

Research Article

Organizational Environmental Protection Climate of a Rubber Products Factory in China

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Abstract: The aim of this study is to reveal the relationship between 1) the variables of position and working age of each objective and 2) responses variables on organizational environmental protection climate of an organizational climate in a rubber products factory located in North China. Organizational environmental protection climate can be measured by organizational environmental protection climate survey using an environmental protection questionnaire. Themes of organizational environmental protection climate are listed and an organizational climate questionnaire containing eighteen environmental protection-related questions is developed. Fifty-fifty multivariate analysis of variance is used to reveal the relationship between 1) the variables of position and working age of each objective and 2) responses variables on organizational environmental protection climate. It is concluded that 1) the factor of position affects total environmental protection climate; 2) objectives in efferent position have significant dissimilar perceptions in the performance of environmental protection of the organization; 3) objectives in efferent position have significant dissimilar perceptions in the priority of environmental protection when the organization suffers from stress of production tasks in the Chinese rubber products factory.

Keywords: Fifty-fifty multivariate analysis of variance, organizational environmental protection climate, rubber products factory

INTRODUCTION

Causes of environmental protection can be divided into two aspects: causes from people and causes from things. Traditional environmental protection works mainly focus on the causes from things (environmental engineering), rather than the causes from people (Masters and Ela, 2008). In fact, most causes of environmental pollution are human errors. Organizational errors of environmental protection are the root causes of these environmental pollution problems.

Organizational environmental protection climate is a part of organizational climate, but limited consideration has been given to the “environmental sensitive cultures” of service providers (Yusof *et al.*, 2010). Organizational culture which leads to more environmental sensitive values and practices is more ostensible to organizations (Yusof *et al.*, 2010). Without embedding the safety and maritime environmental protection culture in the company, external inspections can have only limited and weak influence on the ship’s safety and prevention of pollution caused by shipboard operations (Turker and Er, 2008). Managers’ environmental consciousness is crucial and their tasks in directing environmental strategies include defining company’s prospects, mission, operating ideology and aims, formulat-

ing fresh strategies, fostering environmentally friendly culture, setting up environmentally friendly organizational structure and training employees and so on Li *et al.* (2005). Organizational environmental protection climate is coined as a term used to describe the way in which environmental protection is managed and often reflects the beliefs, perceptions, attitudes and values that employees share in relation to environmental protection. Organizational environmental protection climate can be regarded as the surface features of the environmental protection culture discerned from the attitudes and perceptions at a given point in time.

Of course, the conception of environmental protection climate can be expanded to the scale of a whole country or nation--- “National environmental protection climate”, which is decided by the attitude of a government towards development vis-a-vis conservation of resources (Bowonder, 1983).

Organizational environmental protection climate can be measured by organizational environmental protection climate survey using an environmental protection questionnaire. In this study, the results on environmental protection climate of an organizational climate survey in a Chinese rubber products factory are reported in Table 1.

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Table 1: Environmental protection related questions in the organizational climate survey

| No. | Questions |
|------|--|
| Q27 | Does the organizational climate support the compliance of regulations and laws of environmental protection? |
| Q30 | Are there any cases or stories about the management's committee to environmental protection? |
| Q35 | Are there any emergency and rescue systems in your organization? |
| Q36 | "The ability of environmental protection is strong." Do you agree on the statement? |
| Q117 | Who should be in charge of events causing environmental pollution which may happen in your organization, the environmental protection agency or your organization? |
| Q119 | Is the investment on environmental protection overtaxed of your organization? Do your organization gain profit from the investment on environmental protection? |
| Q122 | Does your organization consider issues on environmental protection before do any things else? |
| Q124 | Does your organization have supervision on environmental protection and implement measures of environmental protection? |
| Q125 | How about the performance of environmental protection of your organization? |
| Q128 | Does the top management of your organization participate and support issues and activities on environmental protection? |
| Q130 | How many tasks will not be done on schedule if the regulations on environmental protection are incompliance absolutely, completely and totally? |
| Q144 | Do the management practice what they preach, and lead by example on issues of environmental protection? |
| Q148 | What is the effect of the local government on environmental protection performances in your organization? |
| Q155 | How the higher authorities of your organization or enterprise support the works and issues on environmental protection? |
| Q158 | How many believes on environmental protection can you list? |
| Q167 | Is the performance on environmental protection considered in the evaluation of your performance and salary structure? |
| Q174 | Is environmental protection still the priority when your organization suffers from stress from production tasks? |
| Q178 | Are the measures and regulations of environmental protection practical, realistic and easy to operate? Can the organization achieve excellent performance of environmental protection if the measures and regulations of environmental protection are in compliance? |

