

# The Eight Critical Elements of Asset Management.

An in depth industry based survey

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## **Acknowledgements**

Firstly I would like to thank all of the respondents to the survey. Being 63 questions long it is quite an investment in time, so I hope the results are of use. I would also like to thank Terrence O'Hanlon from Reliabilityweb for publishing the lead in articles and link to the survey. Without this promotion the level of response may not have been significant enough to develop this report.

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## **The development of the Eight Critical Elements of Asset Management Survey.**

The idea of generating a survey on the “Eight critical elements” came after attending a Maintenance conference where part of the communication at the conference was related to participating in an on-line survey. The survey was interesting, but did not deliver much value, as the data available was limited to overall results from all respondents.

The Eight critical elements survey, allows endless variations of reports generated from the data entered. For example all questions can be reported by business type, business size, country and position of people who answered the survey. As part of the survey questions the respondents were asked what type of report they would like to see as this survey assessment will attempt to meet the customers needs. The most common report requests are:

- An individuals company against all other respondents.
- Comparisons between like industries.
- Responses by the size of the company.
- Comparison of responses by role type.
- Comparison between industry types.
- Comparison of results between countries.

This report will cover many of these requests.

Further to this there are also sub themes within the question groups. For instance all question groups have at least one management question. This allows overall assessment of management attitudes and support to be reviewed. Most sections have questions related to operational practices which allows for operational responses to be assessed. Other themes throughout the questions include the Organisational arrangements, and Stores and materials management. Results from these themes will be investigated throughout this report.

Keep in mind that as responses to surveys are voluntary and the information gathered has not been verified either by the provision of proof or follow-up interviews, and often the respondents only have a good story to tell. To account for this the prompts to answer the questions have been designed so a rating of 3 out of 5 can still be very good. What this has done has allowed for splitting excellent responses from good ones. The only completely negative response is a 1 as it indicates a desirable element or action doesn't exist at all.

The intent of this report is not to advise readers on how they should run their asset management programs rather it is aimed to provide benchmarking information so areas for improvement can be identified and acted on. Often when survey results are published, the readers get a number of graphs and numbers, which then have to be assessed by the individual to try and make some sense of the findings. Each section of the following report will be assessed in detail in an attempt to simplify the findings to the reader.

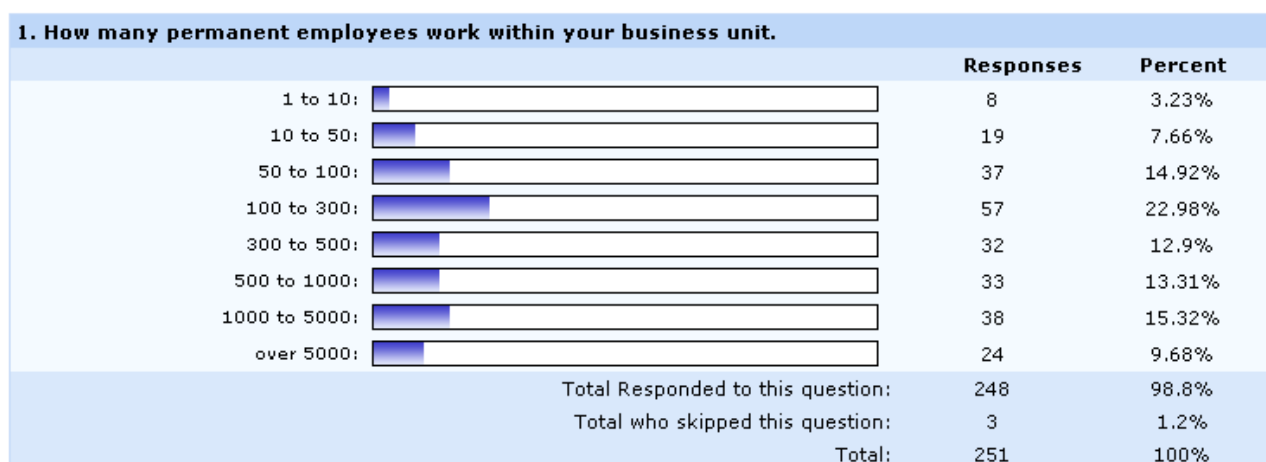
## Assessment of general information questions.

The biggest setback in having a general set of questions where there is no assessment of the respondents is that those outcomes are being compared to the whole sample of responses. This provides no frame of reference when assessing the data. For example, educational facilities may not need to have a significant focus on lubrication. If the results from these facilities are mixed in with all responses from manufacturing, the overall results will be lower. How can you then determine whether your facility is performing well in this area? Having identified industry types allows this information to be segregated. This is called “segmentation analysis” and the first 11 questions were designed to assist with this analysis.

### The logic behind the opening questions and assessment of the results..

#### Number of permanent employees.

**Question 1** asks “How many permanent employees work within your business unit?” The intent of this question is to segregate responses by business size. A hypothesis related to this question would be that “Larger businesses with more resources manage their assets more effectively”. This may or may not be correct, however segmentation analysis should be able to prove or disprove this hypothesis.

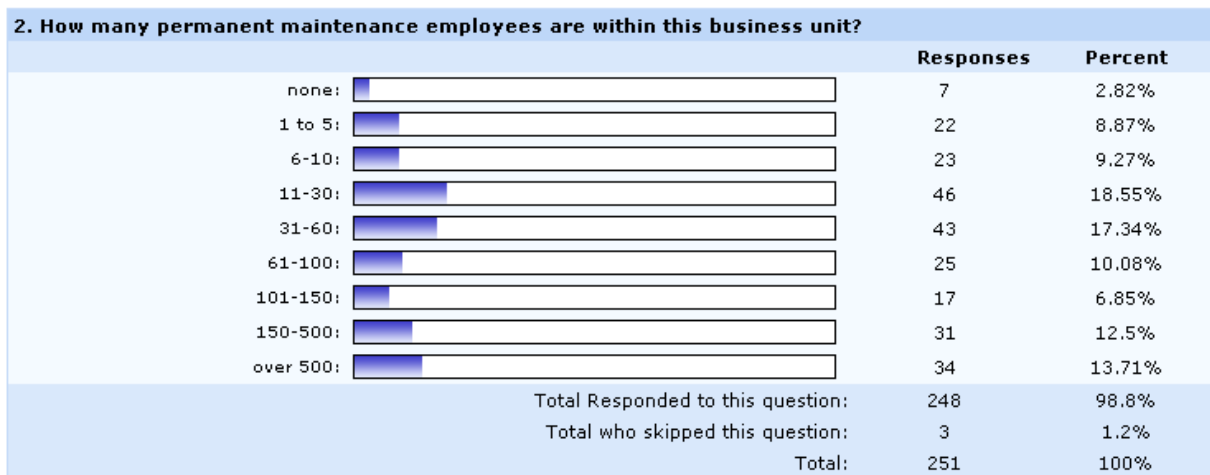


**Figure 1. Question 1.**

There is a relatively even spread of responses to this question with the predominant business size having between 100 and 300 employees. The smallest level of response came from businesses with 1 to 10 permanent employees.

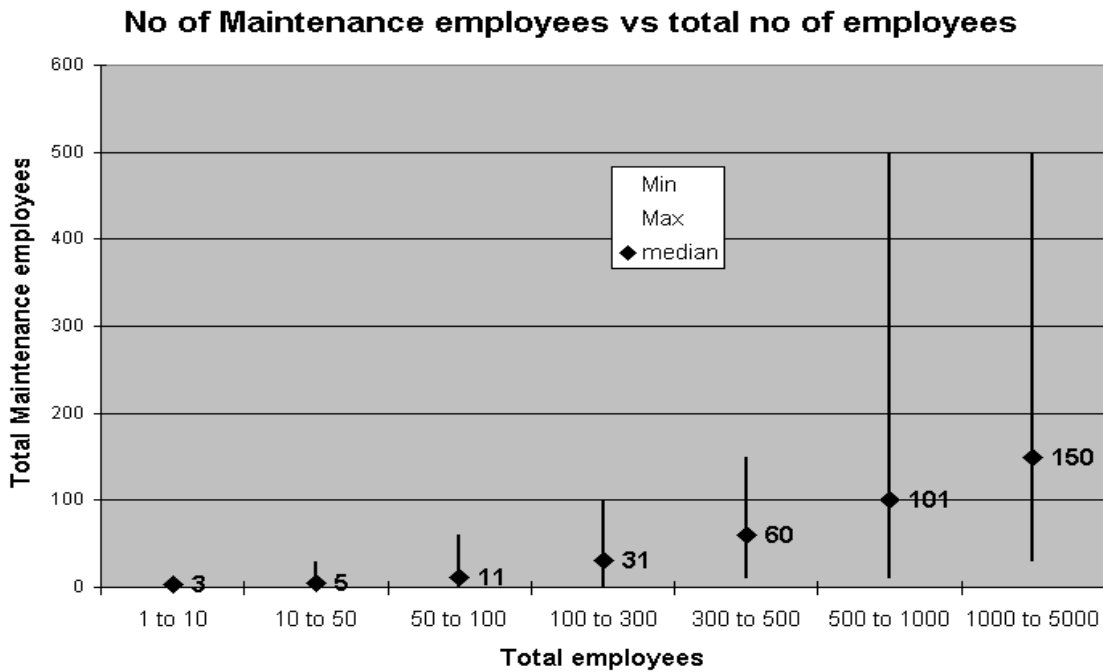
**Number of Permanent Maintenance employees.**

**Question 2** asks, “How many permanent maintenance employees are within this business unit?” The intent of this question is to determine the percentage of employees that are used to maintain facilities of different types and size. The question also allows for comparison of industries of similar size. A question to be asked could be, “Why does a company require more maintenance employees compared to another site of similar size?”



**Figure 2. Question 2.**

Over 35% of respondents worked for businesses with 11 to 60 full time maintenance employees. Further analysis will allow the total no. of employees vs the total no. of Maintenance employees to be assessed.

