THE LONG LEARNING CURVE

Dr Scott Steedman

This summer, under the spotlight of worldwide media and political attention, the world watched as BP worked to stem the flow of oil from the Macondo well into the Gulf of Mexico following the catastrophic blowout on 20 April 2010. Sealing of the well was finally achieved in early August. The last disaster of a comparable size in the Gulf of Mexico was the Ixtoc I oil well which exploded in 1979, spilling oil for nearly 10 months.

The Macondo spill has thrown into question the engineering techniques and equipment used in deepwater drilling, a concept first pioneered in the 1970s. Yet drilling in water depths of 5,000 feet, as at the Macondo well, is relatively commonplace. Technology to drill exploration wells in water depths over 5,000 feet was being developed in the early 1980s. Neither was its total well depth of 18,000 feet unusual – in fact it was only around half the well depth of the deepest oil well ever driven (in late 2009, also by the Deepwater Horizon rig and also in the Gulf of Mexico). So it is clear that this type of engineering operation is well established, despite the fact that the process of deepwater drilling technology development over the past decades has not been continuous.

Major engineering disasters are quick to capture the public imagination and, if lessons are learnt, can be powerful agents for change. So what lessons can we learn from this event? We know from accidents such as the loss of the space shuttle Columbia in 2003 that organisational causes can be fundamental and the investigations into the Macondo spill will need to address these in detail.

However, there is also a wider technical lesson to be learnt. Counter-intuitively, the passage of time following the first full scale deployment of new engineering concepts can increase the risk of disaster – a lesson well illustrated by the history of major bridge failures.

Almost every major bridge form in the world has failed catastrophically over the past 200 years, with each case following a similar pattern. The Dee Bridge, designed by the renowned Robert Stephenson, was a trussed girder railway bridge built some decades after the first introduction of trussed girder bridges. It failed by torsional instability in 1847. The Tay Bridge, another type of truss bridge, was designed by Thomas Bouch and opened in 1876, famously collapsing in a storm due to wind instability in 1879. The Quebec Bridge was to be a major new cantilever bridge similar in design concept to the earlier Forth Rail Bridge, but it failed by compressive buckling during construction in 1907. The Tacoma Narrows Bridge collapsed in 1940, despite the successful use of the suspension bridge design form for similar lengths of span over the previous decade. Additionally, major box girder bridges at Milford Haven in the UK and West Gate in Melbourne both failed in 1970, despite many years of prior experience with this design form.

In each case, the disaster occurred a decade or more after the introduction of the new design solution. In each case, the original engineering concept was very conservative but as the number of successful implementations increased over time, confidence in the design grew and boundaries were pushed, ultimately invoking a failure that had not been anticipated by the designers.

Deepwater drilling is characterised by the very high level of dependence on robotic equipment for safe operations. Although the significance in terms of increased risk of the shift from shallow to deep water operations was recognised in the early 1980s and more investment in research and development of deep water inspection and repair equipment was called for at that time, it is not clear that this was followed through over the following decades.

The risk of an engineering disaster is increased by the separation of research from practice over what can be a long learning curve. Research and development activity needs to follow through the introduction of new engineering practices and technologies potentially for decades after the first deployment to gather data, learn how the new solution really works, optimise and refine the supporting tools and concepts. Only by integrating research skills with delivery experience throughout the lifecycle can engineering which is pushing the boundaries of knowledge manage the risks and maximise the benefits of innovation.

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