APPENDIX 2A: Exploratory factor analysis background.

The sampling adequacy and factorability of variables were tested using several methods. First, the factorability of change and complexity variables were examined in both the council and manager groups using correlation coefficients (reasonable at > .3). Though our sample sizes were small, satisfactory factor recovery has been shown possible under conditions similar to ours. De Winter found that with a sample size N = 17-21, recovery can be successful at factor loadings $\lambda = 0.8$, number of factors f= 3-4, and number of variables p = 6-12 (de Winter et al., 2009). Standard measurements of sampling adequacy returned above recommended values (Kaiser-Meyer-Olkin measure > .5 as per Kaiser (1974); anti-image correlation matrix diagonals > .5; and $p < .05$ Bartlett's test of sphericity in all cases).

We retained factors based on the Kaiser Criterion, Scree test and cumulative percent of variance, in order to retain meaningful factors with satisfactory eigenvalues. Using λ factor loadings cross-loadings of items were examined to find items with significant correlation with multiple factors. Variables with λ below 0.3 were eliminated one at a time and the factor extraction repeated. Final models were chosen based on (i) the leveling off of eigenvalues on the scree plot, (ii) difficulty of interpreting subsequent factors (insufficient λ values, heavy cross-loadings), and (iii) final factor correlation matrix with all correlations less than 0.6. The factors were given descriptive labels based on interpretations of common themes and relationships between the variables. In naming the clusters, attention was paid to the λ values. Any factor loading above 0.6 is considered a strong association, and above 0.4 is considered moderate (Comrey and Lee, 1992; Matsunaga, 2015). Based on these, the relative prominence of variables in addition to their theme played a role in the chosen labels. Where possible and applicable, identical names were given to factors in the council and manager groups if the combination of variables expressed identical themes, even if the exact combination of items was different.

Literature Cited

Baglin J. 2014. Improving your exploratory factor analysis for ordinal data: A demonstration using FACTOR. Practical Assessment, Research & Evaluation 19: 2.

Comrey, A. & Lee, H. 1992. A first course in factor analysis (2nd edn.) lawrence earlbaum associates. Publishers: Hillsdale, New Jersey.

De Winter J, Dodou D and Wieringa P. 2009. Exploratory factor analysis with small sample sizes. Multivariate Behavioral Research 44: 147-181.

Kaiser, H.F. 1974. An index of factorial simplicity. Psychometrika, 39, 31-36.

Matsunaga, M. 2015. How to factor-analyze your data right: Do's, don'ts, and how-to's. International Journal of Psychological Research, 3, 97-110.

Preacher, K.J. and MacCallum, R.C., 2002. Exploratory factor analysis in behavior genetics research: Factor recovery with small sample sizes. *Behavior genetics*, *32*(2), pp.153-161.

APPENDIX 2B: Exploratory factor analysis results

Table A2.B.1 Social-ecological system changes and complexity models shown. Variable names: SC = social system change, EC = environmental system change, SX = social system complexity, EX = environmental system complexity. *Reverse coded variables: In the calculation of *rate of changes,* these statements were reverse coded because they were worded positively, unlike the rest of the items. Positive outlook about the future (higher scores) indicate less uncertainty in the environment, and ability to forecast future trends. These items were reverse scored to keep them on the same scale with other variables. The ability to project future outcomes presupposes continuity of trends and the ability to steer the system toward desired states—traits of low uncertainty in a system (Stacey 2007, Tschakert, et al. 2014).

SES changes factors:

Council Group	**λ**
Unpredictable risks	
EC_6 The sustainability of Northern Alaska communities is highly influenced by unpredictable environmental challenges.	0.77
SC_3 The two boroughs are constantly having to cope with risks that are changing	0.75
EC_5 Environmental research and monitoring needs in Northern Alaska are constantly changing	0.56
Shifting social and political capital	
SC_4 The regulatory environment is continually changing	0.84
SC_5 Social values in society are continually changing	0.81
Future outlook	
revEC_1* The future of Northern Alaska's environment looks positive in the coming years.	0.81
revEC_2* Northern Alaska's environment will support the sustainability goals of its communities in the coming years.	0.50
Kaiser-Meyer-Olkin measure:	.63
Bartlett's Test – Sig.	.001
Eliminated variables: EC_3, EC_4, SC_1, SC_2, SC_6	

