

Is the Ultra-class Truck Dream Dead?

2 mine engineers review lessons from a 'manufacturing leap of faith' and see different futures for the world's biggest haulers

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Sunrise or sunset for the era of the ultra-class hauler? The bigger trucks hit the market in the upswing of a commodities super cycle and now, after the bust and the bottom, the economics of ownership are on the books for review. Experts agree on factors favoring bigger trucks, but diverge on outlook. Above, a hauler casts long shadows. (Photo: Liebherr)

Ultra-class trucks have now been around for almost two decades, a timeframe ample for meaningful reflection. Beyond the data, there are now plenty of case studies and stories to consider that can make the case both for and against their deployment. A couple of mining engineering professors from Canada said after glancing back it becomes apparent the ultra-class hauler does have its place, which is also to say that there are mines where it definitely doesn't belong. A handful of variables determine which is the case for a particular mine. Where they diverge is if there is now a trend at play reflecting this reality and what that trend looks like.

In a lecture at Haulage and Loading 2017 on his study, *Is Bigger Still Better? Considerations for Increasing the Size*

of Haulage Equipment, Dr. Tim Joseph, University of Alberta mining engineering professor, pinpointed the late 20th century as the dawning of the age of ultra-class haulers. The zeitgeist was "bigger has to be better," he said. "We saw a lot of people from the industry pushing to see bigger equipment. Everybody had the thought that if we went bigger, our costs would drop."

The resulting push teetered on recklessness, he said. "We made a huge leap of faith at that time. We jumped from 240-ton class suddenly to 320 and 360," he said. "We'd come from jumps of 20 to 30 tons. Suddenly we jumped 100, 120 tons in one go." In retrospect, at certain mine sites that faith was redeemed, Joseph said. A handful of factors made big-

ger better. Those same factors also made bigger more problematic than beneficial at others.

"Overall, I still believe that bigger is better because you are able to do more relative to the actual ratio of the payload to the gross vehicle weight," Joseph, who is also director of the Alberta Equipment-Ground Interactions Syndicate, said in an interview after the lecture. That belief comes with a caveat, he said. "It becomes a function of how big the mine is."

Dr. Anoush Ebrahimi, principal mining engineer at SRK Vancouver and author of *The Evaluation of Haulage Truck Size Effects on Open Pit Mining* (2004), agreed. "In theory, bigger is better if we can manage the side effects," he said. Ebrahimi, who teaches mine planning and design at

the University of British Columbia, said those side effects can prompt some miners to deploy mixed fleets, limiting the use, routes, and value of the loads of the bigger haulers.

Both said that while ultra-class haulers may haul more using less fuel, they place specific demands on mines and operations that some cannot meet. Breaking that statement down, Joseph said under the right conditions, the bigger haulers live up to expectations when it comes to fuel consumption. "In terms of fuel consumption, the larger trucks are doing better," Joseph said. "As payload size increases, fuel consumption went down per ton."

Ebrahimi agreed, saying "the basic data shows that larger trucks burn less fuel per tonnages moved."

Both said ideal fuel economy occurs under ideal conditions.

Ideal conditions for ultra-class haulers, Joseph said, were large mines with gently sloping, wide ramps and roads made of hard rock. If the slope is more pronounced or if the roads turn to mud, a number of new calculations are required to determine the point of diminishing returns.

First, he said research reveals the ideal ramp gradient is below 8%. "If

you have a mine with a fairly shallow pit and 4% to 6% ramp grades in your mine, you could probably say bigger is better," he said. As for mud, the ideal rolling resistance was that found at hard rock mines, which in research conducted in Australia averaged between 3.5 and 4.5%, he added.

Ebrahimi said that while roads and ramps might typically have limited rolling resistance problem spots, "the ground conditions at the face are a completely different issue." The larger the truck, the more the potential problems could arise from "issues with soft ground conditions," he said.

If the ramp is too steep and the road too soft, among the first noteworthy problems to arise is that of emissions. "We were starting to get down this path of the rising tier engines, which was supposed to give us better fuel consumption and better control," Joseph said. "Looking at those vehicles that operate on ramps or ground that is really soft with high rolling resistance, like the oil sand companies, we really have struggled to see any improvement at all. The reason for that is, when the engine has to work hard when the rolling resistance gets higher when the road deterioration is higher, then you not only are having a bad fuel

burn, but what goes out of your exhaust is not just NOx, carbon monoxide and carbon dioxide, it is also the hydrocarbon itself. It is the fuel." Emissions and failing to meet legislated standards are among "the first and foremost things we are being dinged on in the industry by government," Joseph said.

Worse, a problem spot causing heightened rolling resistance repeatedly traversed by ultra-class haulers could set off a negative feedback loop. "If you have a higher pressure from your tires, you are going to get more ground deformation. The ground is going to deteriorate more. That means more road maintenance. That means higher rolling resistance," Joseph said. "Higher rolling resistance means longer cycle times, more fuel burn, higher emissions. This could actually cost us a lot because we've got a larger truck putting down more load on the running surface."

