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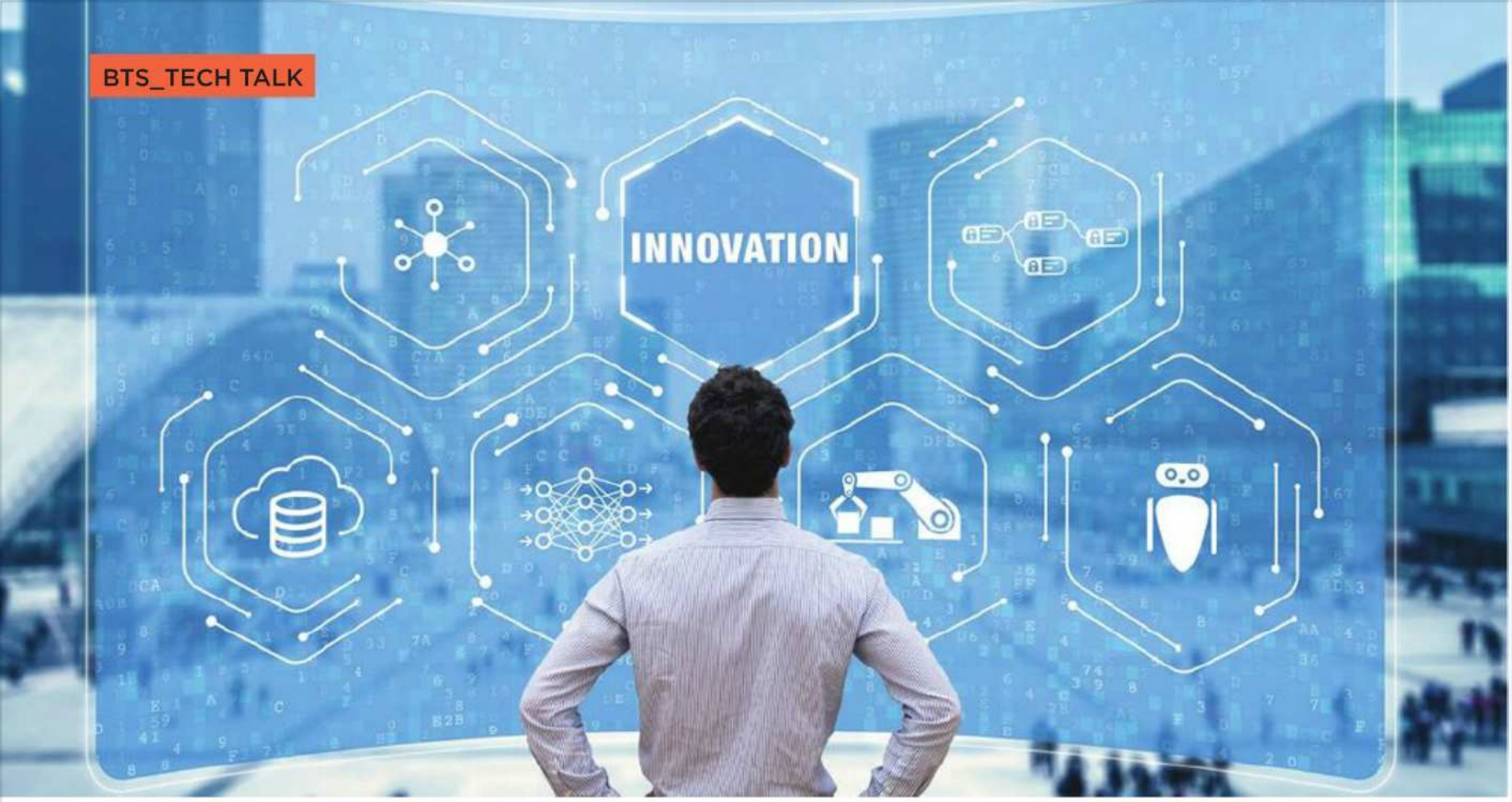
News

LEADERSHIP BY EMPATHY

Todd Watkins of Montgomery County Public Schools in Maryland is honored as this year's Transportation Director of the Year for the consideration he has for his staff, the students and parents served, and his own family at home.

CLIMBING THE TECHNOLOGY MOUNTAIN

Virtual Bus Technology Summit brought together over 1,000 transportation professionals to share adoption strategies and obtain legal insights.



Tech Trends Driving Dramatic Disruption

Electrification, autonomous vehicles and the Internet of Things revolutionize the school bus market.

Written By **Jim Harris**

The price of Lithium-ion batteries has plummeted by 89 percent from 2010 to 2020, according to Bloomberg New Energy Finance (BNEF), and the trend will continue.

The largest cost of electric vehicles (EVs) historically has been batteries. In 2016, for instance, batteries were 48 percent of the cost of electric vehicles. Today, that's fallen to only 26 percent, according to BNEF. Electric vehicles are getting cheaper and cheaper every year.

