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# STATISTICAL ANALYSIS OF OFFSHORE SAFETY CULTURE SURVEY RESULTS

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## Contents

Statistical Analysis of Safety Culture Survey Results .....	2
1. Descriptive Statistics .....	2
2. Factor Analysis .....	6
3. Correlation Approaches .....	6
4. Statistical Approaches.....	6
4. Regression Trees .....	8
5. Narrative .....	9
6. Limitation .....	10

## Statistical Analysis of Safety Culture Survey Results

The safety culture survey analysis presents challenges due to the number of 44 Likert scale questions combined with more than 8 demographic factors, such as job title, asset, years of job experience, years of company experience, and company-specific questions. To address these complexities and ensure reader comprehension, this guide offers multiple approaches for the development and presentation of meaningful results.

The following are some approaches to help with the analysis and presentation:

1. **Descriptive Statistics:** Start with descriptive statistics to provide an overview of the survey data. Calculate means, standard deviations, and percentages for each Likert scale question and demographic factor. Present this information in tables and charts to make it more digestible for the readers.
2. **Factor Analysis:** Consider conducting a factor analysis to group related Likert scale questions into meaningful factors or dimensions. This can help reduce the number of variables to be analyzed and simplify the presentation of results.
3. **Correlation:** Correlation analysis can be used to summarize the relationships between questions.
4. **Statistical Test:** Conduct statistical test to determine what differences are statistically significant.
5. **Regression Trees:** Regression trees provide a method to highlight individual groups inside the analysis.
6. **Create a narrative around the survey findings:** Provide context, explain the significance of certain patterns or trends, and highlight actionable insights to improve safety culture.

### 1. Descriptive Statistics

The report should contain a table of results by question. The summary information in the table should be the main discussion point in the report. Figure 1 is a sample of a summary.

Question	Average	Total Responses	Agree	Slightly Agree	Neutral	Slightly Disagree	Disagree	Percent Negative
1. My supervisor ensures that safety briefings are held at the beginning of every shift.	4.27	3263	2543 (77.9%)	77 (2.4%)	94 (2.9%)	87 (2.7%)	463 (14.2%)	16.9%
2. Our managers show their commitment to safety through their actions.	4.20	3263	2492 (76.4%)	80 (2.5%)	69 (2.1%)	83 (2.5%)	540 (16.5%)	19.1%
3. Managers place a high priority on safety training.	4.21	3263	2495 (76.5%)	77 (2.4%)	94 (2.9%)	81 (2.5%)	517 (15.8%)	18.3%
4. Onshore managers never put schedule or costs above safety.	3.36	3263	1647 (50.5%)	199 (6.1%)	180 (5.5%)	153 (4.7%)	1085 (33.3%)	37.9%
5. When we have to choose between safety and production/schedule, safety is given the highest priority.	4.25	3263	2536 (77.7%)	79 (2.4%)	81 (2.5%)	77 (2.4%)	491 (15%)	17.4%
6. We have enough operations personnel on board to safely operate the asset in all operating conditions, including emergencies.	4.20	3263	2481 (76%)	84 (2.6%)	83 (2.5%)	100 (3.1%)	516 (15.8%)	18.9%

Figure 1. Sample descriptive statistics.

The above table should also be presented in both question order and average response value order to the reader. Both formats provide insight. The average response sort should be discussed in the report text especially highlighting the top 5 and bottom 5 questions.

Grouping by safety factor is another approach to present the data. The safety factor can be added to the above table if the average responses of the safety factors are meaningfully different. The problem with this approach is that one low question in the safety factor might make the overall result negative. For example, the low response on question 4 (scheduling pressures) would make the overall leadership safety factor lower than the rest. While scheduling pressures is an important issue, it is not solved by general leadership improvement but instead solved by specific actions related to scheduling.

Safety Factor	Question	Average	Total Responses	Percent Negative	Average
Leadership	1. My supervisor ensures that safety briefings are held at the beginning of every shift.	4.27	3263	16.9%	<b>4.08</b>
	2. Our managers show their commitment to safety through their actions.	4.20	3263	19.1%	
	3. Managers place a high priority on safety training.	4.21	3263	18.3%	
	4. Onshore managers never put schedule or costs above safety.	3.36	3263	37.9%	
	5. When we have to choose between safety and production/schedule, safety is given the highest priority.	4.25	3263	17.4%	
	6. We have enough operations personnel on board to safely operate the asset in all operating conditions, including emergencies.	4.20	3263	18.9%	
Hazard Identification and Risk Management	7. We have enough operations personnel on board to safely operate the asset in all operating conditions, including emergencies.	4.20	3263	18.9%	<b>4.29</b>
	8. My supervisor encourages me to report near misses.	4.29	3263	16.5%	
	9. We have an easy-to-understand system in place to report near misses.	4.24	3263	17.9%	
	10. Our near miss reporting system is effective in keeping the person submitting the event anonymous.	4.29	3263	16.9%	

Figure 2. Sample descriptive statistics with safety factor.