Knowing this, miners are forced to plan for it, widening roads that must be constructed with better materials. All that represents additional costs and impacts the stripping ratio. "The fundamentals never change, but mining methods change," Ebrahimi said. "Larger trucks need wider ramps, which results in shallower wall slope angle, in-



Bigger is still better, but only in certain circumstances. Komatsu's 980E-4, above, offers a 400-short-ton payload.

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creased stripping ratio and increased mining costs.”

Joseph agreed, saying the bigger trucks require longer ramps, which mandates the miner “set back the pit walls. The more you have to set back the pit wall, the more you have to cut into it to create what essentially for a much larger mine is a more permanent road system of ramps, the more volume you’re taking out.”

In road and ramp planning, “most mines are going 3.5 to four times the width of a truck just because of safety issues and to be able to accommodate a

safety berm on the bench going up the ramp,” Joseph said. “So, the bigger the truck, the wider the roads, the more volume we’ve got to take out. The cost of moving all that additional waste you’ve got to be able to balance against the ability to carry more load out with one single unit.”

This may be the foremost concern of a miner planning on deploying ultra-class haulers, Ebrahimi said. “Ramp geometry and configuration play a big role in mining costs,” he said. “We shouldn’t forget that mine geometry also affects the way we ‘selectively’ mine ore.”

Another concern is fleet management complications that can arise with a reduced fleet size and with increasingly expensive and technologically advanced haulers. “Having fewer trucks in a fleet reduces flexibility,” Ebrahimi said. “This challenge can be addressed by purchasing additional or spare trucks, which can be expensive.”

Again, Joseph agreed, saying, “The advent of the ultra-class was mines saying ‘we’re tired of having to deal with such larger fleets, can we go to a smaller fleet and do the same or better?’” The dream of smaller fleets was one of the driving forces behind the demand for ultra-class haulers. “Moving in that direction, we’ve lost some of the redundancy,” Joseph said. “If we lost a 240-ton truck, no big deal. We have lots of them. You lose a 360- or 400-ton truck, it is now an additional 120 to 200 tons per cycle that we’re starting to lose out of the system.”

Not only is production hit when one of the bigger haulers is sidelined, research revealed the bigger the truck, the costlier the repair, Joseph said. “What we found was when we got into the bigger units, there were bigger types of problems and they happen more often,” he said. Automation, energy recapture, and integrated digital mine tech add to the complexity of the larger haulers. “And those different things require higher levels of expertise,” he said. “The costs of labor have gone up. The tools they require, and the diagnostic systems they use, have gone up in cost.”

At least for a time, another similar cost and challenge was centered on tires. “When we jumped from a 40R57 tire to a 55R51 tire, we made a huge jump in size class,” Joseph said. “We had the manufacturer create a tire class that didn’t exist. It was literally a demand overnight. The manufacturers learned very hard on what would work and what didn’t.”

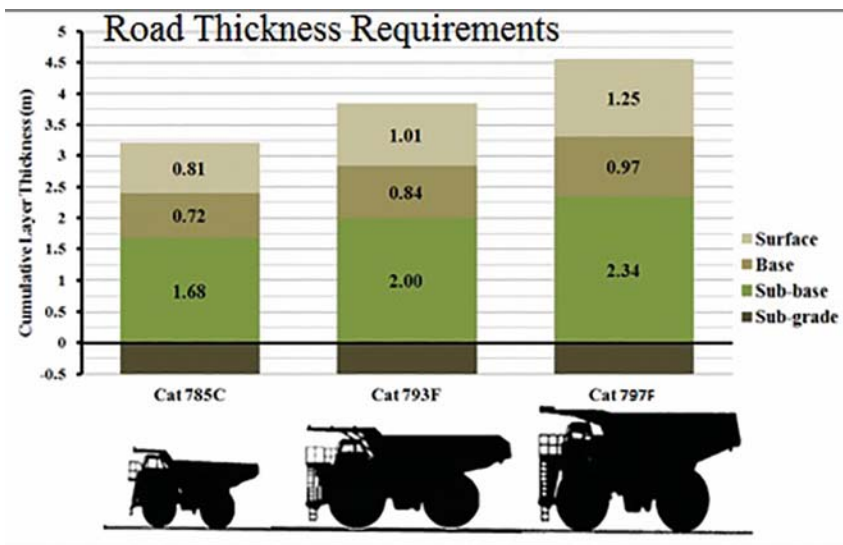
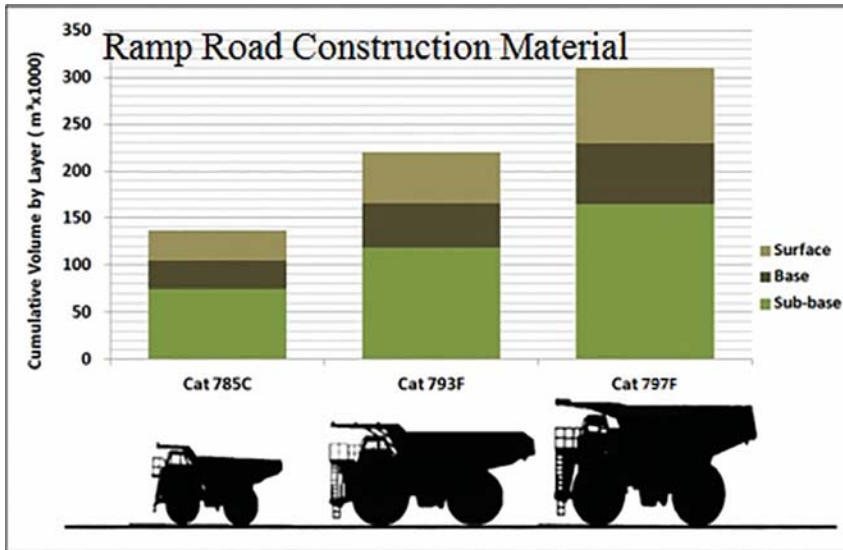
Other cost considerations also enter the equation. For example, the size of the haulers used can affect processes, and thus costs, downstream, Ebrahimi said. “Employing larger trucks requires bigger benches and that means coarser ore fragmentation,” he added.