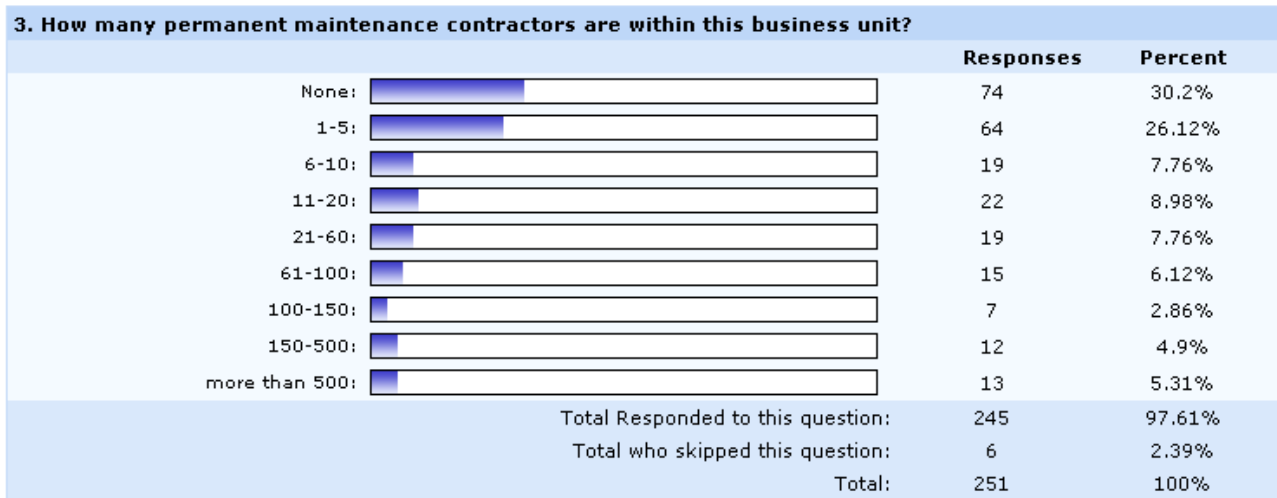


**Figure 3. Distribution and Median answers. No. Maint employees vs total no. of employees.**

Figure 3 highlights the incredible variation of maintenance resourcing that occurs across the range of respondents. When looking at the median results generally as the size of the business became larger the no. of maintenance employees followed. Of interest was that a number of significant size respondents had so few full time maintenance employees.

**Permanent Maintenance Contractors.**

**Question 3** is related to the no. of permanent maintenance contractors used at different facilities. During the 90’s it was common for total maintenance workforces to be outsourced. I believe history has shown this to not be the most effective way to run a maintenance organisation for a number of reasons, but how many organisations operate this way. If they don’t run this way, what is the optimum mix?



**Figure 4. Question 3.**

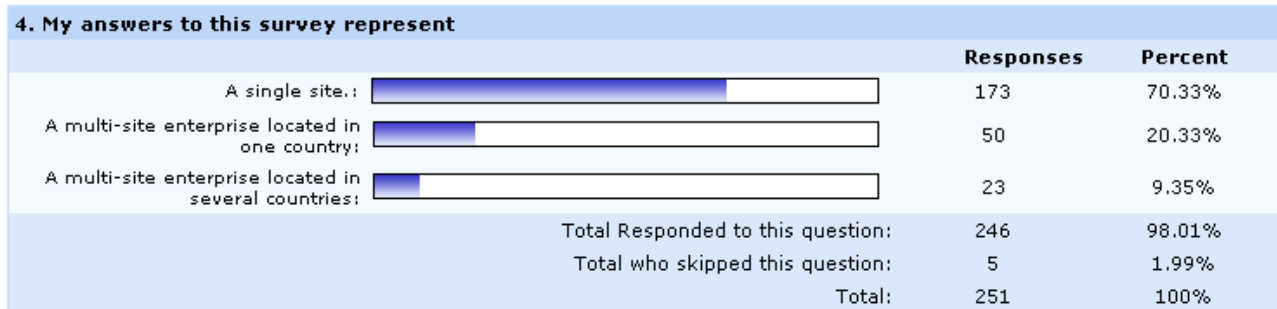
The results from the survey have shown that only two responses indicated their total maintenance resource was all contract. Both of these companies had less than 50 full time employees in total. Of the companies that said they employed more than 500 permanent contractors all had over 5000 permanent employees and the respondent was answering for multiple sites.

The other interesting point of note was that over 30% of respondents said they have no permanent contractors on site. The next biggest response said that 26% of respondents only have 1 to 5 permanent contractors on site. With 56.3% of responses in the top two categories this highlights a clear view that permanent contractors are not preferred in lieu of permanent employees.

It was really pleasing to see these results, as I believe ownership is developed far better from employees. This is backed up by the results.

No. of sites the respondent represents.

**Question 4** is related to determining how many sites the responder is representing in the survey. It is possible that a person responsible for multiple sites may have a different perspective from someone who responds for a single site.

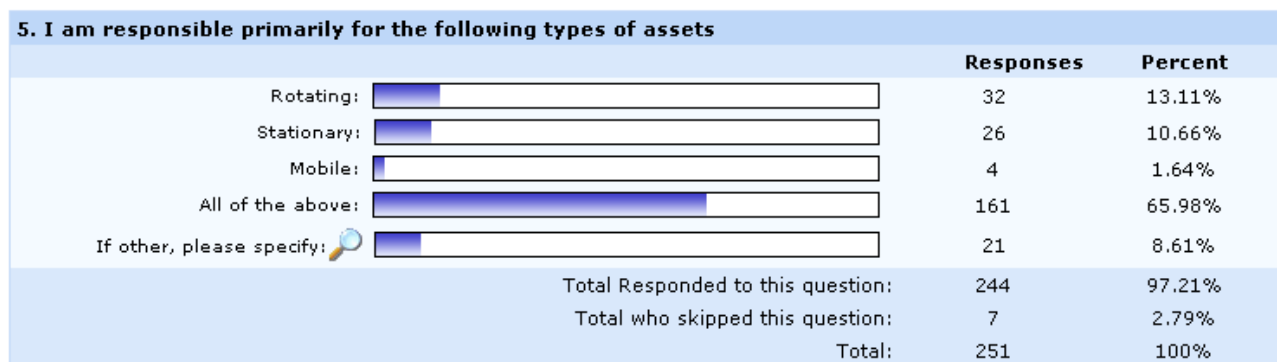


**Figure 5. Question 4.**

The responses to this question shows a clear trend towards single operation based people with over 70% of responses coming from a single site. In most cases the responses for multiple sites were from larger organisation with more than 5000 employees, however there were a small amount of large single site organisations.

**Types of Asset.**

**Question 5** asks whether the assets on your site are rotating stationary or Mobile. The aim of this question is to determine if there are differences in critical element scores for each type of asset. For instance do businesses that maintain mobile equipment score higher in any specific element? This question will also determine what are the predominant types of assets being maintained.

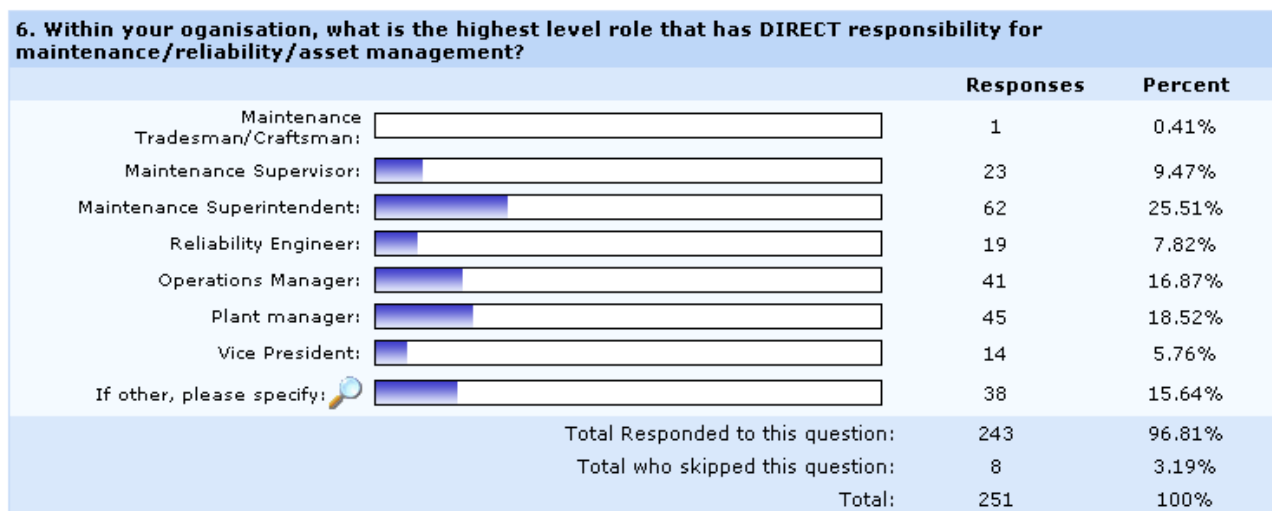


**Figure 6. Question 5**

As 66% percent of responses answered that they looked after “all of the above”, assessments by asset type will be difficult and of little value.

## Who in the organisation is ultimately responsible for Asset management.

**Question 6** asks what is the highest-level role that has DIRECT responsibility for maintenance/reliability/asset management within your organisation. The aim of this question is to determine whether Management have accepted that reliability of equipment is paramount to the success of the business. Having a high level manager made responsible for asset management indicates that the business is serious about asset management.



**Figure 7. Question 6.**

Of the 38 results in the “other, please specify” column, 19 of those could be grouped in the Maintenance Superintendent category which changes the percentage to 34%. With no point of reference it is difficult to make an assessment as to whether these results are good, however having over 40% of responses indicating a Vice President, Plant Manager or Operations manager being directly responsible for Maintenance, reliability and asset management is very encouraging. In my experience I believe this would have been the domain of the maintenance manager/superintendent well over 50% of the time less than 10 years ago.

### The respondent’s role in the business.

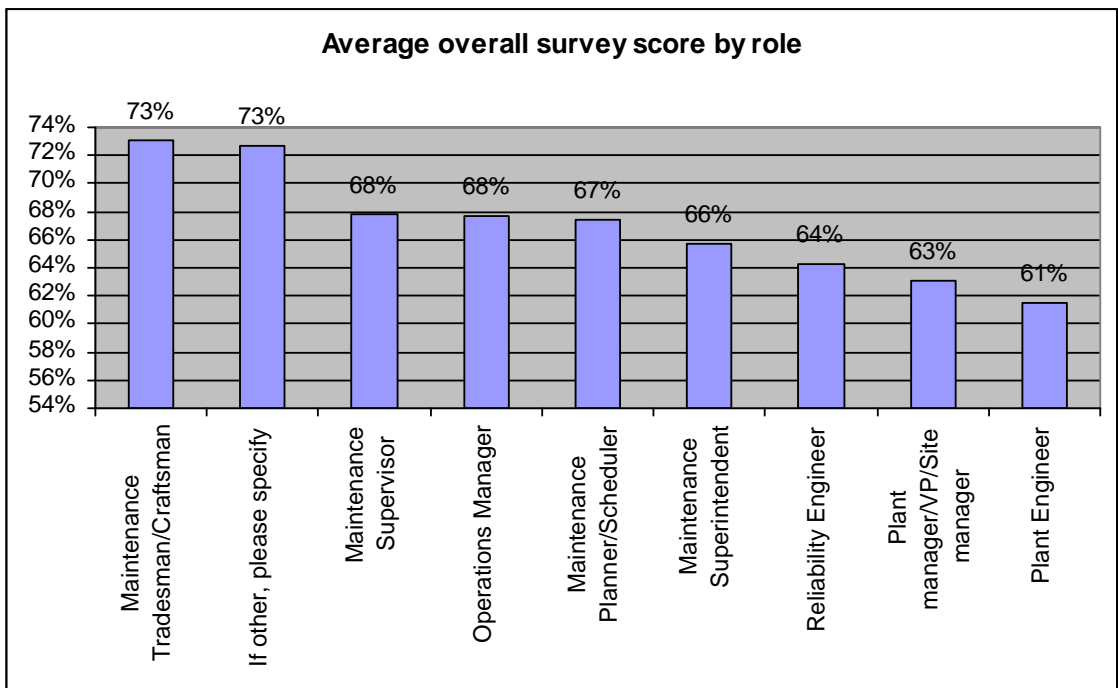
**Question 7** asks what is the role of the respondent in their business unit. It is expected that there will be variation in survey outcomes dependant on the respondent’s position within the organisation. This question will allow verification of this hypothesis.