Presents cross tabs by demographic factors and discusses statistical significance of differences between groups. One effective way to present demographic analysis is to present cross tabs to the reader. A color-coding scheme with arrows is often an effective method for highlighting outlying groups. This results in a traffic light style report (Figure 3). This format should be able to put all crosstabs in a reasonable number of pages. If the number of items in the group exceeds the page length, multiple tables can be employed for one demographic factor.

Values	Asset A	Asset B	Asset C	Asset D	Asset E	Asset F	Asset G	Total
Respondents	350	140	340	837	552	71	69	3264
1. My supervisor ensures that safety briefings are held at the beginning of every shift.	→ 4.20	↑ 4.51	→ 4.20	→ 4.27	→ 4.29	→ 4.04	→ 4.20	→ 4.27
2. Our managers show their commitment to safety through their actions.	→ 4.22	→ 4.24	→ 4.17	→ 4.22	→ 4.15	→ 4.09	→ 4.23	→ 4.20
3. Managers place a high priority on safety training.	→ 4.26	→ 4.13	→ 4.18	→ 4.29	→ 4.26	→ 4.28	↓ 3.94	→ 4.21
4. Onshore managers never put schedule or costs above safety.	↓ 3.46	↓ 3.21	↓ 3.47	↓ 3.31	↓ 3.41	↓ 3.83	↓ 3.68	↓ 3.36
5. When we have to choose between safety and production/schedule, safety is given the highest priority.	→ 4.16	→ 4.25	→ 4.29	→ 4.27	→ 4.20	→ 4.38	↑ 4.65	→ 4.25
6. We have enough operations personnel on board to safely operate the asset in all operating conditions, including emergencies.	→ 4.20	→ 4.19	→ 4.23	→ 4.21	→ 4.24	→ 4.23	→ 4.48	→ 4.20
7. My supervisor sfdaasdsadme to report near misses.	→ 4.25	→ 4.24	→ 4.31	→ 4.26	→ 4.25	↑ 4.58	→ 4.33	→ 4.29
8. We have an easy-to-understand system in place to report near misses.	→ 4.18	→ 4.25	→ 4.37	→ 4.30	→ 4.22	→ 4.06	↓ 3.96	→ 4.24
9. Our near miss reporting system is effective in keeping the person submitting the event anonymous.	→ 4.20	↑ 4.51	→ 4.31	→ 4.27	→ 4.28	→ 4.17	→ 4.28	→ 4.29
10. My safety-related training is completed on time.	→ 4.27	→ 4.02	→ 4.22	→ 4.23	→ 4.35	→ 4.55	→ 4.39	→ 4.27
11. I fully understand my safety and health responsibilities.	↑ 4.82	↑ 4.95	↑ 4.80	↑ 4.89	↑ 4.87	↑ 5.00	↑ 4.64	↑ 4.86
12. Housekeeping is a demonstrated priority on this asset.	→ 4.23	→ 4.19	→ 4.29	→ 4.31	→ 4.18	→ 4.19	→ 4.35	→ 4.25
13. Workers on this asset routinely wear the required PPE.	→ 4.28	↑ 4.59	→ 4.26	→ 4.27	→ 4.22	→ 4.13	→ 4.16	→ 4.23
14. My co-workers follow the safety procedures for the jobs they will perform.	→ 4.33	→ 4.28	→ 4.29	→ 4.23	→ 4.31	→ 4.26	→ 4.35	→ 4.26
15. Visitors to our asset follow our safety procedures and standards.	→ 4.02	→ 4.35	→ 4.25	→ 4.14	→ 4.33	→ 4.32	→ 4.13	→ 4.22
16. Operating procedures are clear, accurate, and easy to follow.	→ 4.33	→ 4.16	→ 4.37	→ 4.27	→ 4.24	→ 4.16	→ 4.30	→ 4.25
17. Maintenance procedures are clear, accurate, and easy to follow.	→ 4.25	→ 4.21	→ 4.30	→ 4.32	→ 4.25	→ 4.38	→ 4.35	→ 4.30
18. This offshore asset has excellent preventive maintenance practices.	→ 4.41	→ 4.06	→ 4.23	→ 4.38	→ 4.29	→ 4.46	→ 4.29	→ 4.30
19. While offshore I get adequate rest to do my job safely.	→ 4.21	→ 4.07	→ 4.36	→ 4.30	→ 4.23	→ 4.42	→ 4.20	→ 4.27
20. Offshore personnel have ready access to all necessary tools, including PPE, to do their jobs safely.	→ 4.23	→ 4.27	→ 4.19	→ 4.19	→ 4.29	→ 4.39	→ 4.30	→ 4.26
21. Pre-job (safety) assessments are completed for all jobs that need them.	→ 4.33	→ 4.40	→ 4.22	→ 4.21	→ 4.28	→ 4.22	↓ 3.86	→ 4.23
