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Figure 1: Selected maintenance ratios

Financial

- Maintenance spend as a % of factory replacement cost
- Maintenance spend as a % of conversion cost
- Labour cost as a % of total maintenance spend
- Material cost as a % of total maintenance spend
- Contractor cost as a % of total maintenance spend
- Overhead cost as a % of total maintenance spend

Staffing

- Factory replacement cost per craftsman
- Operators per craftsman
- Craftsmen per supervisor
- Craftsmen per support person
- Overtime as a % of total manhours
- Labour % on production support and projects

Work planning and control

- Unplanned maintenance work as a % of total work done
- Preventive maintenance work as a % of total work done
- Work scheduled in advance as a % of total work done
- Jobs completed to schedule as a % of total work scheduled
- Average weekly jobs per craftsman

Materials

- % stockouts in maintenance stores
- Inventory per £m replacement value
- Stock turnover (years)
- Issues from stock as a % of total materials
- Annual material cost per craftsman

Count and compare

Kevin Weymes outlines how benchmarking performance ratios can be used to improve factory maintenance

USING ratios for analysis is common in the world of finance and is a very powerful way to assess the performance of business generally. Ask any financial analyst how they assess a business and they will more than likely talk about using financial ratios (measuring return on investment, profit margins, liquidity, solvency etc) to help understand the business' performance and state of health.

Add the ability to compare performance ratios against industry norms and best practice and you have an unbeatable tool for measuring how well a business is doing. However, there is no reason why this kind of analysis should be limited to the world of finance. It can be successfully applied in

many other areas, and factory maintenance is no exception.

what ratios are best for maintenance?

To get the maximum value from your analysis, you have to carefully select those ratios that will give you the most useful information. After reviewing a myriad of possibilities we settled on a set of 22 ratios in total, divided into four groups covering finance, staffing, work planning and control, and materials (see Figure 1). These were selected to include the key areas of maintenance performance and to give a good comparison of the efficiency of maintenance between factories. We have used these ratios for a number of years and



€1m saved

case 1

For one large pharmaceutical factory in Ireland the first application of ratios analysis and benchmarking showed that the overall maintenance spend was significantly above the norm for a group of very similar factories. A resulting cost-reducing exercise cut the annual maintenance spend by roughly €1m/y. Ratios benchmarking may not have shown how to save the money, but it did identify the potential to do so. As a consequence, this factory and others compare their results every year to make sure that they achieve a performance that is at least as good as others in their industry and, if they can do it, get results that are better than most or all of their comparison group.

based on positive client feedback, they have proved to be very successful.

financial ratios

These are used to measure the overall level of spending on maintenance and the breakdown of this spending into labour, materials, contractors and overheads.

The first two ratios in this group (maintenance spend as a % of factory replacement cost, and maintenance spend as a % of conversion cost) allow you to compare your overall maintenance spend with other factories. Comparing your results on these two ratios with the results for similar factories (in the same industry, in the same country or region etc) will tell you very quickly if your maintenance spending is out of line with the norm for your industry.

Of course, there could be a perfectly logical reason why your maintenance spending is higher or lower than similar factories. However, in the absence of some unique feature of your operation, any significant differences may highlight potential improvements that you might not have been aware of.

A note of caution – we have seen factories cut their maintenance spend too far and suffer for it – sometimes not for a year or two – as the condition and reliability of equipment begins to suffer. In the short term, you can achieve a low spend on maintenance with poor performance (reactive maintenance only, poor equipment condition, excessive breakdowns) or with excellent performance (effective predictive and preventive maintenance, good equipment condition, few breakdowns). Just looking at the overall maintenance spend will not tell you what you are dealing with so you have to apply intelligent analysis to the ratios comparison results. In this case, external measures like downtime should tell the story very clearly and other ratios (eg level of unplanned work) will also reveal good or bad performance.

staffing ratios

These allow comparison of maintenance organisations and, of course, staffing levels. Generally, these are informative about norms in the industry and significant deviations from these norms should be examined to understand why they deviate.

The highest or lowest figures reported do not necessarily identify 'best practice'. For instance, in one survey the number of craftsmen per supervisor ranged from about 4–30. The number of craftsmen that a technical supervisor can be expected to supervise properly is about ten and, indeed, the average was about ten. The low figure of four came from a factory where the shift teams consisted of one supervisor and four craftsmen. However, the supervisors were also engaged in other activities such as ordering spares, technical investigations and troubleshooting etc. Where the reported result was 30 craftsmen per supervisor, it turned out that the craftsmen were integrated into the production teams and, from a technical point of view at least, were considered to be autonomous.

work planning and control

These go to the heart of managing maintenance. If there is one ratio that should be viewed as the critical indicator of how well maintenance is being managed, it is probably the level of unplanned (reactive) work. If unplanned work is low, then you are managing maintenance and are in control. If unplanned work is high, then maintenance is managing you and is probably out of control.

