



## Understanding Public Risk Perception in the Oil and Gas Industry

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### Summary

Hydraulic fracturing, or fracking, is an extremely divisive topic. A large component of its controversial nature stems from the public perception of risks associated with it - the perceived risks are often inconsistent with the real risks. Among these risks is the potential for induced seismicity. Although hydraulic fracturing has been around since the 1950s in Alberta (Alberta Environment and Parks 2018), factors affecting public perception of the risks of induced seismicity are not fully understood. Public perception can affect the ability of the oil and gas industry to operate successfully in a given location; i.e. it influences social license to operate. Thus, understanding the factors which influence public perception can lead to smoother interactions between industry and the public and improve the reputation of industry. A better understanding may also ensure safe and economic energy production can continue. Work is underway to create, distribute, and analyze targeted electronic surveys of both industry and public perceptions of induced seismicity. The results of these surveys will enable us to make policy recommendations which will bring local industry, integral to the Alberta economy, more in line with the perceptions and preferences of the Alberta public.

### Theory / Method

Public perception of risk is inherent to many parts of modern society, including living with natural disasters, evolving attitudes toward food, and contemporary energy production (Paranjothy et al. 2011; Evans et al. 2010; Gehman et al. 2016). Topics ranging from nuclear power to hydraulic fracturing to climate change are all controversial and divisive, with their risk levels the subject of much public debate. One study (Gehman et al. 2016) went so far as to say that although public perceptions of risk are often exaggerated, under some very specific circumstances they may be closer to the truth than expert assessments. There is a clear need for increased understanding of public perception as it relates to the oil and gas industry, specifically induced seismicity. One method to accomplish this is through the use of surveys.

Great care must be taken when designing surveys for distribution. The wording of individual questions, the order in which the questions are presented, and the progression of survey sections all have the potential to bias responses, and therefore skew the results. In efforts to accurately capture respondent opinions, it is common to use the Likert scale (Likert 1932), where respondents indicate their opinion by picking from a spectrum of options. The most commonly recognizable style is the scale from strongly disagree to strongly agree. Although this style has been used for decades, another option is gaining popularity: vignettes (Auspurg and Hinz 2015). Vignette questions will typically balance many tradeoffs and ask respondents to indicate their opinion of an entire complex scenario. By varying the tradeoff options within the scenarios, it is possible to determine how respondents perceive each individual component. This style of questioning can minimize problems caused by things such as social desirability bias, where respondents withhold or modify their true opinions due to the pressure to conform to socially acceptable standards.

Once a survey has been developed, distributed, and collected, it is important to accurately assess the results. A survey of industry professionals was taken (survey 1), with questions designed to give insight from the

energy industry into induced seismicity caused by hydraulic fracturing in unconventional reservoirs, specifically the Western Canadian Sedimentary Basin (WCSB). The survey had five sections: demographics, awareness and risk perception, policy and decision making, economic impacts, and mitigation techniques. There were also six additional questions pertaining to the Alberta Duvernay Formation. In total, the survey was intended to increase understanding of how professionals evaluate the risks, costs, and policy hurdles surrounding induced seismicity. Analysis of this survey includes hierarchical data clustering in the form of a dendrogram, stacked bar plots to illustrate the difference in responses between clusters, and comparisons of median responses and spreads between clusters for given questions. A survey of the public was also taken (survey 2), with questions designed to give insight into public perception of the industry and risks associated with industry operations in western Canada. The survey is being delivered via an online link at [tinyurl.com/oilandgassurvey](http://tinyurl.com/oilandgassurvey) and is currently still open. Analysis of this survey is ongoing, but a sneak peek of the demographics and select questions and insights will be given.

