MAINTENANCE MUSINGS

LOUISE MAYNARD-ATEM

This month I'll be continuing the 'My First Project' series with a piece from John Ranyard and his early experiences at the Field Investigation Group (FIG), which was part of the National Coal Board (NCB). John's recollections give us an insight into a highly contentious energy industry and also illuminate the differences between learning about O.R. and the practicing of it in an industrial context.

Also, as I've included a Problem Page puzzle for you to tackle over your Christmas break, just to keep your brains ticking over during the festive period.

My First Project – John Ranyard

In early 1963 I accepted a job offer from the NCB's OR Group, then called the Field Investigation Group (FIG) and decided to start in July, as I had already spent almost 5 years at Leeds University, first on an engineering degree and then on a post graduate diploma in electronic computation. Before I joined, I was thrilled to read a full page article in The Observer entitled 'Lord Roben's Mine of Information' which was all about FIG and how it was about to double in size as a consequence of its success. I could not wait to start!
My first significant project was about the maintenance policy for underground power loader machines, which cut the coal from the seam, transferred it to conveyor belts and eventually up to the surface. These machines had replaced the manual hewing of coal with pick and shovel but were very expensive and had suffered from reliability problems. As a consequence they were withdrawn from the coal face for overhaul at predetermined intervals – a very expensive operation – rather than when the coal face was exhausted. As the reliability of the machines began to increase, senior engineering and production staff began to question whether this policy was best.

I joined a team investigating the maintenance policy for Trepanners, one of the main power loaders at the time, with 228 in operation at the end of 1961. A typical coal face is around 200 yards in length and the yardage cut by a Trepanner – the number of strips times the face length - was recorded weekly as it was regarded as a good measure of the workload on the machine. At around 60,000 yards the machine would usually be withdrawn for overhaul dependent on the colliery engineer's knowledge and experience; thus, in practice, some Trepanners might run for 100,000 yards, or even more before being withdrawn for overhaul, but in the majority of cases, a machine would be overhauled two or three times during the 'life' of a typical face.

The team was tasked with looking for evidence that the machines were becoming less reliable the longer they were operating, since a breakdown would interrupt coal production and was very costly. We devised a simple test: the operating period for each machine was divided into 10k yard segments, 0 – 10k, 10 – 20k and so on up to 100k and for each segment we collected information on the breakdown incidents and repair costs. Of course the numbers of machines still operating as the yardage increased would decline, partly because of the 60k withdrawal policy but also because some coal faces would finish earlier than planned because of an unexpected geological fault and very few had operated beyond 100k yards. Whilst some faces provide harsher conditions than others, causing a greater strain on the machine, we believed that our sample was big enough for this to be balanced out, except for the low numbers of very high yardage machines.

We collected information on breakdowns from manual records stored in the colliery engineer's office and this provided my first lesson. These records were quite detailed and if we could not understand anything there was usually an engineer around to help. This contrasted with computer databases which came later, which were often less detailed and where the 'owner' of the database was often remote from the operation. (I would always advise students of the importance of identifying and speaking to this 'data owner' so as to understand the quality and reliability of the information being collected.) We classified the breakdown information according to cause, for example 'mechanical', such as a seized gearbox; 'geological', such as having to cut through a hard band of stone; or 'damage' such as a roof fall causing external parts of the machine to be broken. Our analysis showed that a high proportion of breakdowns were random i.e. caused by damage rather than wear and that there was no evidence of increasing breakdowns with increasing yardage.

We then collected cost information from central workshops where the machines were overhauled and this provided a second lesson to me. Those carrying out the overhauls were judged on the performance when the machine returned to use but not for the cost of the overhaul, which was paid for by the supplying colliery. Thus the machines were overhauled to a very high standard, for example, all of the bearings were always replaced. Since it took between 3 and 6 months to carry out the overhaul (when the machines were unproductive) it became clear to us that the machines should be kept out of the workshops for as long as possible.

At the end of the project we produced a report recommending that this machine, the Trepanner, should be kept working for as long as possible (but with careful records kept of use beyond 60k yards) and also that machines that had failed because of damage rather than wear should be repaired at the colliery if at all possible, thus enabling them to be returned to use more quickly and increasing the utilization of these expensive machines.

In presenting our recommendations I learned a third lesson from my more experienced colleagues. We did not blame management for poor practice, as an auditor might do, but suggested that manufacturing improvements had increased the reliability of the machines and our study had shown that they could safely be run for longer periods before being overhauled.

I recall that our report was widely circulated to the relevant management in the industry, initially with the recommendation not to withdraw Trepanners until they had achieved at least 100k yards and also to encourage more overhauls at collieries. With hindsight, this was a very effective introduction to O.R. for me, although at the time I was disappointed that I had not been able to apply some of the O.R. techniques that I had learnt during my studies.

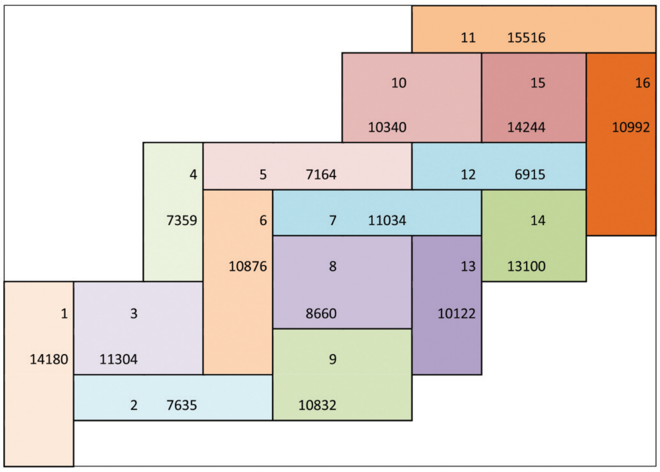
Figure 1: A Trepanner in action on the Coal Face

Problem Page: Christmas Edition

The problem pages have been the most popular series this year by far, so I thought it would be a nice Christmas treat to publish another puzzle to keep your brains working over the festive season. Try out this month's puzzle and send your working and answers to me on the usual address (lmaynardatem@live.co.uk). I should warn you, there's more than one way to tackle this problem, and more than one correct answer so I look forward to seeing what you come up with, best of luck!

Constituency Allocation

The new town of Louisville has a population of 170,273 registered voters. These are spread across 16 wards as shown in the map below. Thus Ward 1 has a voting population of 14,180 whereas Ward 5 only has 7,164 voters.



It has been decided that this town should return three representatives to parliament in the next General Election. Each of these three constituencies will be made up of a number of wards such that each ward is in one, and only one constituency. Ideally, each of these three should represent the same number of voters – no constituency should be more than 5% larger or smaller than the mean. They must be contiguous – i.e. it should be possible to go from any one ward in a given constituency to any other without having to go outside that constituency so for example (1,2,3,4) would be acceptable but (1,2,3,8) would not. **List the three constituencies and the wards that they each contain.**