22. Our workspaces are well designed and organized.	→ 4.30	→ 4.22	→ 4.23	→ 4.24	→ 4.29	→ 4.01	→ 4.09	→ 4.25
23. Corrective action is taken promptly when my manager is told about accidents, incidents, or near misses.	→ 4.36	→ 4.16	→ 4.03	→ 4.25	→ 4.24	→ 4.26	→ 4.12	→ 4.22
24. Causes of accidents, incidents and near misses are effectively resolved.	→ 4.05	→ 4.23	→ 4.32	→ 4.20	→ 4.24	→ 4.33	→ 4.20	→ 4.24
25. I receive timely feedback on accidents, incidents, or near misses that occur on this asset.	→ 4.26	→ 4.21	→ 4.34	→ 4.27	→ 4.35	→ 4.12	→ 4.48	→ 4.30
26. My coworkers are willing to report instances where safety rules are violated.	→ 4.24	→ 4.21	→ 4.30	→ 4.25	→ 4.27	→ 4.36	→ 4.29	→ 4.26
27. I am willing to report instances where safety rules are violated without fear of negative consequences.	→ 4.19	→ 4.23	→ 4.19	→ 4.23	→ 4.35	→ 4.32	→ 4.17	→ 4.22
28. I am encouraged to ask questions when I am unsure about the safety precautions related to my work.	→ 4.29	→ 4.24	→ 4.37	→ 4.27	→ 4.22	→ 4.12	→ 4.06	→ 4.24
29. I am able to constructively question the decisions or actions of leadership without fear of negative consequences.	→ 4.33	→ 4.29	→ 4.26	→ 4.20	→ 4.16	→ 4.26	↓ 3.70	→ 4.23
30. My supervisor stresses that I have the authority and responsibility to stop work I consider to be unsafe.	→ 4.18	→ 4.04	→ 4.22	→ 4.14	→ 4.31	→ 4.23	→ 4.19	→ 4.21
31. My supervisor tells me about safety issues that were discussed in management meetings.	→ 4.27	→ 4.34	→ 4.23	→ 4.25	→ 4.22	→ 4.16	→ 4.26	→ 4.24
32. We have good communication during hitch handover so that important information is transferred.	→ 4.39	→ 4.25	→ 4.41	→ 4.28	→ 4.38	→ 4.12	↑ 4.54	→ 4.32
33. We have good communication during shift handover so that important information is transferred.	→ 4.21	→ 4.31	→ 4.06	→ 4.28	→ 4.28	→ 4.14	→ 4.22	→ 4.26
34. Offshore personnel have adequate training in emergency procedures.	→ 4.12	→ 4.11	→ 4.17	→ 4.24	→ 4.23	→ 4.41	→ 4.29	→ 4.20
35. All of the workers onboard have sufficient language skills to perform their jobs safely.	→ 4.17	→ 4.25	→ 4.19	→ 4.29	→ 4.20	→ 4.33	→ 4.23	→ 4.25
36. I am usually consulted on matters that affect how I do my job.	→ 4.31	→ 4.36	→ 4.29	→ 4.28	→ 4.27	→ 4.32	↑ 4.55	→ 4.28
37. The managers on my offshore asset, are genuinely concerned about my safety.	→ 4.17	→ 4.21	→ 4.30	→ 4.19	→ 4.19	→ 4.13	↓ 3.99	→ 4.21
38. I have not been asked to break the rules or take shortcuts to achieve a production/schedule target.	→ 4.27	→ 4.21	→ 4.39	→ 4.33	→ 4.23	→ 4.23	→ 4.23	→ 4.30
39. Workers treat others with respect at this asset.	→ 4.35	→ 4.35	→ 4.21	→ 4.27	→ 4.20	→ 4.22	↑ 4.57	→ 4.26
40. I have been trained sufficiently so I am confident that I can safely operate the equipment within my area of responsibility.	→ 4.11	→ 4.24	→ 4.12	→ 4.21	→ 4.14	→ 4.25	→ 4.16	→ 4.19
41. My supervisor encourages us to make suggestions to improve safety.	→ 4.31	→ 4.34	→ 4.24	→ 4.27	→ 4.19	↑ 4.55	→ 4.41	→ 4.26
42. When mistakes occur, management are more interested in solving the problem than assigning blame.	→ 4.36	→ 4.19	→ 4.29	→ 4.27	→ 4.26	→ 4.17	→ 4.03	→ 4.26
43. If I am interrupted in the middle of a task, I routinely review the procedure to help make sure no steps are left out.	→ 4.24	→ 4.46	→ 4.19	→ 4.18	→ 4.31	→ 4.23	→ 4.16	→ 4.25
44. I am comfortable asking for help when unsure how to do a task.	→ 4.37	→ 4.11	→ 4.18	→ 4.19	→ 4.24	→ 4.19	→ 4.35	→ 4.24

Figure 3. Traffic style report.