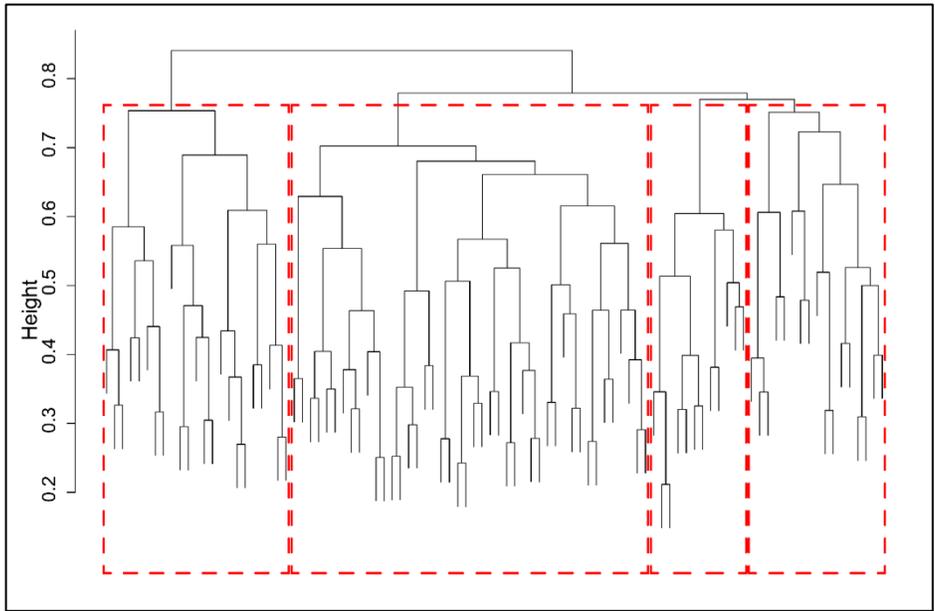
## Results, Observations, Conclusions

A dendrogram of the hierarchical clustering for survey 1 can be seen in Figure 1. There appear to be four clusters within the data, as outlined in dashed red boxes. Using the clusters identified in the dendrogram, stacked bar plots can be made, like the one seen in Figure 2. This stacked bar plot illustrates the level of industry experience each cluster has. It can be seen that in general, cluster three has more experience than clusters one, two, and four. Responses given by the different clusters, as identified in Figure 1, can also be visualized across a number of questions by calculating the median response and the spread. This type of visualization is seen in Figure 3, with the accompanying scale in Figure 4. It should be noted that “not sure” has been placed between slightly disagree and neutral, as it is most similar to neutral rather than being similar to strongly agree or strongly disagree (as placement on the far extremes of the scale would suggest). The questions/statements included in Figure 3 are:

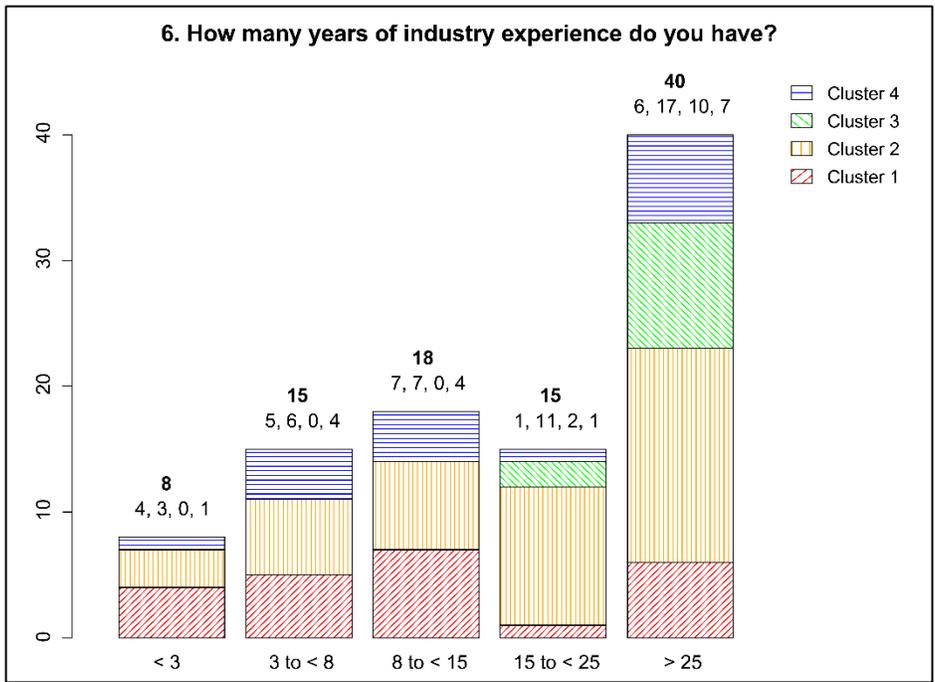
6. How many years of industry experience do you have?
9. Induced seismicity poses an environmental risk.
10. Induced seismicity poses a risk to public health and safety.
11. Induced seismicity poses an economic risk to operators.
30. Induced seismicity poses an unacceptable risk to surface infrastructure in the Fox Creek area.

For question 6, it is clear that cluster one has the lowest median level of experience, and cluster three the highest. Clusters two and four also have a high level of experience, but a larger spread of responses than clusters one and three. With question 9, we see that cluster one is the most likely to agree that there is an environmental risk; cluster two primarily disagrees, with a wide spread of responses; and cluster four disagrees the most strongly. Cluster three also disagrees that there is a risk. In question 10, cluster one agreed the most strongly with the statement that there is risk to public health and safety. Although the median response for cluster four was disagreement, the spread of responses stretches well into agreeing with the statement. Cluster two agrees that there is a risk to public health and safety while cluster three disagrees, both with little spread in responses. For question 11, all four clusters felt there was an economic risk to operators, with cluster one having a spread into strong agreement. With question 30, clusters two, three, and four disagreed with the statement that there is risk to infrastructure in Fox Creek, with cluster two having the widest spread into the unsure category. Cluster one indicated slight agreement with the statement.

