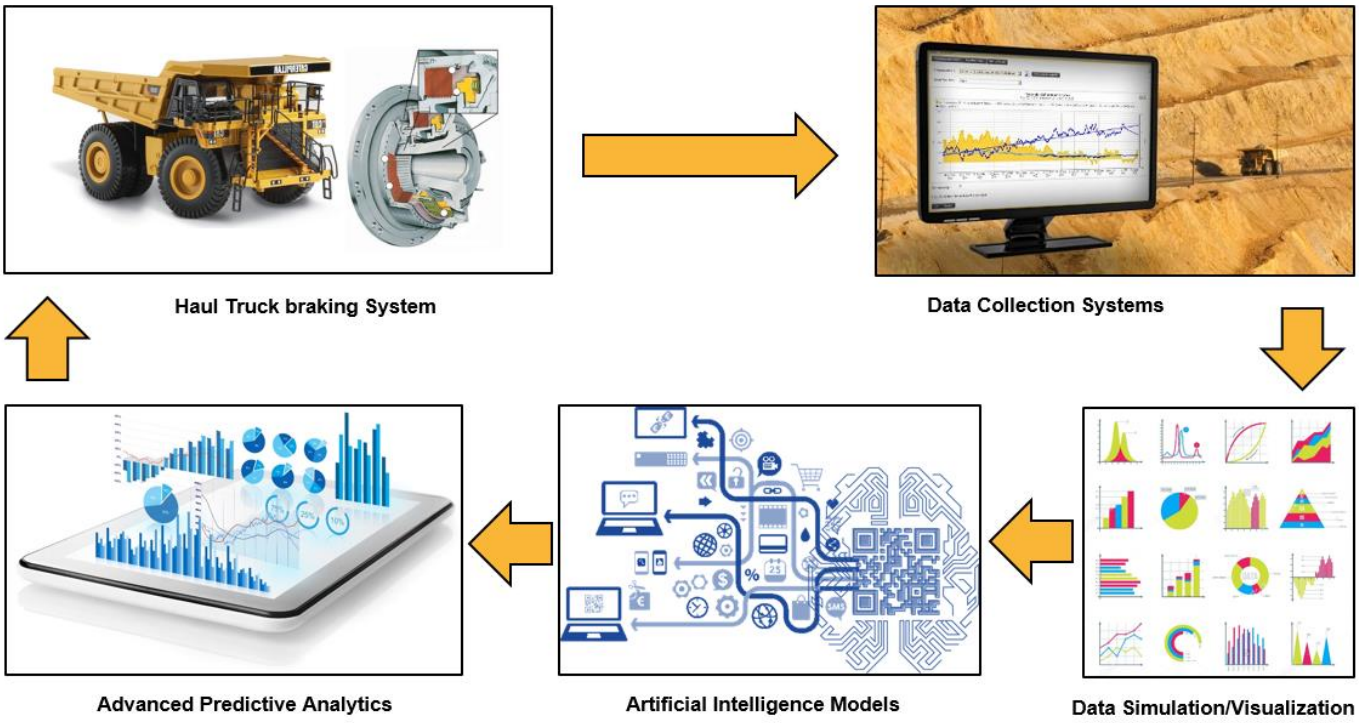


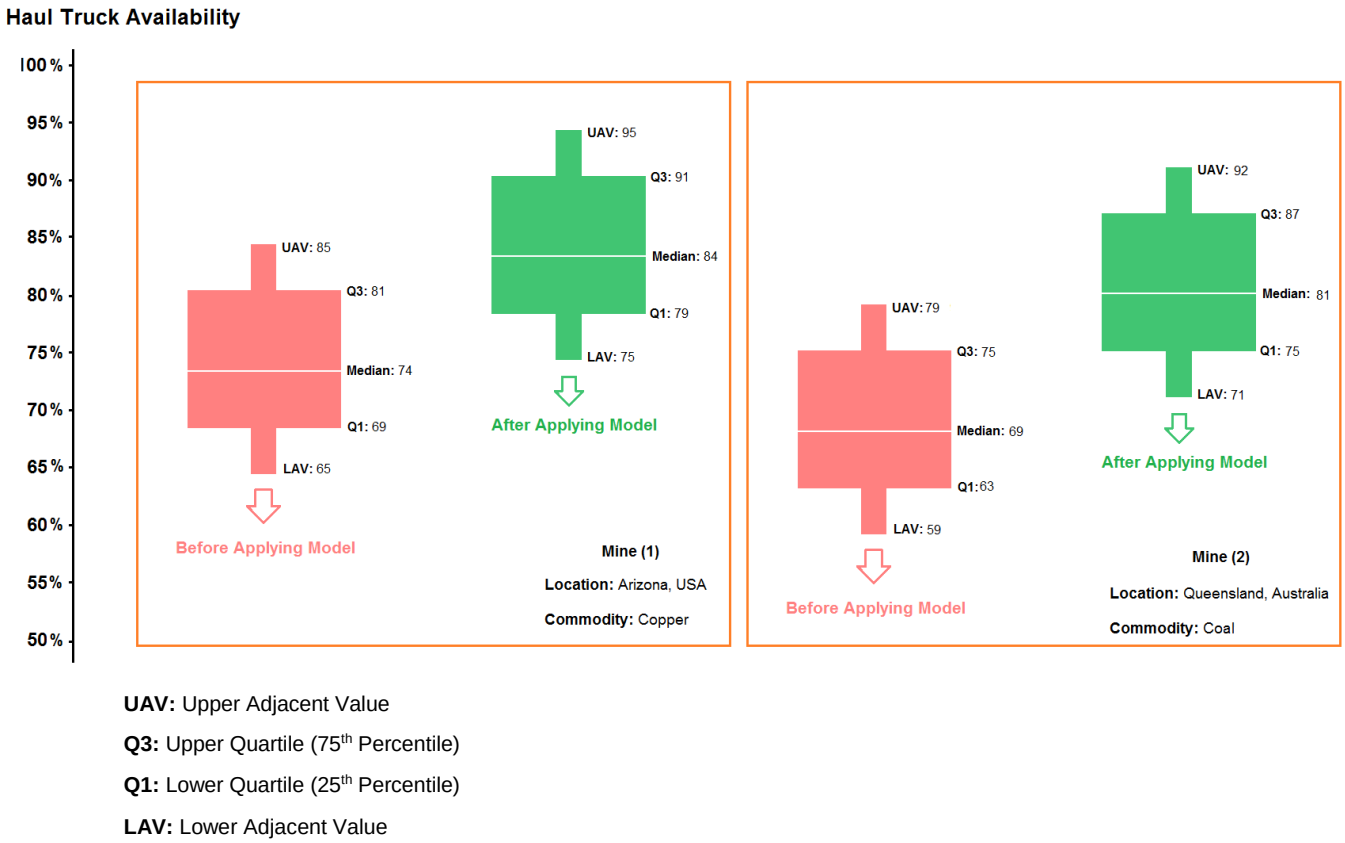
Figure 1: Developed multi-objective computer model using Artificial Intelligence Methods to complete predictive analytics for haul trucks braking system

Haul trucks move the main part of mine materials in open cut mines. One of the most important components of trucks is braking system. This system plays a main role in hauling trucks availability and as a result mine productivity. Moreover, 30%-40% of total open cut mines costs spends for scheduled and unscheduled maintenance annually. Based on the collected data from some big open cut mines in the United States and Australia the main part of maintenance costs is just for haul trucks repairing. Furthermore, one of the effective parameters on increasing safety in open cut mines is improving haul trucks activities in the fleet.

There are different collecting data systems installed on haul trucks connected to control room for monitoring trucks' components performance. These developed systems transfer a millions byte of data in just a couple of seconds. All developed analytic computer models prepare different types of on-line and off-line graphs, tables and reports for operators, supervisors and managers. These reports do not assist a person on site as they do not provide the information that shows the problem unless you are a machine expert. The reports do not provide recommended actions so even if you are an expert you still have more work to do. It is for these reasons that the main part of reporting from developed

software packages is ignored and we still see the premature failures in open cut mines. Many actual alarms are not resolved in a timely way, leading to equipment damage and potential HSE risks. Drivers and supervisors are inundated with alarms, many of which are spurious.

Developed computer model has been validated in two surface mine in the United States and Australia. The first mine is a copper mine located in Arizona, represents one of the largest copper reserves in the United States and the world. Having estimated reserves of 3.2 billion tonnes of ore grading 0.16% copper. The second mine is a coal mine located in Queensland, Australia. The mine has coal reserves amounting to 900 million tonnes of coking coal, one of the largest coal reserves in Asia and the world. It has an annual production capacity of 13 million tonnes of coal. Some results of using the developed model in two above mentioned mines are illustrated in Figure 2.



UAV: Upper Adjacent Value

Q3: Upper Quartile (75th Percentile)

Q1: Lower Quartile (25th Percentile)

LAV: Lower Adjacent Value

Figure 2: Haul truck availability improvement by using the developed model

The achieved results show that the haul truck availability has been improved about 14% in Mine 1 (Copper Mine, Arizona, USA) and 17% in Mine 2 (Coal Mine, Queensland, Australia). Modelling and validation have been completed based on the real mine site data sets collected for CAT 793D in both mines.

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