BROWN: Sad tale of train wreck numbers

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Math behind the Quebec tragedy

The news last month out of Quebec was horrifying. A catastrophic train derailment and subsequent fireball in Lac-Mégantic killed 47 people in the small town. As the dust settles (and the embers cool), we are all left to wonder where to assign the blame, and how to prevent such tragedies in the future.

Ed Burkhardt, the Illinois-based owner of the Montreal, Maine and Atlantic Railway, was quick to suspend the engineer, Tom Hardin who was the only employee on the train and who is suspected of not setting all the handbrakes properly. But I think the assignment blame goes much deeper than that, and some simple math can highlight the issues.

One of the areas I carry out research in is called network reliability. All networks, whether computer networks or subway lines, are prone to problems, due to random factors that can't be controlled. One of the goals of network reliability is to use your resources wisely to build sufficient redundancy into the structure so that it can perform reliably, even in the presence of some components failing. There is, of course, a cost to this adding of redundancy to a network, but if the operation of the whole system is critical, the cost is not hard to justify.

So let's take a simple example. Suppose, for argument's sake, a train engineer has a 95 per cent success rate for correctly implementing the appropriate measures (e.g., applying handbrakes throughout all attached cars) to a train once stopped. That still leaves a five per cent chance of the train being improperly braked, with the ensuing danger to neighbouring communities. Five per cent may seem like a small probability, but it means there is a 1-in-20 chance of things going dramatically (perhaps even fatally) wrong.

But if we have, say, two engineers on the train, and each independently checks the handbrakes, then the chance of both of them failing to properly apply the brakes falls from five per cent to 5% x 5% = 0.25 per cent, or less than one per cent. And the results get even more dramatic when we increase the number of engineers checking the cars to three or four, where the probability of all engineers failing drops to 0.0125 per cent and 0.000625 per cent respectively, minuscule possibilities compared with the original failure rate of five per cent.

We haven't improved the quality of the checking ability of the engineers, only the number of such engineers, and the decreased risk dramatic.

Whether the chance of a single engineer improperly braking the train is five per cent, one per cent or some other number, the princip is still the same — the more independent eyes are present, the more drastically safer the overall system is. That's why I have alway had someone read through my articles and books looking for mistakes. I have a certain error rate, even when being most careful, an appreciate the double- and triple-checking of my work.

I don't know how much blame the one engineer, Harding, should bear. But I do know that a process without built-in independent redundancy is more prone to catastrophic failure.

There is always a trade-off in risk versus cost, but the Lac-Mégantic tragedy points out how critical it is to have the issue and its mathematics front and centre.

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