Tesla Battery Day

Tesla's Battery Day was on Sept. 22, which happened to coincide with my Tech Talk on Day 2 of the virtual Bus Technology Summit presented by *School Transportation News*. Tesla CEO Elon Musk announced many innovations that will dramatically drive down battery prices even further over the next three years. By the end of 2023, batteries will be 56 percent cheaper per kWh—$58/kWh based on BNEF's weighted volume average price.

This will completely disrupt the $10 trillion global transportation market and it will have a profound impact on the school bus market.

By the end of 2023 electric vehicle (EV) passenger cars will become cheaper than gas powered autos. Musk announced that Tesla will release a $25,000 EV, which has been nicknamed the Model 2 by the company's fans. Given that the average new gas car costs $35,000, that spells big trouble for the U.S. auto industry.

Transportation Markets Transforming Faster Than Expected

Because of exponential improvements in the price performance of technology, transportation markets are changing faster than most people realize.

In 2008, when Google introduced its autonomous vehicle, the self-driving technology cost an extra $200,000 in addition to the cost of the car.

Detroit auto executives looked at the experiment and said that Google was wasting money. Who was going to buy autonomous features that cost an extra $200,000?

But these executives didn't understand the impact of exponential change. Two years later, the technology was $100,000. Again, Detroit executives still saw no reason to explore autonomy. A year later, the tech was only $50,000. Today, it's less than $1,000—that's the compounding effect of exponential change over 12 years.

Now, Detroit car companies are scrambling to buy autonomous vehicle start ups. Traditional car companies typically take five years to plan, pilot and perfect new cars. Do you see a problem? Google has a 12-year head start on traditional car companies.

Let's look at the cost of just one part of the autonomous system, called Lidar, a technology for measuring distances of objects. In 2012, the Lidar systems for autonomous vehicles cost $75,000. By 2018, that had fallen to just $40 because there were multiple technologies in Lidar that were all exponentially improving in price performance, compounding the cost declines. In 2020, the cost is only $10.

Tesla's Value

As of last month, Tesla's value is $387 billion. Compare that to the value of Ford added to General Motors added to Fiat Chrysler. Today, these three traditional Detroit automakers are worth $86.4 billion combined. So, you can quadruple their combined value and they're still worth less than Tesla. That should be a clear warning that profound change is eventually coming to the school bus market.

Cheaper, Faster, Smaller, Better, Easier to Use

Technology isn't just getting cheaper its getting smaller, faster, better, more versatile and easier to use all at the same time. Do you remember when you bought a GPS—a Garmin, TomTom or Magellan? It probably set you back $700, plus you had to pay to subscribe to map updates. Well, if you own a smartphone, you have GPS embedded in it for free, and it can find the fastest routes around traffic jams and accidents. And it means you never have to buy a map book again. So exponentially improving technology can eliminate costs while improving the driving experience.

The improvements announced by Tesla, mean that batteries will be 56 percent cheaper per kWh in three years. At the same time, range will increase by 54 percent and the cost of investment to produce each GWh of batteries will fall by 69 percent. In other words, there are multiple benefits to the innovation.

Let's look at what happened to taxis in the largest U.S. taxi market, New York City. Dispatched trips fell from 500,000 a day in 2012 to half that many in 2019. Meanwhile, Uber rose from fewer than 100,000 daily trips to nearly 600,000. As a result, NYC Taxi Medallion prices plummeted 90 percent from a high of $1.1 million to $110,000 recently.

Life Cycle Cost

EVs are already cheaper in life cycle cost, sometimes referred to as total cost of ownership. While EVs are currently more expensive than gas- or diesel-powered vehicles to buy up front, fuel and maintenance costs are more than 70 percent lower. For high use vehicles, like taxis and in some cases school buses, the economics of fleet management completely change.

In analyzing cost, an organization needs to look at both the capital costs (CAPEX) and the operating costs (OPEX). For vehicles that have a long life and high use, OPEX costs are often more important that CAPEX.

Here's a staggering statistic: The average gas car has more than 2,000 moving parts. By contrast an EV has 20. That's one of the reasons that EVs have dramatically lower maintenance and repair costs—the design is dramatically simpler.

Tim Shannon, the director of transportation for Twin Rivers Unified School District in Sacramento, California, has 30 EV school buses and is expecting delivery of another 27 by the end of 2021. That means that his district has the most EV school buses of any district in the U.S.—a record he's very proud of.

From actual experience of running this fleet of EV school buses, Shannon confirmed the fuel costs for EV buses are 80 percent less than fossil fuel buses and maintenance costs are 60 to 80 percent less.

Twin Rivers doesn't have to replace brakes as often on EV buses because the electric engines slow the vehicles down when braking. What was unexpected and surprising is the wear-and-tear on tires is less. Batteries are located in the center of the bus to more evenly distribute weight than in traditional buses, thus greatly reducing tire wear.

