Development of Bus Maintenance Information Advisory System

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New York City Transit's Department of Buses faced a problem of buses frequently breaking down during operation. Two approaches were explored to reduce the number of breakdowns. The first approach involved using transit data to develop statistical models to effectively predict the failures of critical components. This would also help in scheduling the buses for maintenance operations. In order to have an impact, systems that had the most number of failures were identified for the study using Pareto Analysis. These systems consisted of a plethora of components, which were grouped into families. Relevant data were extracted from the central database and validated before being reduced and prepared for statistical analysis. Various models were studied, but reliability analysis was preferred over the rest. A software application using Visual Basic was developed to automate the process and assist in determining the life various components in a bus.

1	Air System MO Causes GMC RTS 04 1981			
2	Jan 1997 - Sep 1999			
3	**Component Name**	**Comp #**	**Frequency**	**%**
4	AIR DRYER ASSY.	06	68	0.221
5	AIR COMPRESSOR	04	46	0.149
6	AIR COMPRESSOR AREA	0402	35	0.114
7	AIR LINES OVER DU	040502	19	0.061
8	AIR COMPRESSOR PUMPING OIL	04012	16	0.052
9	AIR GOVERNOR	01	13	0.042
10	AIR DRYER MOISTURE EJECT VALVE	0605	10	0.032
11	AIR SEAT, OPERATOR'S	8005	9	0.029

The second approach for reducing breakdowns that was explored was smart sensor technology. It is evident that a more accurate method of predicting a bus's next failure, such as predictive maintenance, would be useful. One specific application of predictive maintenance is to install sensors on each bus that collect and analyze data in real-time (while the bus is running). These data can be used to predict when the failure of certain components will occur. With the advent of high-speed personal computers and the boom of technological advances in the electronics industry, the cost of using computers to collect data from a network of sensors is decreasing rapidly. Such technology is the focus of companies like Clever Devices, developers of the IVN II system.

The IVN II (Intelligent Vehicle Network) system uses automatic vehicle monitoring, a network of sensors connected to a computer that collects the types of data required by a predictive maintenance system. This study identifies what data should be collected from buses to effectively implement a predictive maintenance program. Several steps were taken to achieve this goal. The first step was to determine which systems, such as the air system, engine, and transmission, are critical to the operation of buses, and which systems cause the most unscheduled maintenance. After the critical systems were identified each system was studied in detail to determine the components critical to the operation of that system. Consequently, a catalogue of sensors that can collect data to predict the failure of components was generated. After the completion of this study further work is expected be done to develop methods of checking for proper operation of buses based on data from the sensors.

Sponsors: New York City Transit
Completion Date: 2002