7. My role within the business unit I am responding for is:		
	Responses	Percent
Maintenance Tradesman/Craftsman:	8	3.29%
Maintenance Planner/Scheduler:	16	6.58%
Maintenance Supervisor:	25	10.29%
Operations Supervisor:	1	0.41%
Maintenance Superintendent:	36	14.81%
Operations Superintendent:	0	0%
Reliability Engineer:	54	22.22%
Plant Engineer:	14	5.76%
Project Engineer:	5	2.06%
Operations Manager:	13	5.35%
Site manager:	4	1.65%
Plant manager:	11	4.53%
Vice President:	6	2.47%
If other, please specify:	50	20.58%
Total Responded to this question:		243 96.81%
Total who skipped this question:		8 3.19%
Total:		251 100%

**Figure 8. Question 7.**

There was no real surprise in the predominant response here with Reliability Engineers and Maintenance Superintendents/Managers being the most predominant. To verify if the answers are affected by the position of the person completing the survey, all of the answers to the questions were allocated a value from 5 to 1, with 5 being the best outcome. For each of the eight elements these values were converted to a percentage of the possible score. The total score is an average of the eight elements. When this data is segregated by position the chart in Figure 9 is the outcome.

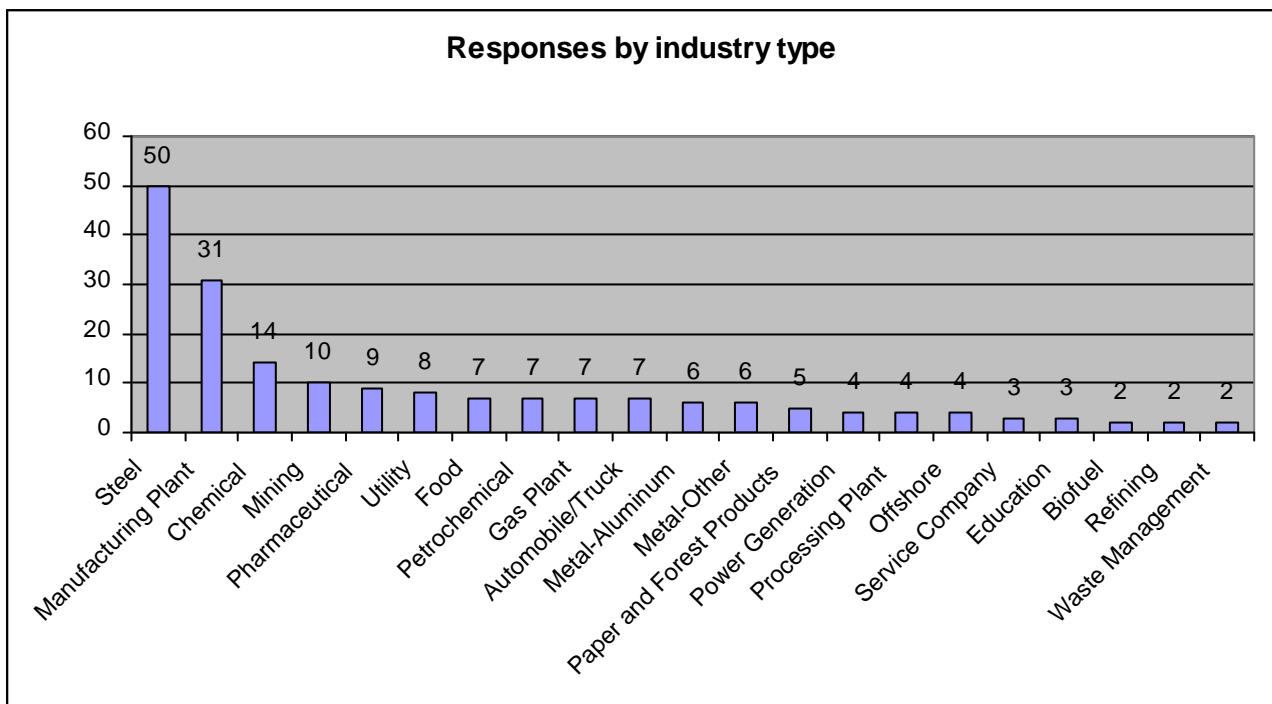


**Figure 9. Average overall ratings by role.**

The range of scores depicted above is between 61% and 73% with the tradesmen/crafts being the most generous in their ratings. On the other end of the scale are Plant Engineers and higher-level Managers who have been harsher with scoring. This indicates that the responses to the survey may be affected by the position in the organisation. This doesn't identify who is right or wrong, it just shows that perceptions can be different.

**Primary function of the workplace.**

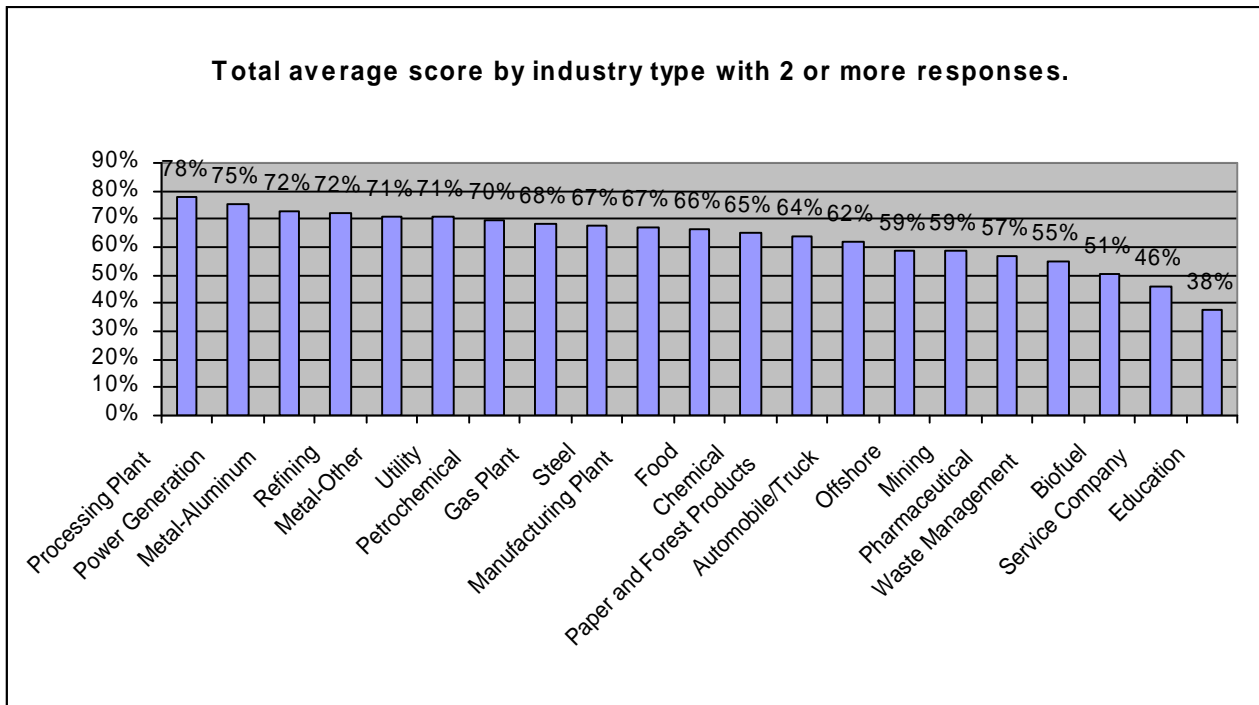
**Question 8** asks what is the primary function of your workplace. Do Steel industries perform better than mining? This question allows comparison of different industry types, or the same type of industry that are different sizes.



**Figure 10. Responses by industry type where there was 2 or more responses.**

Figure 10 shows the no. of responses in the survey by industry type where there was 2 or more responses.

Approximately 20% of responses have come from the steel industry with Onesteel accounting for 38 responses being 15% of the total. This was expected as the survey originated within Onesteel and was heavily promoted, within the business.