Manager Group	**λ**
Future outlook	
revEC_1* The future of Northern Alaska's environment looks positive in the coming years.	0.84
revEC_2* Northern Alaska's environment will support the sustainability goals of its communities in the coming years.	0.73
revSC_2* Opportunities for the two boroughs look good for the next few years	0.72
revSC_1* Regional and global markets will grow for several years in ways that support sustainability in the two boroughs.	0.68
Shifting knowledge demands	
SC_6 There is high demand placed on Northern Alaska communities having to innovate because of new rules and regulations	0.87
SC_4 The regulatory environment is continually changing	0.63
EC_5 Environmental research and monitoring needs in Northern Alaska are constantly changing	0.58
Kaiser-Meyer-Olkin measure:	.59
Bartlett's Test – Sig.	.001
Eliminated variables: EC_3, EC_4, EC_6, SC-3, SC_5	

SES complexity factors:

Council Group	**λ**
Global-local links	
EX_2 The Arctic environment is very complex with many unclear factors and relationships influencing the two boroughs.	0.90
SX_3 Actions taken at the Pan-Arctic level affect lives strongly in the two boroughs.	0.60
EX_4 New and unpredictable environmental changes are constantly occurring.	0.43
Unpredictable policies	
SX_6 The sustainability of Northern Alaska communities is highly influenced by unpredictable public policies	0.79
EX_5 The two borough's environment is highly influenced by unpredictable public policies.	0.71
Changing economy & environment	
SX_2 The business environment is very complex with many unclear factors and relationships affecting the two boroughs	0.86
EX_1 Environmental changes in the northern region of Alaska will affect the state and region strongly	0.42
Kaiser-Meyer-Olkin measure:	.63
Bartlett's Test – Sig.	.02
Eliminated: EX_6, SX_1, SX_3, SX_4, SX_5, SX_7	

Manager Group	**λ**
Unpredictable environmental changes	
EX_6 The sustainability of Northern Alaska communities is highly influenced by unpredictable environmental challenges	0.94
EX_4 New and unpredictable environmental changes are constantly occurring	0.69
EX_1 Environmental changes in the northern region of Alaska will affect the state and region strongly	0.65
EX_2 The Arctic environment is very complex with many unclear factors and relationships influencing the two boroughs.	0.56
SX_7 There are many unexpected threats that the two boroughs have to cope with.	0.51
Unpredictable policies	
SX_6 The sustainability of Northern Alaska communities is highly influenced by unpredictable public policies	0.94
EX_5 The two borough's environment is highly influenced by unpredictable public policies.	0.77
SX_4 New and unpredictable economic and political events and interests in the Arctic are constantly occurring	0.50
Kaiser-Meyer-Olkin measure:	.70
Bartlett's Test – Sig.	.001
Eliminated: EX_3, SX_1, SX_2, SX_3, SX_5	

Literature Cited

Stacey RD. 2007. *Strategic management and organisational dynamics: The challenge of complexity to ways of thinking about organisations*. Pearson education.

Tschakert P, Dietrich K, Tamminga K, et al. 2014. Learning and envisioning under climatic uncertainty: An African experience. *Environment and Planning A*. 46:1049-1068.

APPENDIX 2C: Factor scores

As a final step, composite scores were created for each of the factors, based on the mean of the items in each, ignoring λ values (Table A1.C.1). DiStefano et al. (2009) noted that this unrefined method has been established as appropriate for exploratory research (Hair *et al.*, 2009; Tabachnick *et al.*, 2001). Because this study aims to simplify complex and dynamic human perceptions, but without claiming to predict them, Exploratory Factor Analysis and unrefined factor scores produce adequate basis for such discussions.

Table A2.C.1 Factor scores (mean scores indicated)

Council Group	**Factor score**	**SD**
SES Changes		
1. Unpredictable risks	5.3	1.3
2. Shifting social and political capital	5.3	1.2
3. Future outlook*	4.6 (Mdn=5)	1.4
SES Complexity		
1. Global-local links	5.7	1.2
2. Unpredictable policies	5.1	1.5
3. Changing economy and environment	5.0	1.3
Manager Group		
SES Changes		
1. Future outlook*	3.6 (Mdn=4)	1.2
2. Shifting knowledge demands	4.4	1.2
SES Complexity		
1. Unpredictable environmental changes	4.9	1.1
2. Unpredictable policies	4.2	1.2

*significance of association with group membership at $t(59) = 3.2$, $p = .002$