Trucks

When it comes to cutting costs, it's vital to look at the whole picture and challenge the status quo. Brian Tinham reports on huge improvements, available to some, from light weighting and aerodynamics

Of the various interventions available to transport engineers wanting to cut fuel consumption and costs, aerodynamic body styling has been – perhaps surprisingly – among those viewed with most suspicion. So, although that's changing, it was invaluable for delegates at the IRTE Conference to hear real-life experiences from two quite different operators, as well as an engineering consultancy's views on the science behind the claims.

First up was Ian Ford (above), group procurement director for transport and logistics at DS Smith, who explained that he has spent the last eight years – at Lafarge and latterly DS Smith – taking steps to counter increasing costs by taking an holistic and proactive approach. For him, this is about tackling the challenges from a total cost perspective, taking into account everything from vehicle specification to loading and unloading times, health and safety, administration, carbon footprint and payload potential – as well as aerodynamics.

"One of the approaches has to be about vehicle specification, but that includes thinking carefully about the application and appropriate innovations – both incremental and radical, with new and different technology," he urged. "Improving payload, for example, is simple in concept: we all know that the less a vehicle weighs, the more it can carry and you're saving money. But lighter materials cost more, so there may be capital cost implications, which you need to set against operational savings, improved residual values etc."

Outside the box

Ford suggested that fleet managers need to think outside the box and believe that anything is possible to improve payload. He cited targets for light weighting, ranging from the cab type on a tractor unit to specifying alloy air tanks, fuel tanks and wheels, and reconsidering lead-up ramps and wheel chocks. "You can improve payload by 4.5 tonnes in the UK," he insisted. "It's about looking at the design and implementing changes."

However, Ford is also a firm advocate of aerodynamics, which he sees as part of the same equation. Likening a conventional trailer to moving a very large brick through the air, he encouraged transport engineers to look at Don-Bur's teardrop shape trailer, with its significantly reduced resistance, if they want to see serious improvements in payload and fuel improvement.

Commenting on his pioneering work at Lafarge, Ford said: "On our Mark 1 teardrop trailer, we used lighter materials and managed to increase payload by 1.3 tonnes, but we also saw fuel savings of 7%. And that was with a negligible increase in capital cost and no effect on residual values."

But then came continuous improvement: in this case, re-engineering with Don-Burr and Wincanton, to reduce tare weight even further. "That resulted in the Mark 2, which gave us an additional payload benefit of 580kg against the Mark 1. And with side

on steroids

skirts and bucklesss curtains, we also improved the fuel benefit by a further 1.5%."

Can't argue with that, can you? And Ford went on to reveal some of his team's other, equally impressive, transformational work around the globe. Citing South Africa, for example, he explained that Lafarge, MAN and Don-Bur achieved a 6-tonne payload improvement over the then traditional tractor and flatbed trailer combination, as well as a full 12% fuel reduction. That was achieved by light weighting both units and changing to a teardrop aerodynamic curtainsider. "Sticking with accepted, standard equipment can be a false economy. These trucks were running all the way from Johannesburg to Cape Town, so the savings were very, very big."

So big that DS Smith is now adopting Ford's approaches. "We came up with another new design and we've now got six new teardrop trailers on order. They're due to be into the business in the next couple of weeks. And it won't stop: once we've achieved this improvement, we'll carry on to the next."

Look before you leap

However, if you're rightly thinking it's high time to review your vehicle specifications, conference also heard a cautionary tale from Coca-Cola Enterprises' logistics asset manager. Darren O'Donnell explained that the operator ran a one-year trial alongside its gas engine testing (page 18), with a standard bodied Iveco Stralis 21 tonne 6x2 rigid pitted against an identical, consecutively registered truck, fitted with Bevan aerodynamic styling.

"We introduced a cab collar spoiler and profiled the body roof, and we fitted a Lysanda Ecolog to verify fill-to-fill fuel consumption. But there was no in-cab aid for the drivers and no additional training. Drivers and routes were also regularly revolved to even out any of those influences. We got around 70,000km worth of data over the year – to avoid any seasonal differences – and the standard bodied vehicle achieved 8.78mpg, but the vehicle fitted with aerodynamic styling achieved only 8.13mpg."

Why? "The fact is that aerodynamic drag is proportional to the frontal area multiplied by wind pressure. So the addition of the profiled roof, while potentially reducing the drag, actually increased the frontal area of the vehicle," reasoned O'Donnell. "Also, the largely urban nature of our operation does not lend itself as well to aerodynamic intervention as longer-haul operations. And the additional weight introduced by the profiled roof and aerodynamic components – although not impairing our payload – was unhelpful."


Rob Lewis


Darren O'Donnell

All has not been lost, though. O'Donnell told delegates that Coca-Cola Enterprises has since dispensed with the profiled roof, but the body sub-frame now has an out-rigged construction to drop the vehicle height and reduce its frontal area. Also, a shallower roof spoiler and cab collar now marry to the body. "Although fuel consumption has still not been significantly enhanced, this relatively low-cost intervention has achieved more positive results," he stated.

The science of drag

So what about the science behind the anecdotes? Dr Rob Lewis, a director of engineering design consultancy TotalSim – which specialises in CFD (computational fluid dynamics) to reveal the detail of air flows over objects – provided useful insight.

"There are three main aspects to movement: input effort, aero drag and rolling resistance, and the influence of each depends on the application," he told delegates. "For gold-winning paralympian David Weir, aero drag is a much greater component than rolling resistance. But for a truck and trailer combination, aero drag and rolling resistance are approximately equal – although aero drag varies with speed squared."

However, it doesn't stop there, he said. There are also three key sources of aerodynamic drag: skin friction (7% for a truck and trailer), pressure drag (by far the biggest component) and induced drag, due to lift, which is negligible here. "There's also parasitic drag – drag on small components and features on the vehicle that disturb the flow," added Lewis.

Hence the importance of shaping surfaces – and hence also, he explained, the fact that optimal shapes sometimes appear counter-intuitive. Increasing the curvature of a trailer profile at the front, for example, turns out to increase drag, rather than reduce it. "That's why the teardrop shape is so effective. Sometimes, you can afford a bigger frontal area," he confirmed.

For Lewis, although there may be diminishing returns beyond the teardrop trailer shape, they are still worth addressing – and the future will see further improvements. "Back pressure is one of the problems and a next step might be to introduce high-pressure air jets to reduce that. And since tractor units are responsible for 80% of the drag and 40% of the overall resistance, we might want to re-think design here, too. And what about trailer units that change shape when partly loaded."