**Figure 11. Average Survey Score by Industry Type.**

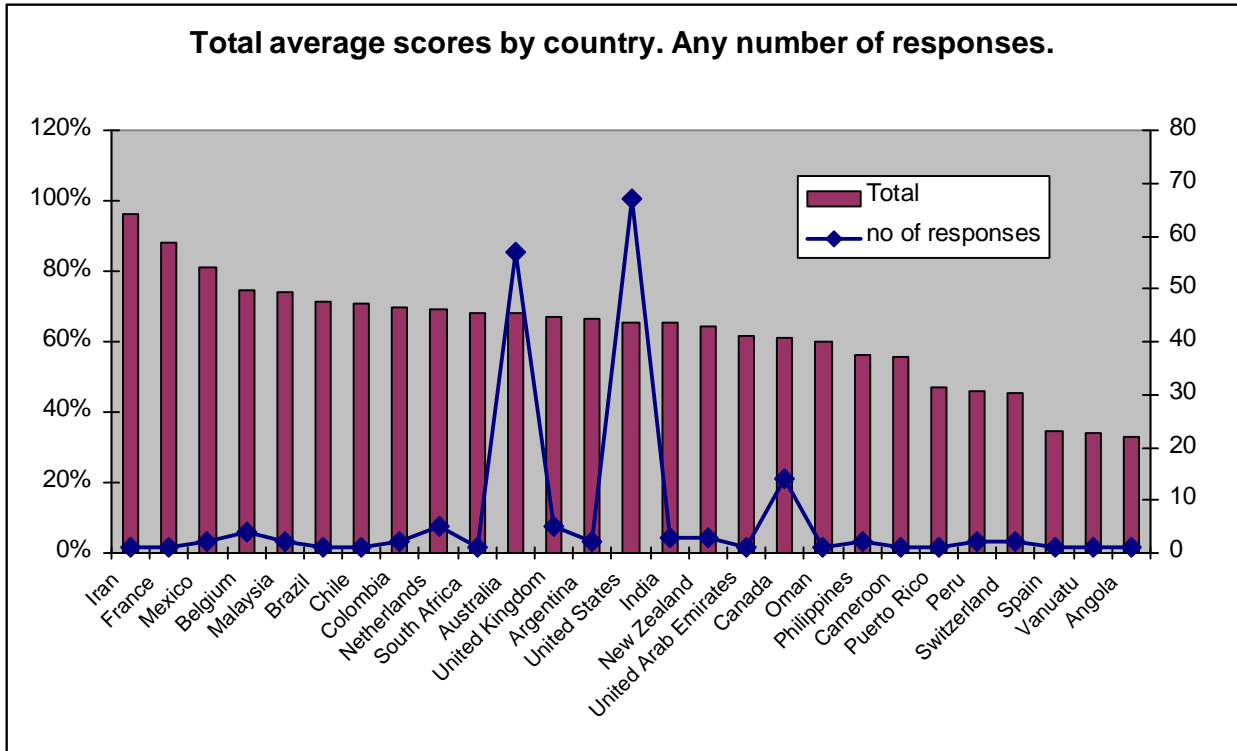
Figure 11 shows that Processing Plants have been rated the highest by respondents with a total average score of 78% closely followed by Power generation, Metal-Other and Utilities. Of surprise were the Mining and Offshore scores of 59%. With 7 and 3 responses respectively this should start to ring alarm bells for some. Later in this report each the eight elements are reviewed individually and assessed by industry type, size and respondent role.

### **Company Name.**

In **Question 9** the name of your company is requested. The aim of this question is to allow the segregation of data for an individual company, for example a single company vs all other respondents. This information is restricted to direct requests from each company's respondents.

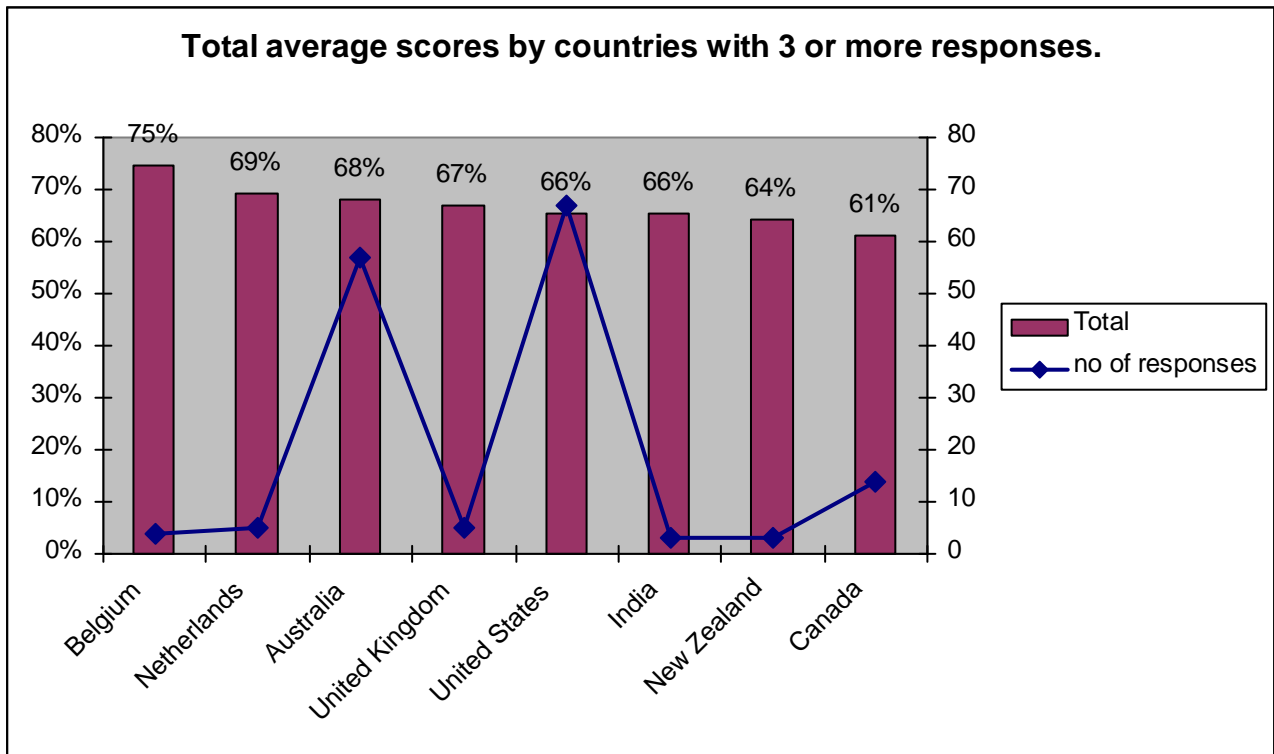
### **Country where the business is based.**

Question 10 requests which country you are based in. The purpose of this question is to directly compare responses between countries. Does one part of the world manage their assets better than anyone else?



**Figure 12. Score by country. Any no. of responses.**

The assessment in Figure 12 shows the scores of respondents by country even if there was only one response. For this reason the data is only really of general interest. The line highlights the no. of responses from each country whereas the bar graph indicates the total average score.



**Figure 13. Total scores from countries with 3 or more responses.**

Figure 13 highlights the average totals from countries with 3 or more responses. The spread of results is between 75% and 61%. Belgium had by far the best average score of 75% but the average was only over 3 responses whereas the results from the USA were based on nearly 70 responses. Of the big two in relation to the no. of responses Australia scored 2% better than the US.

The value of the country data appears to be of minimal value when viewed in this manner.

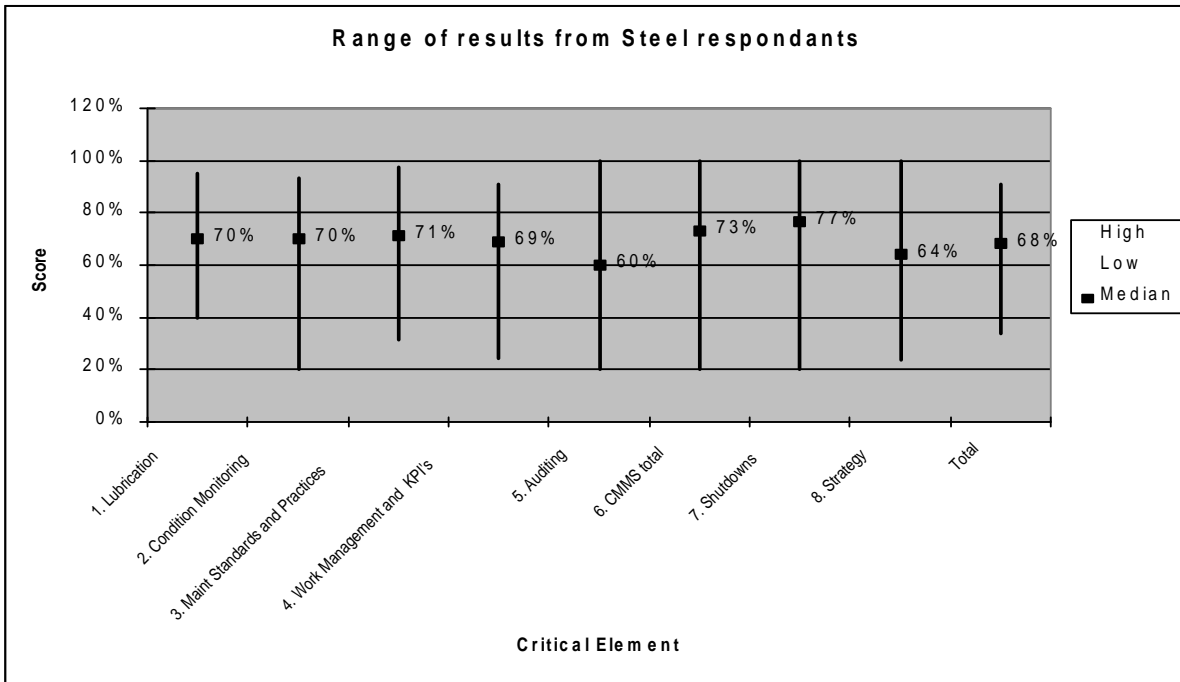
### **Location of Business.**

The City/town is requested in **Question 11**. The purpose of this is to segregate data for different plants within the same company. For example, if there was 10 responses from one company with plants based in 5 different locations, direct comparisons between each site will be able to occur. Again this type of information will be limited to direct requests by respondents for their own company.

From the explanations of these questions and examples shown, you should now have an understanding as to the number of ways the data from the survey can be represented.

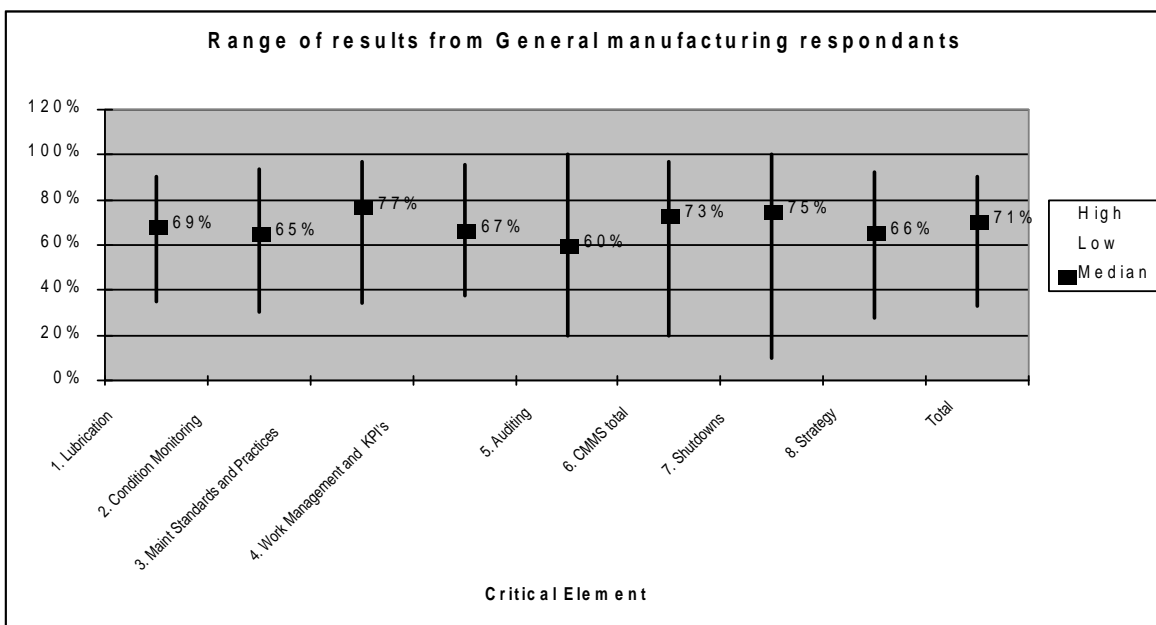
### **Spread of scores for responses by industry type where there were 10 or more respondents.**

The problem with averaging results is that when there is a large response from one industry type the really good and very average results are masked. To accommodate this further assessment has been completed on industry types where there were 10 or more responses. The following graphs show the range of results recorded against the critical elements as well as the median results for the Steel, General Manufacturing, Chemical, Mining and Pharmaceutical industries.