Combined, for some miners the above-mentioned costs and potential challenges are greater than the expected returns on investment. “When you consider all



Ramp slope, road conditions, maintenance costs, and fleet management challenges should all be considered when planning to deploy an ultra-class truck, two mining engineering professors say. Above, a Caterpillar 794 AC tops off.

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Bigger haulers mandate more planning, thicker roads and ramps made of better materials, and wider shallower ramps, the latter of which could impact mine geometry with effects downstream. (Photos: Tim Joseph)

those things, the whole question of is bigger better is still up in the air," Joseph said. "When you are looking at the cost of maintenance, the redundancy in the system, you start to question that and bite your lip, and say maybe it isn't everything we've considered if we look at the complete cost of ownership, including the cost of moving all that waste, and the creation and maintenance of these much larger road systems, wider road systems, longer road systems."

Ebrahimi said the costs and challenges mandate extensive analysis and planning before committing to deploying an ultra-class hauler. "Mining is so complex that scenarios cannot be copied blindly," he said. The optimal hauler fleet

for one mine may not be the same for another quite similar mine, he said. "Every single mining project must be evaluated independently, under its own conditions," he added.

The professors diverged on their vision for future demand for ultra-class haulers. Joseph pointed to what he said could be a trend in fleet management at Western Australian mines as one example of what the future could hold. "These guys have stuck with the 240-ton class, or maybe even the 220-ton class," he said. "They didn't go ultra-class." This has a lot to do with the value of the ore mined. "The actual value of the ore, they don't need to produce as much volume per day and they're still making money."

That reality could play out globally, Joseph said. "I think we basically have two types of large mining operation developing," he said. "Those that have high-value ore or fairly shallow mines, the preference is toward the midrange classes, the 240-ton classes, maybe a little smaller." Joseph said this is the case in South Africa, China, Southeast Asia and much of Europe. "You go into Europe, you go into the metal mines of Russia, you go into Kazakhstan and maybe further north from there, you suddenly realize they are concentrating very much on the smaller size trucks," Joseph said. "They're not going with the trucks we know, they're going with their own brands. These operations are specifically choosing and sticking with those smaller size classes."

Ebrahimi said whatever trend is at play now is likely due strictly to global economics and the metals bear that followed the peak of what many referred to as a mining super cycle. "In the past 10 years, the mining industry was in state of extreme uncertainty and this prevented the development of new systems," he said. "I see some indication that the mining industry is coming back to its booming state. With improved industry conditions, we may see more discussion and use of larger equipment."

Bigger haulers will continue to have a place in the larger operations fielding bigger fleets, he said, but their assignments may change based on the value of the ore mined. "I believe the mining industry will move toward larger equipment for general earth moving tasks such as waste mining in large open pits," Ebrahimi said. "However, when it comes to ore, we will see a tendency to use smaller equipment. In the future, we will see more mixed fleet sizes in mines, larger trucks working in waste, smaller trucks working in ore."

Doing such could, however, present mine plan and management challenges, Joseph said. "Invariably these generate loading mismatches through needs-based dispatch supplementary fleet allocations that cross the waste versus ore hauls," he said. "Road design issues develop where larger haulers find their way onto narrower roads." A mixed fleet also presents unique availability dilemmas and maintenance cost considerations, he said.