## 2. Factor Analysis

Factor analysis, when applied to safety culture factors, proves to be a valuable approach for organizing results and formulating recommendations. Formatting the report in terms of safety factors provide a clear structure to make recommendations. However, the method of using a single average to merge multiple questions within a factor may lead to significant information loss unless a robust correlation exists among the questions. In other words, individual questions are likely to elicit diverse responses, rather than all questions within a specific response group being different from other groups. To assess the viability of factor analysis, one can employ tests like Kaiser-Meyer-Olkin (KMO) and examine the correlation within groups. Plots and reviewing descriptive statistics can also be employed. Unless clear within group correlations exist, statistical analysis and visualization is best done at the question level.

## 3. Correlation Approaches

Correlation approaches are somewhat difficult due to the large number of questions and demographic factors. A correlation matrix between all 44 questions would be 44\*44 and cover many pages of text. A Spearman rank correlation is suitable for ordinal Likert data. The correlation matrix can be useful in demonstrating the limitations of factor analysis. The correlation can be presented in a heat map format that slightly reduces page length. While heat maps are effective, the size (44\*44) of the correlation matrix minimizes the usefulness of interpretation for most readers since the size of the cell will be small and too much data will be presented at the same time..

An alternative to address this issue is to employ a clustering approach. This method allows for the grouping of questions with similar response patterns, offering a more concise and informative way to showcase the correlations among the Likert scale questions. Often multiple clustering models provide similar levels of data fitting, so multiple similar fits make interpretations difficult.

## 4. Statistical Approaches

The statistical significance of the groups within the individual questions can be found using Kruskal-Wallis Test. This data is observational. So the statistical significance does not show causal relations. Many relationships might be significant due to the large number of questions and sample size of the survey. The actual amount of the relationship is not established by demonstrating statistical significance. To find strength of relationship, Epsilon square ( $\epsilon^2$ ) and Freeman's Theta can be employed. These are measures of the predictive power of ordinal and

categorical responses. They range from 0 to 1 with zero being no correlation and 1 being perfect association. Epsilon square ( $\epsilon^2$ ) and Freeman's Theta do not have negative correlations since one of the demographic variables is categorical and the other variable is ordinal. Interpretation of Epsilon square ( $\epsilon^2$ ) and Freeman's Theta is like the interpretation of simple correlation coefficient with value going between 0 and 1. A reasonable interpretation for social science for correlations is:

- < 0.01 – Negligible
- < 0.16 - Weak
- 0.16 < 0.36 – Moderate
- 0.36 < 0.64 - Moderately Strong
- 0.64 < 1.00 - Strong

As a writeup approach, the question can be listed and all relationships with p-value for the Kruskal-Wallis test less than .05 can be displayed. Note if you allow blank demographics for anonymous reporting, individuals who did not enter demographic information might tend to have lower responses to the Likert questions. A sample of the results in outline format would be as follows:

1. My supervisor ensures that safety briefings are held at the beginning of every shift.

- For Job Title, the Kruskal-Wallis Test (p-value = 3.426e-07) for '1. My supervisor ensures that safety briefings are held at the beginning of every shift.' shows significant relationships. The power of this relationship is estimated with a Freeman Theta of 0.208 and a square root of Epsilon Squared of 0.0969.
- For Asset, the Kruskal-Wallis Test (p-value = 2.809e-08) for '1. My supervisor ensures that safety briefings are held at the beginning of every shift ' shows significant relationships. The power of this relationship is estimated with a Freeman Theta of 0.106 and a square root of Epsilon Squared of 0.0518.

All other relationships are not statistically significant.

A Mann-Whitney U Test can be performed for each comparison within the demographic factors. Given the large number of groups, a Mann-Whitney tests for all demographics responses for all questions would generate a massive amount of page length. While this might be acceptable for an appendix, the use to the reader is limited. An illustrative presentation of the Mann-Whitney U Test is the following text.

For "1. My supervisor ensures that safety briefings are held at the beginning of every shift.", Kruskal-Wallis Test (p-value = \_\_\_\_ ) shows significant difference between years of experience. Detailed comparison results based on Mann-Whitney Test if available are as below (if group size is less than 8, no Mann-Whitney Test is executed).