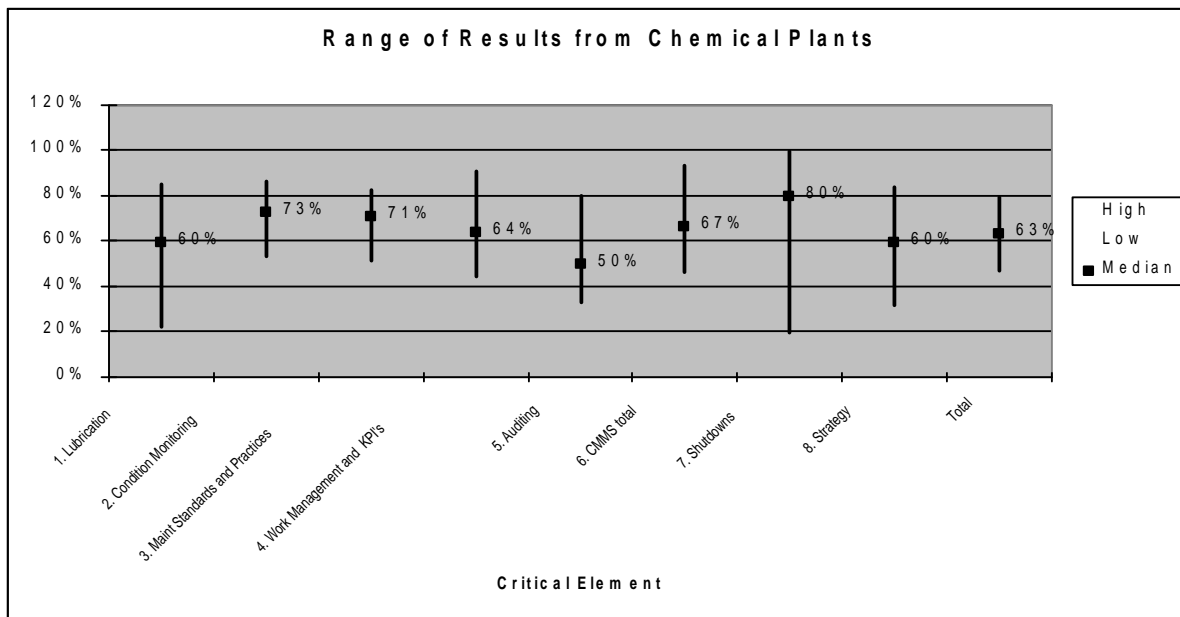
**Figure 14. Range of results from Steel Industries.**

The number of responses from the Steel Industry was by far the largest primarily because of the origin of the survey. The area where the steel industry scored well was in Shutdowns, and this makes sense, as well-managed shutdowns have been a part of the culture for many years. The area where steel scored poorly is Auditing, closely followed by Strategy. It is interesting, as these two elements are closely related to the application of continuous improvement processes. Auditing is required to determine your current reality, and improvement in strategies is often the outcome. The overall score from the Steel industry responses at 68% was the second highest of the five industry sectors assessed.



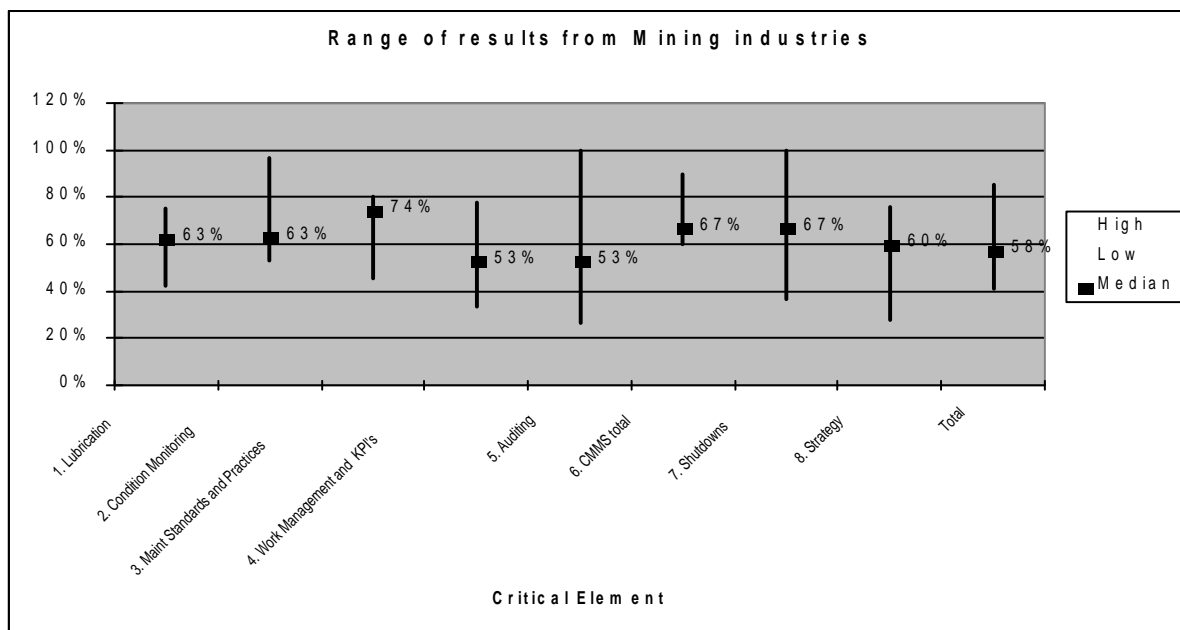
**Figure 15. Range of results from General Manufacturing Industries.**

Maintenance standards and practices and shutdowns are where the General Manufacturers scored themselves the highest with Auditing again coming out with the lowest result. The overall result of 71% was the highest of the five industry sectors assessed.



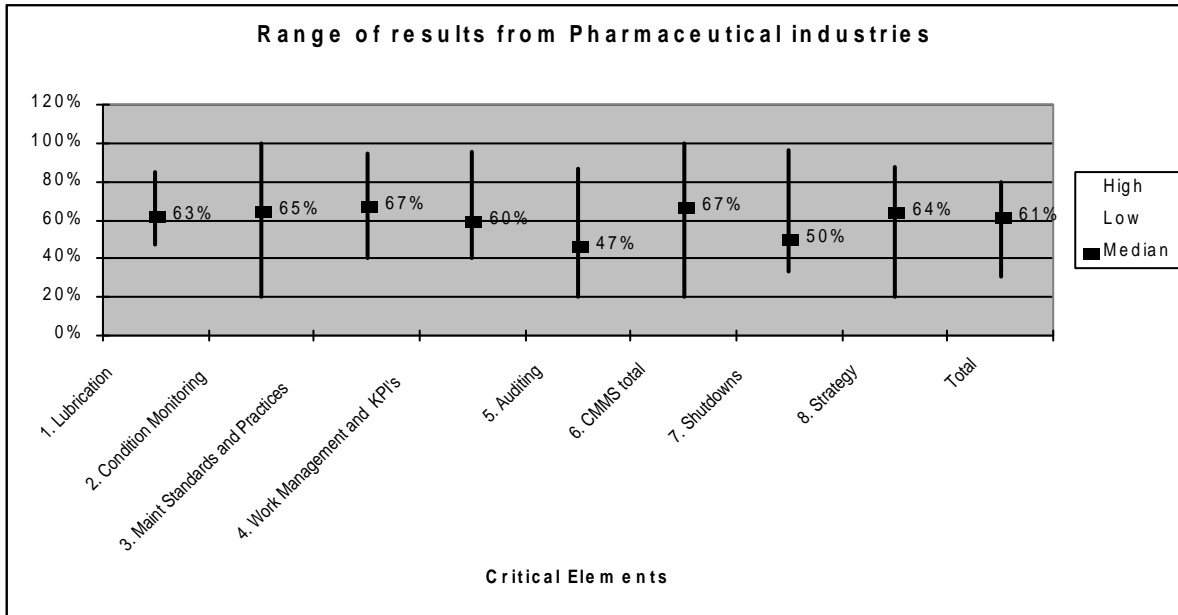
**Figure 16. Range of results from Chemical Plants.**

The result for shutdowns from Chemical Plants was the highest median score recorded in any element from these five industry sectors. Generally Chemical Plants perform much of their preventative maintenance over large shutdowns, which have to be well managed so this high score is expected. Auditing again scored poorly with a score of 50%. The other areas of potential improvement were Lubrication and Strategies. It is probable that the lower Lubrication result is related to the type of assets that are generally found in chemical plant.



**Figure 17. Range of results from Mining Industries.**

The mining sector had the worst overall median score of 58%. The only reasonable result was in the area of Maintenance standards and practices. If these scores are representative of Mining in general, there is significant room for improvement to reliability and hence equipment uptime.



**Figure 18. Range of results from Pharmaceutical Industries.**

Results from the Pharmaceutical respondents are only marginally better than mining, but in this instance there are no areas that stand out as be better than average. Auditing again is rated the lowest rated element closely followed by Shutdowns.

The overall results from the analysis of these five industry segments indicate that the value of Auditing Asset management processes is not considered important by any of the industries assessed. This is clearly where the largest gains can be made, as it is the starting point of improvement. Remember, “You can’t manage what you don’t measure”. To move forward Auditing Asset Management processes is critical.



## **Critical element 1.**

### **Lubrication.**

Lubrication is listed as the first of the critical elements because how this is managed will have the single largest effect on reliability of companies that have primarily rotating assets.