This ratio varies a lot by industry and type of production unit. The level of reactive, unplanned, maintenance work that would be considered excellent in dealing with a high speed packaging line would be thought abysmal in a chemical plant. So industry comparisons are the key to finding out what can be achieved, and how. However, there are exceptions, as case 2 shows.

materials ratios

These are mainly concerned with the performance of the spare parts store. There are clear trade-offs here – you can reduce the level of stockouts by increasing your inventory – but, again, knowing what others can achieve gives you a yardstick by which you can assess your store's performance.

how does it work?

The data in Figure 2 is an extract from a ratios benchmarking report detailing the analysis of a fictional company, Acme Fine Chemicals, against real data for the work planning and control ratios from 11 other bulk pharmaceutical companies.

The comparative information for each ratio is presented so you can easily see the minimum, maximum and average results for the group. This way, you can see 'best practice' performance levels as well as the group 'norm'.

The 'normal' range (within 1 standard deviation of the mean) where statistically

“ just looking at the overall maintenance spend will not tell you what you are dealing with so you have to apply intelligent analysis to the ratios comparison results ”

Figure 2: Work planning and control ratios

	Unplanned maintenance work as a % of total work done	Preventive maintenance work as a % of total work done	Work scheduled in advance as a % of total work done	Jobs completed to schedule as a % of total work scheduled	Average weekly jobs per craftsman
<i>Acme Fine Chemicals</i>	39	56	25	78	11.0
<i>Other bulk pharmaceuticals factories</i>					
<i>Min</i>	12	29	20	50	3.2
<i>Minus StDev</i>	21	33	29	70	4.3
<i>Average</i>	42	44	55	84	17.9
<i>Plus StDev</i>	63	56	81	98	31.5
<i>Max</i>	80	60	90	95	50.0

about 68% of results are expected to lie is also shown. If your results are outside this range then this may be an indication of exceptionally good or bad performance which, at the very least, you should be aware of and understand.

From these results, Acme Fine Chemicals might reasonably conclude that (a) it could make an effort to improve its work scheduling, since it is well below the group norm (average 55%) and way below the best group result (90%); and (b) the average number of jobs reported as being completed by the craftsmen each week looks very low and should be investigated further. It could be that the work being completed is not recorded or it could be that labour productivity is, in fact, very low.

the benefits

Many of our clients have reported significant benefits because the ratios benchmarking exercise pointed them to areas of potential improvement. In Ireland, we have also facilitated factories getting together to compare notes on how they achieve the best results and this has amplified the benefits of performance ratios and benchmarking.

Some of the benefits reported were a little less tangible, but real none the less. One maintenance manager reported a corporate audit where he was aggressively queried on his department’s performance by the corporate expert on maintenance but was able to not only show that he knew what his department’s level of performance was but had comparative information showing he was doing well compared to similar factories in the same area. Any maintenance manager who has been through this will realise the value of hard data.

Another client was able to demonstrate that his maintenance operation was, by comparison, less expensive than maintenance at similar factories and was

“ in a survey in the US a few years ago, 96% of factory managers believed their factory’s performance was above average ”

thus able to successfully resist cuts that would, in the medium term, have had a very detrimental effect on his factory’s overall performance.

Of course, there were cases where managers discovered that their maintenance performance was poor compared to their peers but at least they had identified the problem areas and were able to put remedial programmes in place without the intervention of their superiors. It’s bad enough if you have got something wrong but it’s much worse if your boss is the one who has to tell you about it.

Hard numbers often cut through uncertainty or complacency. In a survey in the US a few years ago, 96% of factory managers believed their factory’s performance was above average. Obviously this is impossible. But it highlights the tendency we all have to think we’re doing well even when we’re not. The only answer is objective measures and, for maintenance, ratios analysis and benchmarking is a valuable tool to provide those measures. **tce**

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case 2 – unplanned maintenance

In some cases, just looking at the numbers is enough to trigger positive change. One company recorded the level of unplanned maintenance work for the first time as part of participating in our ratios benchmarking exercise.

Once it saw the results (80% unplanned, reactive work) it knew it had a serious problem to solve. Within two years it had turned this situation around, achieving less than 20% unplanned work and boosting both efficiency and customer satisfaction substantially.