- Significant difference (MW p.value = \_\_\_\_ ) exists between Less than 1 yr (avg=\_\_\_\_, n=\_\_\_\_) and 1 to less than 3 yrs (avg=\_\_\_\_, n=\_\_\_\_)
- Significant difference (MW p.value = \_\_\_\_ ) exists between Less than 1 yr (avg=\_\_\_\_, n=\_\_\_\_) and 5 to less than 7 yrs (avg=\_\_\_\_, n=49)
- Significant difference (MW p.value = \_\_\_\_ ) exists between 1 to less than 3 yrs (avg=\_\_\_\_, n=\_\_\_\_) and 5 to less than 7 yrs (avg=\_\_\_\_, n=\_\_\_\_)
- ... *For many items this list could be several pages.*

Note the above format can be very long and repetitive for a safety culture report often requiring many pages. The analysis would need to be summarized with key finding highlighted.

## 4. Regression Trees

Regression models can be effective, but difficult to explain to the end reader. The parameters within regression models are often difficult to explain, especially if ordinal logistic regression is employed. Simple linear regression cannot be used since the range of Likert values is restricted to be between 1 and 5.

Given the Likert Scale data combined with categorical data for demographic, a regression tree such as Rpart provides a useful tool that can be easily presented to the reader. The results from RPart can be converted into graphical output or text descriptions. A reasonable format for this output is as follows:

The average response for this question is \_\_ with \_\_ agree, \_\_slightly agree, \_\_neutral, \_\_slightly disagree, \_\_ disagree, and \_\_ without response. The responses to the question were positive. The data has 3 distinct groups with different responses. Groups can be targeted to improve performance on this question. The difference between groups was 0.54. This difference is moderate. The lowest group average was 4.37 indicating all groups are reasonable positive for this question. The model identified groups in the data are:

1. Group 1 defined by location \_\_\_\_ employees with an average value of 4.37 and 121 observations.
2. Group 2 defined by all other employees with an average value of 4.72 and 1824 observations.
3. Group 3 defined location \_\_\_\_ with an average value of 4.91 and 543 observations.

These can be put into a chart. The following is a sample format.

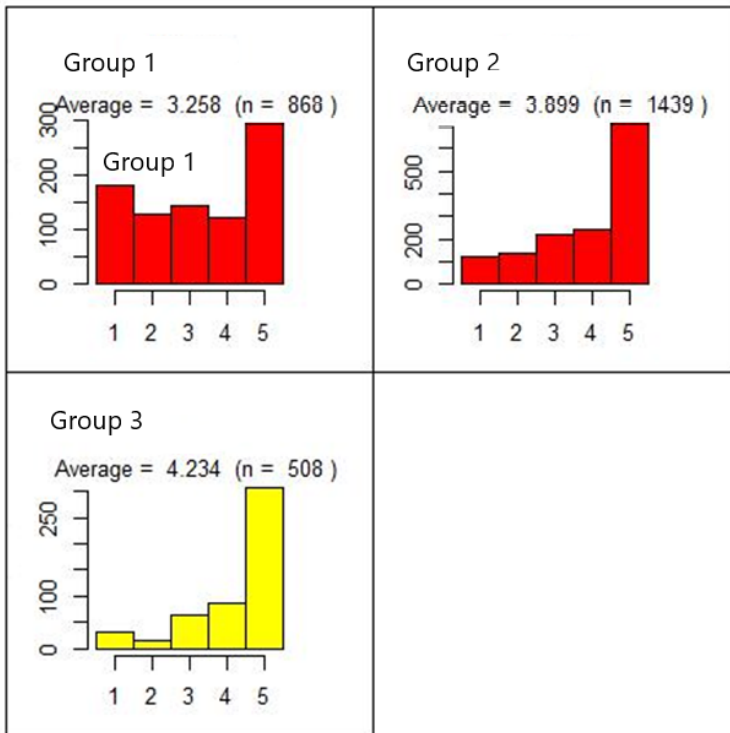


Figure 4. Sample presentation of RPart Likert Models.

The above regression tree approach provides a concise summary of key demographic factors impact on a question. A limitation is that many tree models with similar performance exist that might have different interpretations in terms of the groups to be targeted. As such, this analysis can be misleading.

## 5. Narrative

Developing a narrative from the data analysis is challenging. The following are some suggestions:

1. Identify the five to ten questions with the highest and lowest average responses.
  - a. Discuss the areas of strength reflected in the top-rated questions and the potential areas for improvement highlighted by the bottom-rated questions.
  - b. Provide context and explanations for why certain questions received high or low scores, linking them to specific aspects of the safety culture.
2. Arrange the survey results by question response to showcase the distribution of responses for each Likert scale question. This presentation will allow readers to grasp the variation in responses and identify any patterns or trends in the data.
3. Identify High and Low Responding Groups.