Lubrication itself can be considered part of the overall maintenance strategy element, but because of this potential effect on output it was deemed to be a worthy candidate for significant focus. So what do we need to do to ensure you have effective lube systems?

1. Ensure the correct lube is being used in every piece of equipment.
2. Ensure lubricants are stored in a clean and dry and place.
3. Control the storage of you lubricants within your stores system.
4. All equipment should be labelled to indicate what lube is required where.
5. Oil must be filtered before use, as often-new oil is not clean.
6. PM inspections should be in place to check oil levels and then maintain correct level.
7. PM inspections should be in place for Oil sampling/ planned change out.
8. PM inspections should be in place for inspection and cleaning/replacement of oil filters.
9. PM inspections should be in place to inspect and repair of oil flow/pressure detection systems.
10. Oil use must be the correct viscosity
11. Limit moisture ingress into lubricants to less than 100ppm.
12. Limit contamination of lubricants to agreed company standards.
13. Employ dedicated lubrication technicians whose primary role is to manage and improve lubrication inspections and measurements.
14. Train operators to perform basic lubrication tasks on the equipment they are responsible for. The lubrication technician should mentor these operators.
15. Develop a strong working relationship with your lube supplier.
16. Manage lubricant leaks and ensure repairs are expedited in a timely fashion.

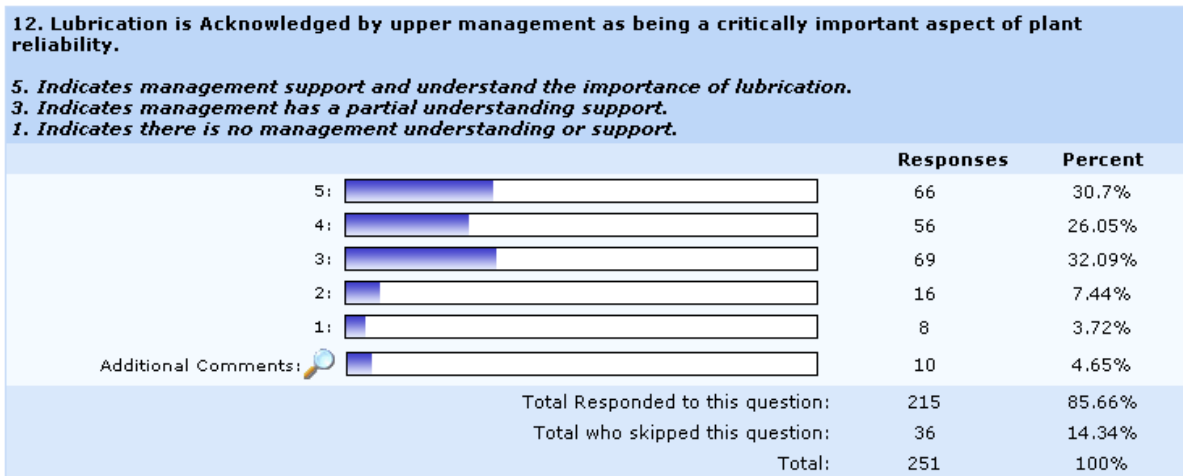
If you have all of the above in place and have implemented the actions, you are likely to be operating at world class and have few lubrication failures, but how many businesses are operating at this level?

The questions in the lubrication section of the survey have been designed to determine if there is a company or industry type that meets all of the criteria above. If this isn't the case then the aim is to identify the current best practices.

## Assessment of lubrication data.

### Management Support of Lubrication.

**Question 12.** is aimed at determining the level of understanding of the importance of lubrication by upper management. Do managers of smaller companies have a different view to those in larger companies? Does management in certain industries value lubrication more than others?

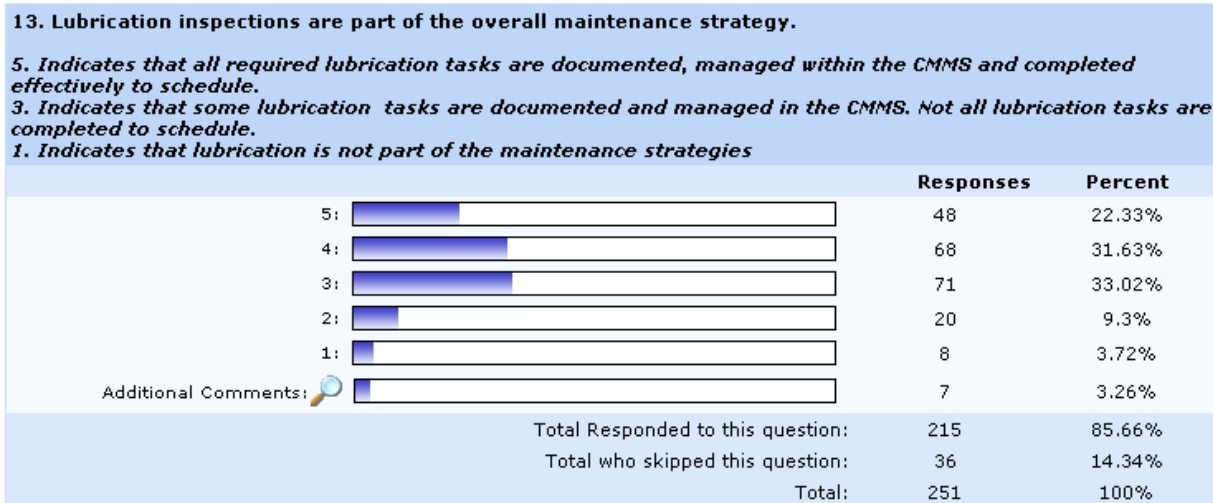


**Figure 19. Question 12.**

The response to this question was very encouraging with over 30% of responses being rated a 5. A further 58% were rated 3 and 4. With such a high level of management support you would expect that many companies would have their lubrication systems working really well. Questions 13 through to 19 investigate this further.

### Lubrication should be a significant part of the overall maintenance strategy.

**Question 13** asks if lubrication inspections are part of the overall maintenance strategy? This includes the existence of an overall lube schedule, PM inspections that are managed through the CMMS, and the effective completion of these PMs.



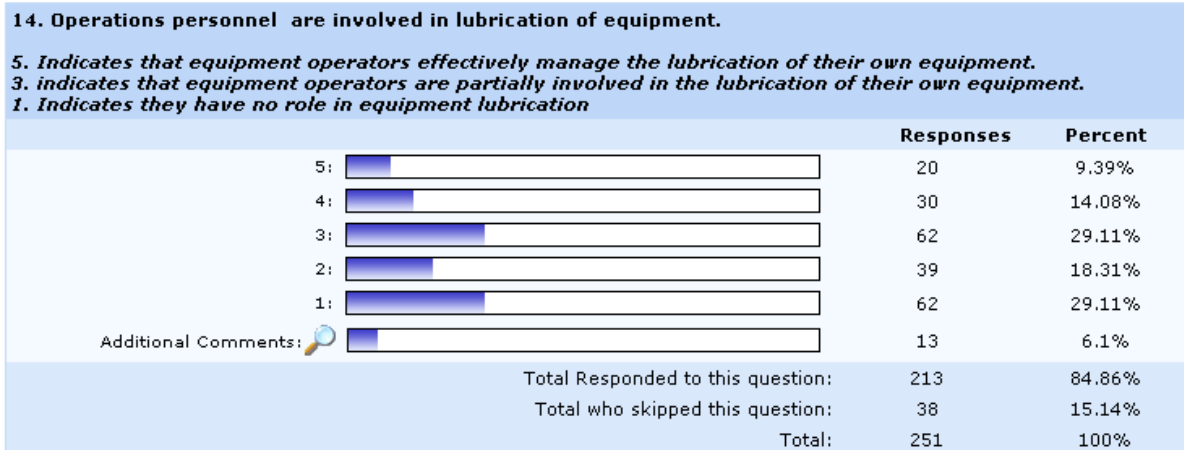
**Figure 20. Question 13**

There were more encouraging results here where 54% of responses were rated a 4 or 5. This indicates a high level of acceptance of the importance of lube inspections. To be truly effective all lube tasks must be documented and controlled within the CMMS. From this, completion of the work and close out of the work orders is important as there is no use having well written inspections and an accurate schedules if they are not followed.

On the flip side the 33% of responses that highlighted that not all tasks are documented or completed is a worrying trend. In this instance a rating of 3 is much closer to a rating of 1 than a rating of 5. How many of these tasks not being completed are on equipment that is considered critical to the business from an operational, safety or environmental perspective. A rating of 1 or 2 is only acceptable if the equipment being maintained does not require lubrication. There would be few instances where this is the case.

### **Are operations employees involved in the lubrication of equipment?**

The aim of **question 14** is to gauge the involvement of Operations personnel in the lubrication of equipment? There are a few different streams of thought in this area for example; some believe operations are there to produce not to lubricate. Lubrication is not considered core to their role. Another view is that dedicated lubrication technicians will provide a more professional service due to consistency of their work. A third view is that operators should look after lubrication of their own machines, as it will promote ownership. There is no correct answer here, as it will dependent on the complexity of the equipment and process, however it is generally accepted that operations must have some input into the maintenance of their equipment.

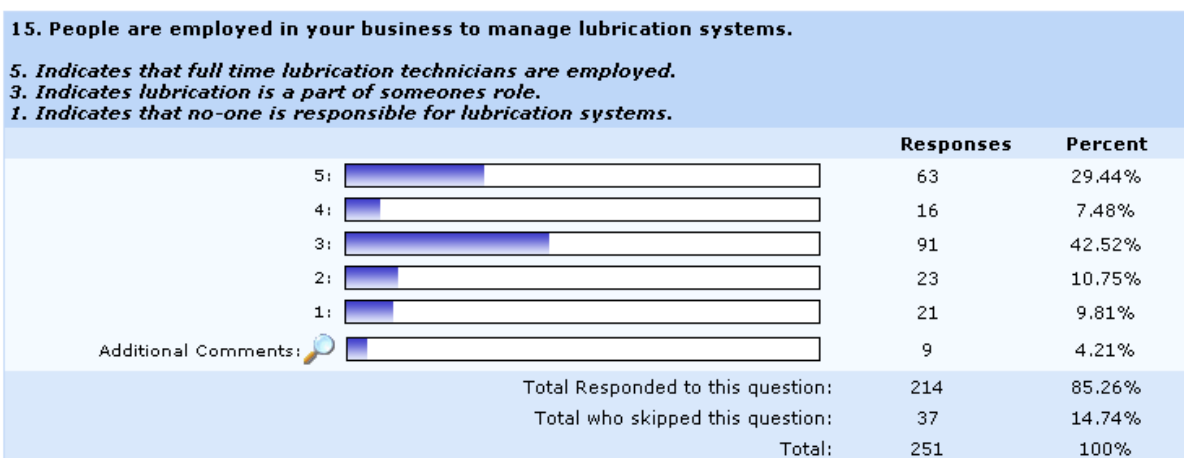


**Figure 21. Question 14.**

The results to this question are particularly disappointing with 29% of respondents indicating operations personnel have no role in equipment lubrication. Only 23% have been rated a 4 or 5. The ideal situation would be where operators understood the significance of the effect of lubrication on reliability, had been trained in basic lubrication practices and were responsible for lube tasks that are directly related to the functions they perform. Considering the results from question 12 where nearly 90% of the management have partial understanding and support of the importance of lubrication there is clearly room for movement in this area.