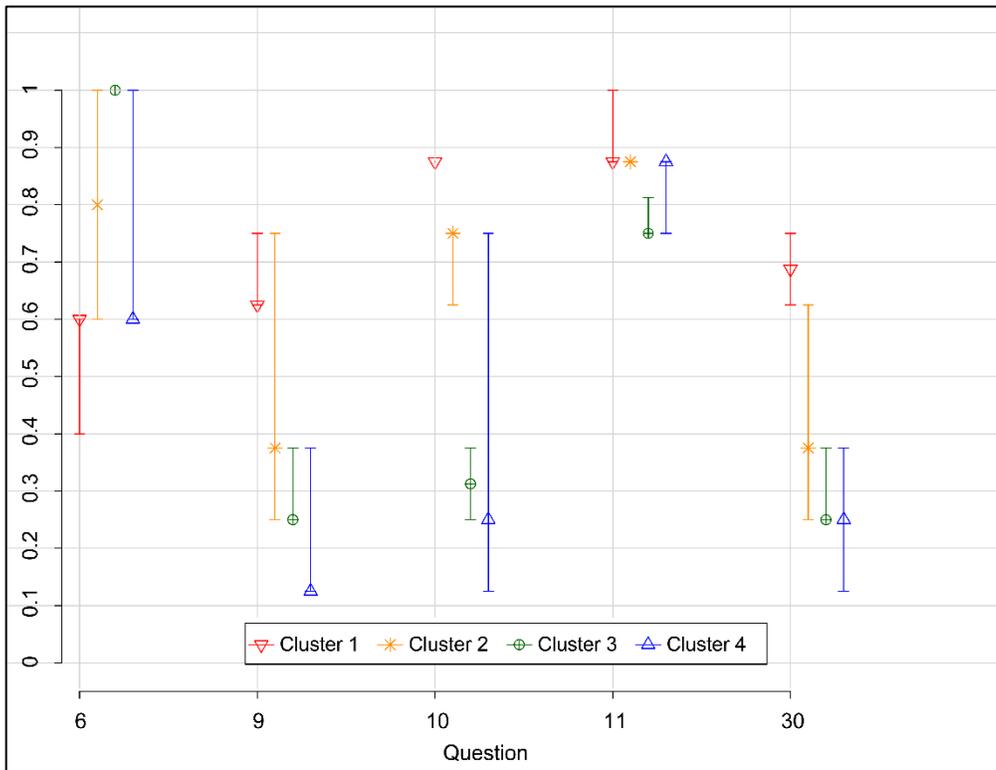
It is interesting to note in Figure 3 that cluster one, with the lowest experience, indicated a higher level of risk for the environment, public health and safety, the economy, and infrastructure in Fox Creek than the other three clusters. One possible explanation may be that they lack the experience to fully appreciate the factors that require consideration in assessing these kinds of risks. Another may be that they are younger, and therefore more aware of novel methods and information that are impacting and transforming current practices in the industry. It is likely that a combination of these and other factors are contributing to the different responses we see in the survey.



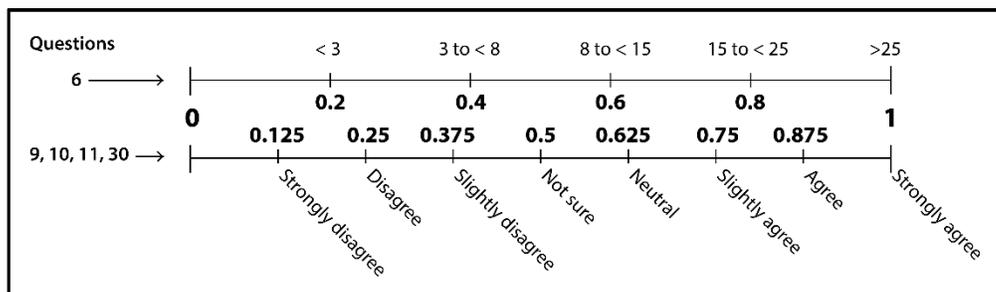
**Figure 1** - Dendrogram (hierarchical clustering) of data from survey of industry professionals. There appear to be four clusters, as outlined in dashed red boxes. Clusters are identified from left to right as one, two, three, and four, respectively.



**Figure 2** - Stacked bar plot of years of industry experience for each cluster. In general, cluster three has more experience than clusters one, two, or four.



**Figure 3** - Median and spread of responses within each cluster for questions 6, 9, 10, 11, and 30 of the survey of professionals. The accompanying scale is shown in Figure 4. Question 6 shows that cluster one has the least industry experience of the four clusters. Question 9 shows that clusters 3 & 4 felt there was low risk to the environment, while cluster 2 was largely uncertain with a wide spread and cluster 1 felt there was a risk. Question 10 shows that clusters 3 & 4 felt there was low risk to public health and safety, while clusters 1 & 2 felt there was a risk. Question 11 shows that all four clusters agree that there is an economic risk to operators due to induced seismicity. Question 30 shows that clusters 2, 3, & 4 feel there is low risk to infrastructure in Fox Creek, while cluster 1 feels there is a risk.



**Figure 4** - Scale from 0 to 1 indicating corresponding options for questions 6, 9, 10, 11, and 30. Accompanies Figure 3. Question 6 ranges from less than 3 years to over 25 years, and questions 9, 10, 11, and 30 range between strongly disagree and strongly agree. “Not sure” was placed to the left of neutral to avoid associating it with either strongly agree or strongly disagree.

## Acknowledgements

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