- a. Segment the survey data based on demographic factors (e.g., job title, years of experience) to identify groups with high and low responses.
  - b. Discuss the findings related to these groups in the summary, highlighting any noteworthy differences in safety culture perceptions.
4. Utilize descriptive statistics (means, percent positive, percent negative, counts by Likert scale value, percentages) as the main analysis tool to summarize the survey results.
5. Save more complex analyses, such as correlation analysis and statistical tests, for appendix material or supplementary reports, making them accessible for readers who seek more in-depth information.
6. Write an overall summary at the start of the report with the rest of the report acting as supporting materials.
7. Clearly present the limitations of safety culture surveys discussed in the next section. Highlight the influence of question wording on responses.

By implementing these suggestions, the narrative from the data analysis can become more focused, insightful, and easy for the audience to comprehend. Effective communication of the safety culture survey results will enable better understanding and engagement from stakeholders, enhancing the potential for meaningful improvements in safety culture within the organization.

## 6. Limitation

No single approach works best for analyzing Likert scale data. While Likert scale might be capable of find major issues in safety culture, order of Likert questions might not be driven by company specific issues, but instead by wording of question, societal, and industry wide factors (Figure 5). The following examples were constructed during this project to identify limitations in the survey.

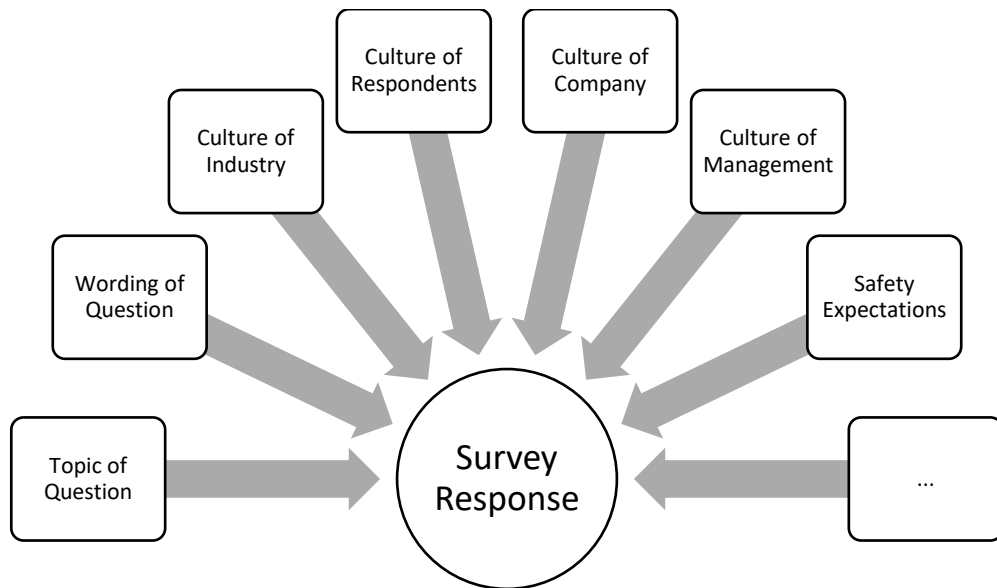


Figure 5. Influences on Likert Scale responses.

A good example of question wording influence is to ask about lifeboat safety at the top of the question list. Lifeboat drills are an activity with some inherent risk due to raising and lowering a lifeboat from a significant height via cables or free fall. A negative response on lifeboat safety is difficult to interpret in terms of safety culture since negative responses might be based on reasonable risk identification instead of a safety issue. A question about lifeboat safety can be worded in different ways such as safety performance, capabilities, adherence to procedures, or appropriateness of procedures. The question could also be asked at the individual level, team level, or group level. The question can be asked in terms of absolute safety or performance relative to other organizations. When a survey is analyzed, how the question is asked and the role that organizations may play might be important.

Question	Aspect of Safety	Level
<b>I always follow correct procedures during lifeboat drills.</b>	Adherence to Procedures	Self
<b>I can safely perform a lifeboat drill.</b>	Capabilities	Self
<b>I am worried about my safety during lifeboat drills.</b>	Safety Performance (reverse)	Self
<b>I fear for my personnel safety during lifeboat drills.</b>	Safety Performance (reverse)	Self
<b>Lifeboat drills on this ship are safe.</b>	Safety Performance Local Team	Team
<b>This company's lifeboat drills are safe.</b>	Safety Performance Company	Company
<b>Lifeboat drills are safe.</b>	Safety performance Industry	Industry
<b>Reasonable safety procedures are employed during safety drills.</b>	Procedures	Unspecified
<b>Compared to other companies, lifeboat drills are safe.</b>	Relative Performance	Company
<b>Compared to other ships, lifeboat drills are safe on this vessel.</b>	Relative Performance	Team

Figure 6. Alternative question wordings.