**Employees dedicated to lubrication.**

**Question 15** asks if people are employed in your business to manage lubrication systems. This question is closely linked to question 14. For larger business's it can be a good option to employ a person whose whole role is equipment lubrication. For smaller businesses you may not have a dedicated lube manager, however someone must have lube management as part of their role.

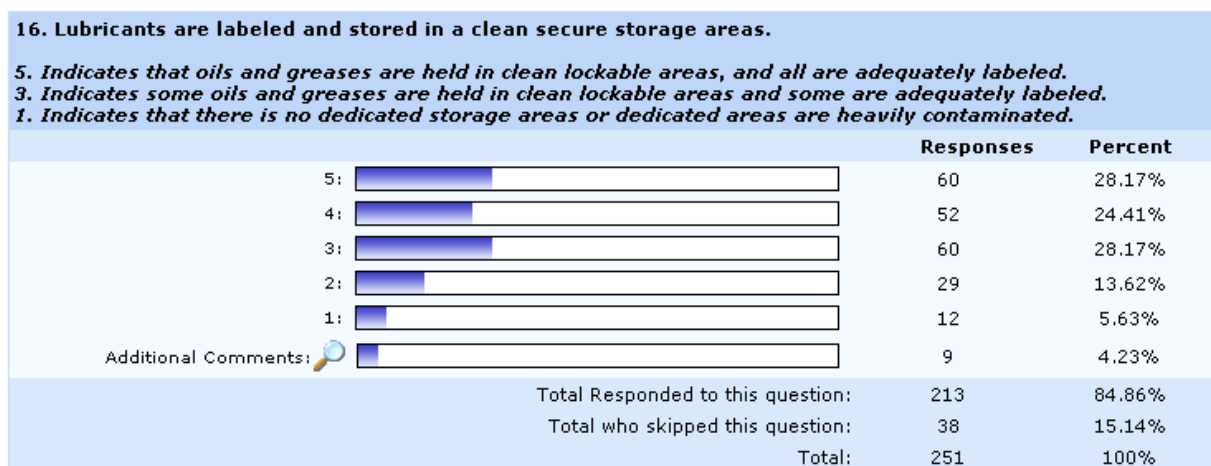


**Figure 22. Question 15.**

Whereas in question 14 the involvement in lubrication from operation is poor, most companies clearly understand the value in having someone dedicated to manage their lubrication systems. For organisations with few assets that require lubrication or less than a couple of hundred employees it is appropriate to have lubrication as a part of someone’s role. For organisations with large amounts of assets that require lube you should have people where their whole role is based around lubrication. At first this looks to contradict what was said for question 14, but these roles should not be aimed at doing all of the lube, but should focus on developing and managing lubrication systems. This could include but not be limited to: Creating Procedures for lube, managing Bills of materials for lube by machine, training of staff in lube practices, managing of lube sampling, auditing the lube process, fault finding and assessing lubrication and other mechanical failures, and completing lube PM’s where resources are not available or the situation dictates the need.

### Lubrication storage practices.

**Question 16** focuses on the storage issues with lubrication. Are lubricants labelled and stored in clean secure storage areas? It is difficult to quantify the overall effect of adding contaminated lube to a machine, but there is no question it will not benefit your equipments reliability. Best practice asks for all oils and greases to be labelled and stored in clean dry controlled areas.



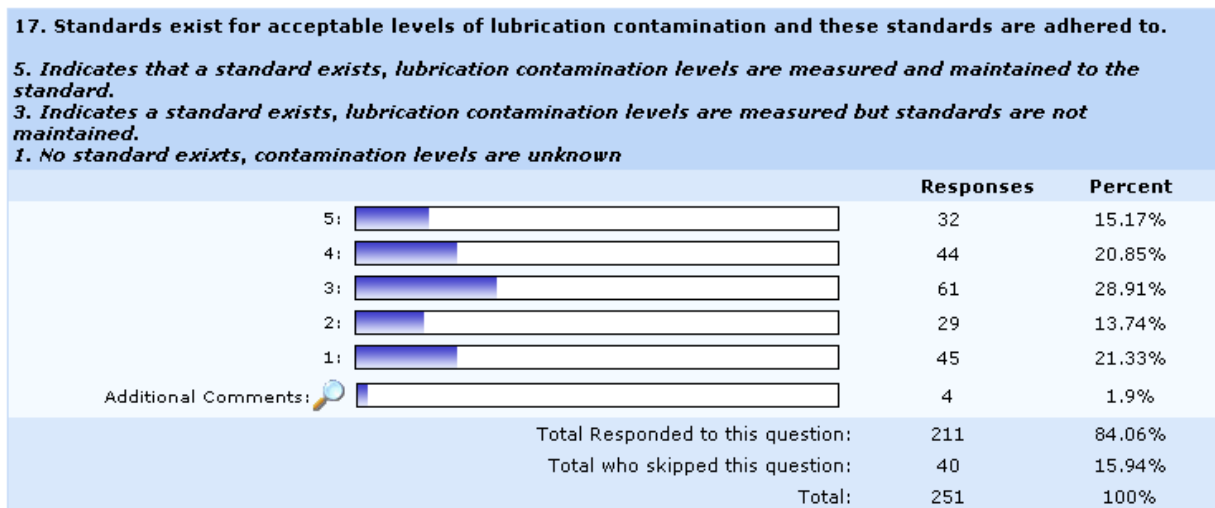
**Figure 23. Question 16.**

The level 4 and 5 responses here indicate that the majority of industry understands that good storage practices are an important part of their lubrication strategies. Poor practices such as leaving a bung off a 44 gallon drum will invariably lead to a contaminate entering the oil. Not having an adequate labelling system will almost certainly lead to the wrong oil being used. How many different types of grease do you use on your site? I would guess that most would

answer, “I don’t know”. Your newly dedicated lubrication specialist would make sure the right greases are at the right machines and are stored in a clean place.

### Lubrication Standards.

**Question 17** is identifying whether lubrication contamination standards exist and are adhered to. Do standards exist for Fluid properties, Contamination and wear debris? Are samples taken to determine the condition of your oils and greases? If you have contamination standards in place but can’t meet them with your current practices what do you do? It is common to find that industries have these standards but cannot meet them.



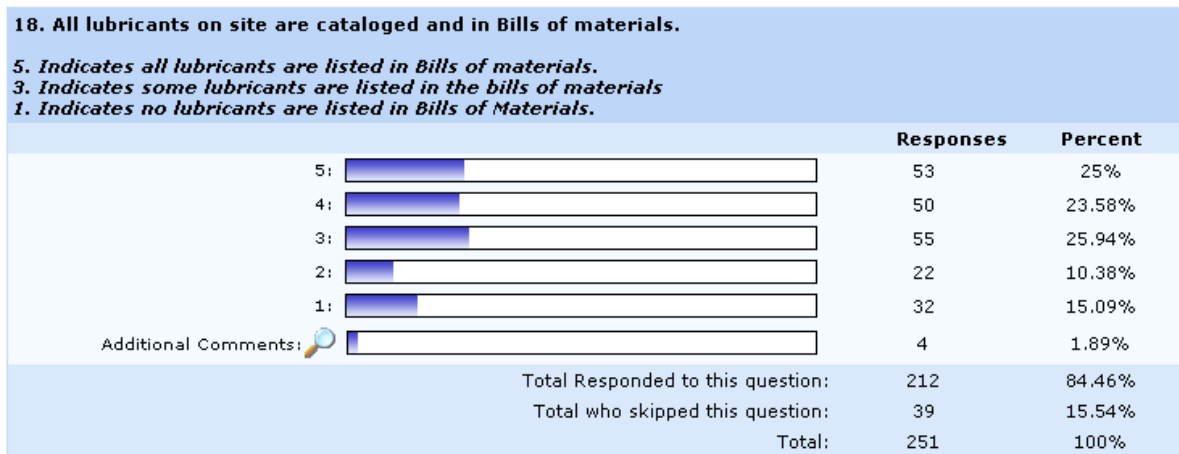
**Figure 24. Question 17.**

The response to this question confirmed the previous statement as 63% of respondents either have no standard or do not keep to the standard they have. On the flip side 65% of respondents do have a standard and having a standard is the first step to improvement. The long-term viability of your rotating equipment is heavily dependant of the condition of the lubricant. Lubrication contamination testing is relatively inexpensive, so set up a monitoring schedule and build a relationship with a lube lab that will be able to guide you in setting acceptable standards.

One of the issues regularly seen in relation to standards is that they are set at unrealistic levels and can never be met because of the conditions of the installation. If the best obtainable level is not leading to premature failure then that is where your standards should be set. If improvement of the best obtainable standard is required build your case to justify the cost of the improvement. Don’t set yourself up to fail.

## Are your lubricants catalogued and in BOM's.

**Question 18** asks if all lubricants on site are catalogued and in Bills of materials? To manage your lubrication program effectively all oils and greases must be managed through a bill of materials for the equipment it is used in. This provides a permanent controlled method of tracking what is used where.