Other unexpected benefits include not having to have as large of a maintenance team because these buses don't break down as often as the district's diesel or CNG buses, and the garage doesn't have to carry as much inventory of spare parts. "In fact, the only thing we've really had to do is change light bulbs," Shannon noted.

Many of Shannon's buses have been funded 100 percent through grants, while others only required a $60,000 contribution by the school district. "It's a use it or lose it principle," Shannon added. In other words, chase these grants today because they might not be here tomorrow.

Safety & Insurance

A staggering 94 percent of accidents on U.S. roads are due to driver error. We are on the cusp of the age of autonomous vehicles. This is exciting because it means that a staggering 40,000 American lives will be saved every single year and 2.5 million people won't be permanently maimed. That's the great news.

If you sell auto insurance however, it's another story. When there are 94 percent fewer accidents on the roads, the $500 billion a year paid in auto insurance premiums

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globally will be at risk.

Tesla is now offering insurance for Tesla owners in California. Tesla's cars have 85 percent fewer accidents per million miles traveled compared to regular gas cars with no autonomous features. Tesla insurance rates are 20- to 30-percent lower than those from traditional insurance companies. Do you think this spells disruption for the insurance industry?

The important point is that autonomous vehicle mean lower cost of ownership on many different levels: repairs, law suits and insurance are just a few.

Autonomous Vehicles

Waymo is Google's self driving car division that has driven 20 million miles. Tesla drivers have driven 3-billion miles in autonomous mode. We are not that far away from the technology being capable of autonomous driving. Law makers will have to catch up with the regulatory environment.

While the cost of cars has remained constant for almost 100 years at 70 cents per mile, the moment we have autonomous fleets of cars—think about Uber and Lyft just without a driver—the cost of travel drops to 25 cents a mile. At that point, the number of Americans buying cars will drop.

I don't foresee a future where we won't have an adult on a school bus. Once we do get to fully autonomous systems, the adult might be an activity coordinator.

Autonomous or, more aptly for school buses, automated fleets can have other benefits for school districts. Imagine being able to get more drivers by having autonomous vehicles pick up drivers on a route in the morning to get the yard.

Changing Business Model

The town of Innisfil north of Toronto where I live is using Uber as its public transit. The town is saving $8 million a year by not having to buy buses, hire drivers and have a maintenance yard and staff.

And which would you rather do in minus 20-degree weather? Wait at a bus stop, praying that the bus arrives soon, or be treated like the president of any small republic and have the car pull right up in front of your home and take you to where you want to go? (The only difference being that you might stop on the way to pick up other people but you'll be dropped off at your destination.)

We often think that if you have a higher quality of service, you have to pay a higher price. That's true if you do things the way you've always done them. In this case, the residents and taxpayers in Innisfil are getting better service at a lower price.

How could insights from this example help student transportation directors?

Some districts with low population density and students in far-flung directions are using less expensive smaller vehicles, like vans or even cars, to pick up students that would otherwise require more expensive buses to drive thousands of extra miles per year.

I was working with part makers in Sweden. One of the firms represented at the event was Volvo. One of the sales reps told the following story:

"We were working with a U.S. municipality that had no capital budget to buy buses. We just weren't going to make a sale.

But this municipality had [an] operating budget.

You've heard of SaaS (Software as a Service)? With an SaaS model you don't actually buy or own the software you essentially rent it on a daily, weekly or monthly basis.

So, we adjusted our business model to essentially rent our buses to this municipality. There were lots of challenges in working through all the details of the contract. But we did it."

I've found over the years that the key to successful consulting is coining a new term that becomes a buzz word. Here's one of mine: BaaS. Buses as a Service.

Preventative Maintenance

I was in Rome for the launch of a Trenitalia's new high speed-train that does 224 mph (360 km/hour). The company had installed 1,000 sensors on the train to monitor wear and tear of parts.

Maintenance historically has been scheduled based on the timeline for when a part will wear out on average. But some parts break down before they are meant to and some later, which means that maintenance is either reactive, or replacing parts before they need to be.

Using the sensors is the key to replacing parts before they break. It is saving Trenitalia 10 percent of its €1.4 Billion ($2 billion U.S.) a year maintenance budget. The result is fewer breakdowns, increased safety, increased on time performance, higher customer satisfaction while achieving significant savings! That's a win-win-win-win-win strategy.

This is called the Internet of Things—or IoT—because all the parts are connected and monitored remotely via the Internet. ●

Jim Harris was a recent keynote speaker at the first ever virtual Bus Technology Summit. He is also the author of the Blindsided, which focuses on disruptive innovation. It is published in 80 countries worldwide and is a No. 1 international bestseller. He is currently working on a new book, which will contain research he has performed on the school bus industry. You can follow him on Twitter @JimHarris or email him at jim@jimharris.com.