Similar questions can have very different responses in terms of tone. For instance, the substitution of “worried” and “fear” provides a very different sounding question in the two alternatives about lifeboat safety:

- I am concerned about my safety during lifeboat drills.
- I am worried about my safety during lifeboat drills.
- I fear for my personnel safety during lifeboat drills.

This project performed a correlation analysis between past maritime safety culture survey results. A safety culture survey data correlation analysis was conducted on the responses from five maritime shipping companies in a past project. The surveys produced similar results for the question responses and ranked order of responses. To analyze the degree of commonality, the team took the average response for each question based on converting the Likert Scale to a numeric value where 1 is disagree and 5 is agree. After taking the average response, the team developed a data table that contained question ID and average responses for each company in columns. The team then examined the correlation amongst the questions between companies' average response by question using `cor.test()` from the R stats package. The text of the questions is displayed in Figure 7.

<p>1. When ship management is told about accidents, incidents or near misses, corrective action is taken promptly.</p> <p>2. Shoreside managers never put schedule or costs above safety.</p> <p>3. Ship management is personally involved in safety activities on a routine basis.</p> <p>4. Management places a high priority on safety training.</p> <p>5. Crew members are actively encouraged to improve safety.</p> <p>6. This company has excellent maintenance standards.</p> <p>7. Our crew has adequate training in emergency procedures.</p> <p>8. People are hired for their ability and willingness to work safely.</p> <p>9. Language differences in multi-cultural crews are not a threat to safety.</p> <p>10. There are no differences in the performance of crew members from different cultures.</p> <p>11. There is good communication on this ship about safety issues.</p> <p>12. I am always informed about the outcome of shipboard meetings that address safety.</p> <p>13. Watch hand-overs are thorough and not hurried.</p> <p>14. When I joined this ship I received a proper hand-over, including familiarization with any new tasks.</p> <p>15. Safety is the top priority for crew onboard this ship.</p> <p>16. Whenever I see safety regulations being broken, I report it.</p> <p>17. The crew is expected to adhere to the work/rest cycle.</p> <p>18. There is a system in place for observing my time off-duty.</p> <p>19. I get adequate rest on the work/rest cycle that I work.</p> <p>20. I am confident that I can operate the automated equipment within my area of responsibility.</p>	<p>21. I am very satisfied with the follow-up measures taken after accidents, incidents and near misses.</p> <p>22. Mistakes are corrected without punishment and treated as a learning opportunity.</p> <p>23. The crew is always given feedback on accidents, incidents or near misses that occur onboard this ship.</p> <p>24. I am encouraged to conduct risk assessments and report near misses.</p> <p>25. An effective anonymous reporting system exists in this company.</p> <p>26. This company cares about my health and safety.</p> <p>27. Suggestions to improve health and safety are welcomed.</p> <p>28. I fully understand my responsibilities for health and safety.</p> <p>29. The crew is always given feedback on injuries that occur onboard this ship.</p> <p>30. The crew has access to all necessary personal protective equipment (PPE).</p> <p>31. I am always informed about the outcome of shipboard meetings that address health and safety.</p> <p>32. If I am interrupted whilst carrying out a task, I carefully check what I did, or start again, before resuming the task.</p> <p>33. Safety briefings and training are never overlooked.</p> <p>34. I have good control over the safety outcomes of my job.</p> <p>35. I am usually consulted on matters that affect how I do my job.</p> <p>36. The crew is not encouraged to break the rules to achieve a target.</p> <p>37. I am comfortable asking for help when unsure how to do a task.</p> <p>38. Pre-job assessments are completed for all jobs that need them.</p> <p>39. I always give proper instructions when I initiate any work.</p> <p>40. I always ask questions if I do not understand the instructions given to me, or I am unsure of the relevant safety precautions.</p>
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Figure 7. Sample questions.

Table 1 presents and Pearson correlation analysis result for the survey results from the five maritime shipping companies A, B, C, D, and E. The Pearson Correlation between the average response by question for different companies was very high ranging from .804 to .927 indicating a high degree of commonality in response patterns. A Pearson correlation measure the strength of the linear relationship between two variables.

Table 1. Pearson correlation between question responses based on average response.

	A	B	C	D	E
A	1	0.890	0.927	0.899	0.905
B		1	0.827	0.888	0.804
C			1	0.863	0.880
D				1	0.857
E					1

Beyond the linear correlation, the Kendal Tau ranked correlation (Table 2) and Spearman correlations (Table 3) were also both high. Both are measures involving rank of questions in the data set.