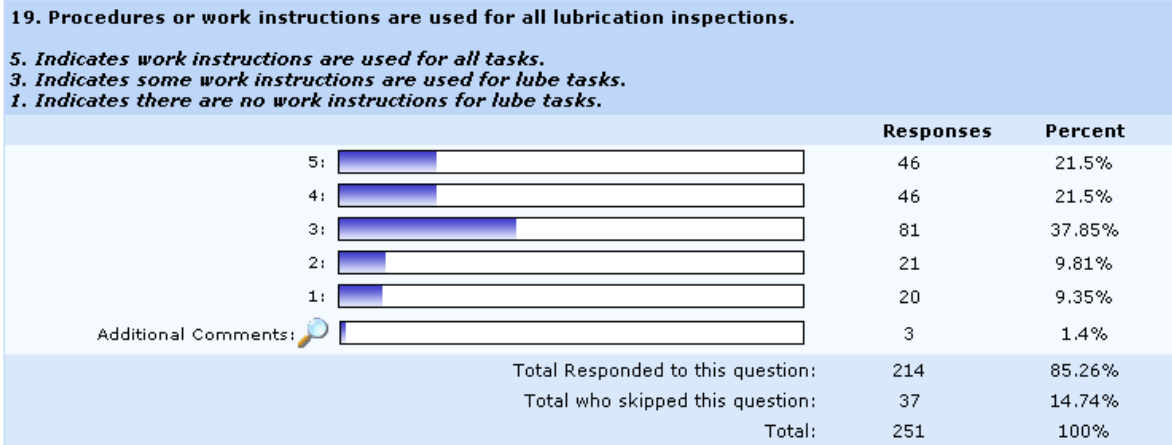


**Figure 25. Question 18.**

The response to this question was pleasing as 75% of respondents had some or all of their lubricants catalogued and BOM'd. As is the case with any critical spare, use the capabilities of your CMMS and stores management systems to manage your lubricants. This will assist in ensuring that the right lubricant is used on the right machine at the right time.

## Are procedures used for lubrication inspections?

**Question 19** determines to what level procedures or work instructions are used for lubrication inspections. The ideal situation is that all lubrication tasks are captured as work instructions in the CMMS or as Standard Operating Procedures that are displayed at the site. People that complete these tasks must be trained and competency assessed.



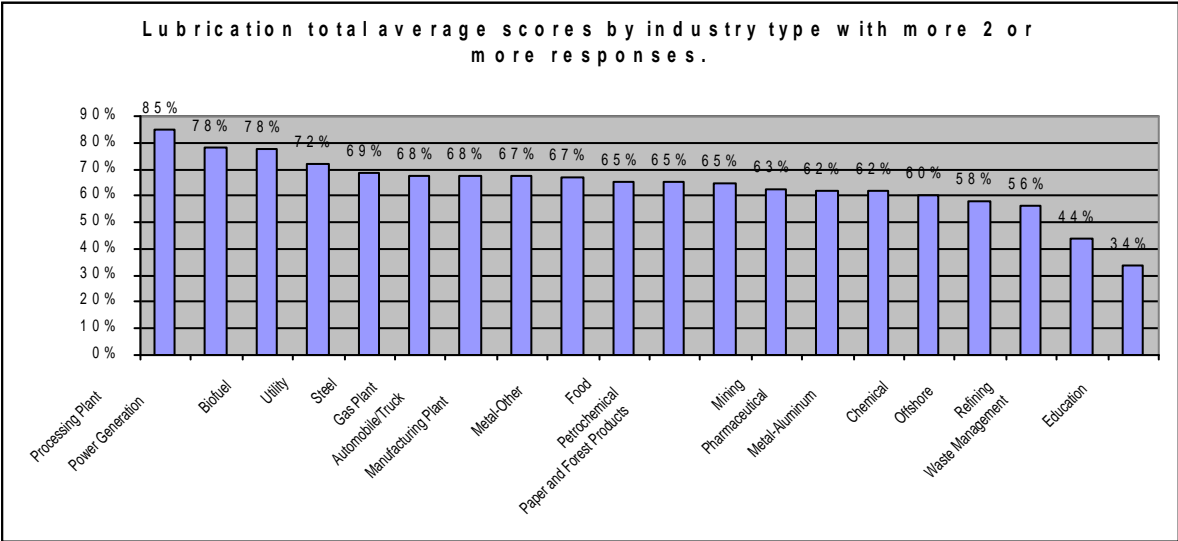
**Figure 26. Question 19.**

Over 80% of respondents to question 19 have work instructions for some or all of their lubrication tasks, however the 38% of mid range responses shows plenty of room for improvement. Good reasons for having work procedures are:

1. If the procedure is followed the job will be done the same way every time. This is in line with LEAN thinking related to standard practices. Standardisation ensures consistency and maintains reliability.
2. The right equipment and materials will be used for the task every time.
3. Standardised procedures are inherently safer to perform.

**Segmentation analysis of Lubrication results.**

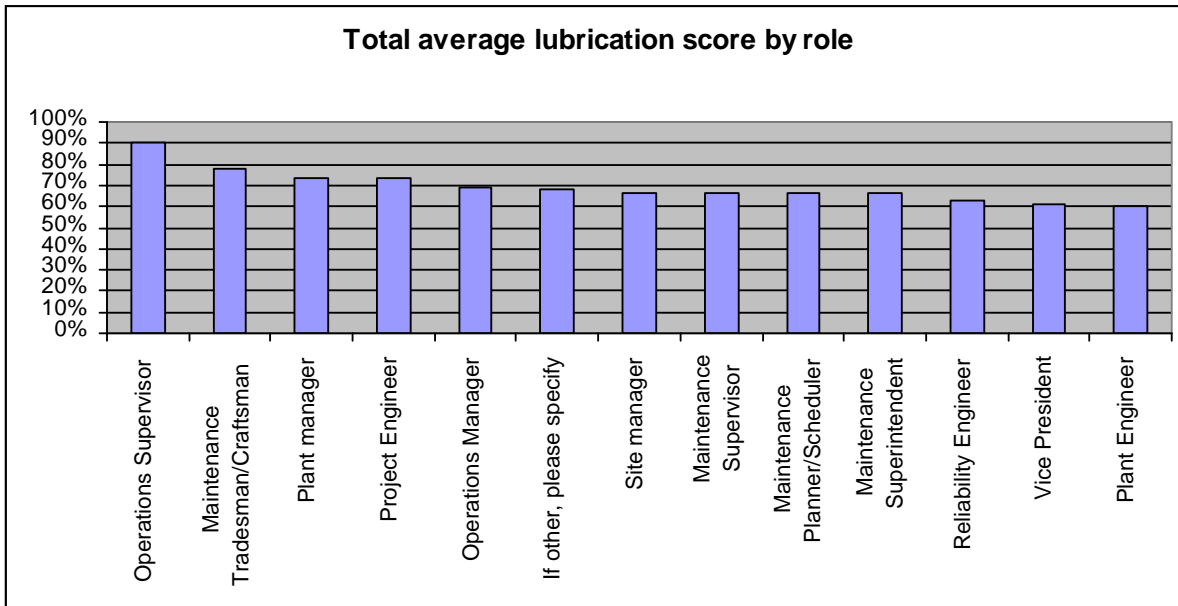
The results of the eight lubrication questions have had scores allocated from 1 to 5 in line with the scoring criteria. The total scores have then been averaged by Industry type, the position of the respondents and total no. of employees to give the results below.



**Figure 27. Lubrication total average score by industry type.**

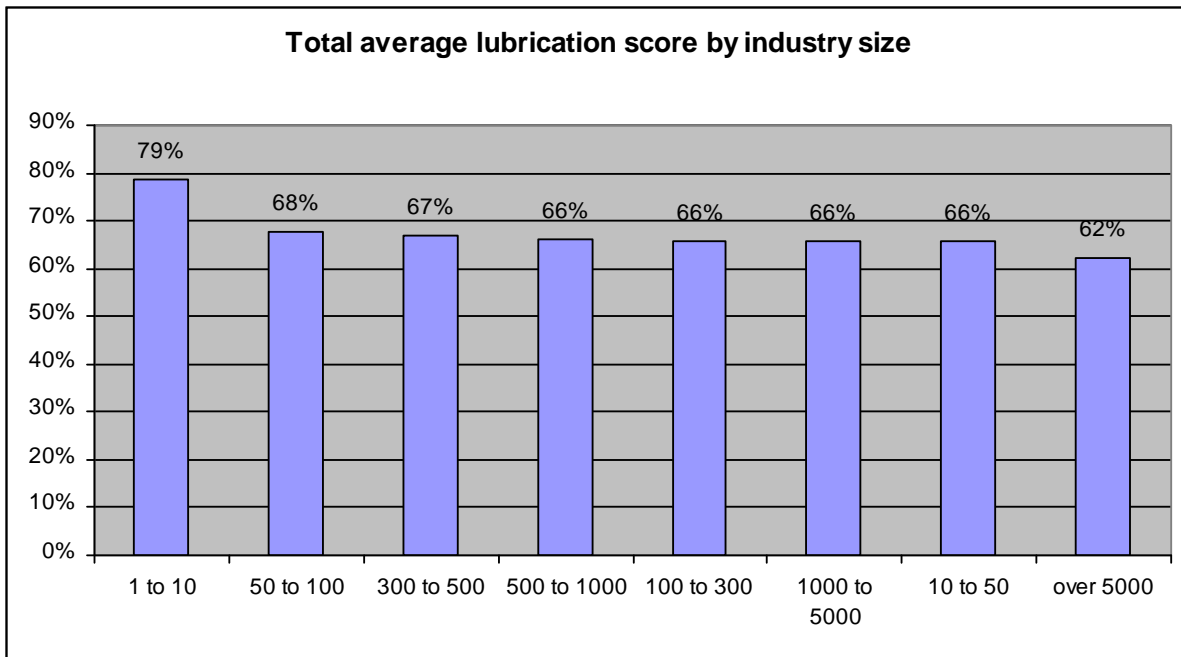


The range of scores depicted in Figure 27 are from 85% for processing plants through to 34% for educational facilities, with the majority of scores between 60% and 70%. There is no surprise that education is at 35% when the greater majority of assets are property. Of note are the poor ratings of the Offshore and refining groups with scores less than 60%.



**Figure 28. Total average lubrication score by role.**

Figure 28 depicts the opinions on Lubrication by role within the organisation. The spread of average scores ranges from 90% for operations supervisors down to 60% by Plant engineers. It is of interest that the majority of the higher scores were linked to operations or management. This is in line with responses to question 12 on management support. At the other end of the scale are the people who primarily see the results of poor lubrication being maintenance supervisors, reliability engineers and plant engineers all scored at the lower level. Is this acknowledgement that there is still plenty of improvement to be had?



**Figure 29. Total average lubrication score by size of industry**

The lubrication scores when sorted by industry size range between 89% for businesses with 1 to 10 employees down to 62% for businesses with over 5000 employees. Are smaller industries better at lubrication because they have more ownership of their equipment? This may be the case as they generally are the maintainers of their own plant. Of interest is that the larger businesses scored less. Would you expect them to be better?

**Lubrication Conclusion.**

In general the responses for the Lubrication section of the survey show general acceptance of the importance of this element. The key learning's are:

1. There needs to be more focus on operator care in the area of lubrication.
2. Contamination standards need to be set at realistic levels and then maintained.
3. Lubrication procedures need to be developed and improved.

The survey is still open for those who would like to assess themselves against the results presented in this report. Use the following link to participate.

<http://tinyurl.com/onesteelsurvey>

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