Table 2. Kendal Tau Correlation between question responses based on average response.

	A	B	C	D	E
A	1	0.626	0.586	0.662	0.535
B		1	0.594	0.710	0.648
C			1	0.689	0.665
D				1	0.622
E					1

Table 3. Spearman Correlation between question responses based on average response.

	A	B	C	D	E
A	1	0.794	0.766	0.822	0.704
B		1	0.786	0.880	0.833
C			1	0.852	0.834
D				1	0.813
E					1

Figure 7 is a dot plot of average response for each company by question. The plot shows most questions have a positive response with only small minor differences between the surveys. The plot also illustrates the strong correlation between responses for the different companies as demonstrated by the above correlations.

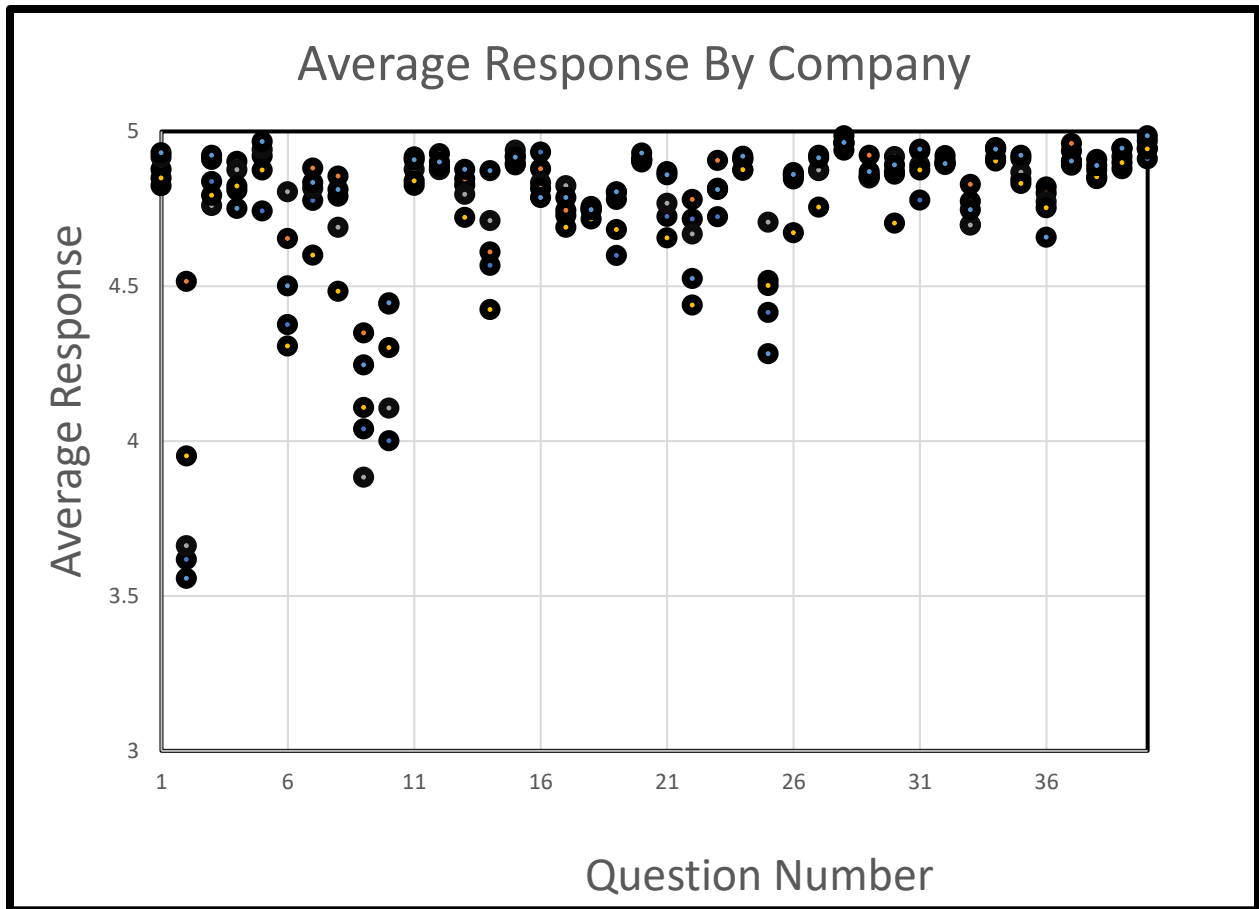


Figure 8. Dot plot of responses.

The takeaway from the above analysis is that the finding of the survey might be company specific or industry specific. The wording of the questions might also determine the order of responses as opposed to the underlying performance. As such, care should be taken when using the results of the safety culture survey to make policy changes.