THEMES OF ORGANIZATIONAL ENVIRONMENTAL PROTECTION CLIMATE AND QUESTIONNAIRE DEVELOPMENT

Themes of organizational environmental protection climate involve:

- Organizational structures of environmental protection
- Work efficiency on environmental protection
- Environmental protection communication
- Environmental protection training
- Environmental protection behavior
- Environmental protection performance
- Evaluation of employees' performance considering environmental protection
- Perception on the relationship between salary and environmental protection
- Management's commitment to environmental protection
- Compliance to regulations of environmental protection
- Environmental protection responsibility system
- Perception on the relationship between profit and environmental protection

- Environmental protection believes
- Environmental protection supervision
- Support to environmental protection
- Participation in environmental protection
- The role played by local government in environmental protection

Only under the leadership of managers' environmental consciousness, environmentally friendly organizational structure and environmental protection culture might be constructed up to realize environmental organization management and root environmental consciousness into the mind of workforces (Li *et al.*, 2005). Managers should make full use of chances to protect or improve environment, positively instill the conception of environmental protection into every division and build an environmental culture (Li *et al.*, 2005).

A questionnaire survey was administered to the six owners and fifty-one employees of all resort operators located at Lake Kenyir, Malaysia (Yusof *et al.*, 2010). The organizational climate questionnaire used in the study is developed according to theories of organizational climate and contains 281 questions in the form of five point scales (Likert, 1932). Eighteen environmental protection-related questions in the organizational climate questionnaire are listed in Table 1.

Samples: The organizational climate survey is done in a rubber products factory located in Hebei Province of China, which produces rubber parts for household appliances and auto-mobiles, including washing machine V-belt, rolling washing machine poly V-belt, washing machine gasket, auto-mobile V-belt and auto-mobile exhaust system damping lug. Methods of interviews and questionnaires are both used in the organizational climate survey. The administrators and managers of the rubber corporation show their regulations, handbooks and standards of operation, administration and management.

Seventy seven objectives are sampled by stratified sampling form more than 240 employers and employees of the corporation, but there are only 57 feedbacks and 53 of them are effective. Some objectives did not respond to the questionnaires, either because they are old, busy or unable to read.

RESULTS AND DISCUSSION

In this section, we give some descriptive statistics of the organizational environmental protection climate survey in the first place. Furthermore, fifty-fifty multivariate analysis of variance (50-50 MANOVA) (Langsrud, 2002 and Langsrud *et al.*, 2007) are used to reveal the relationship between the variables of position and working age of each objective and responses variables on organizational environmental protection climate.

Block variable Position has four levels, which represent management, professionals, supervisors and first-floor workers, respectively. In the behavioral experimental study, variable Position are regarded as independent variables and scores in different themes of the safety climate surveys are regarded as a large number of dependent variables (multiple response variables).

Traditionally, each response variable has been analyzed one-by-one (Box *et al.*, 1978; Montgomery, 2008; Langsrud *et al.*, 2007), but with the introduction of modern measurement instruments that characteristically produce a great number of highly correlated variables

and with the increased complexity of scientific problems, simultaneous analysis of several response variables has become more in focus (Ellekjaer *et al.*, 1996; Langsrud, 2001, 2002; Nair *et al.*, 2002; Smilde *et al.*, 2005; Langsrud *et al.*, 2007). There are a number of additional faces that have to be taken into account for multivariate extensions of univariate analysis of variance and regression analysis (Langsrud *et al.*, 2007). A relatively fresh Multivariate Analysis of Variance (MANOVA) method, named as fifty-fifty multivariate analysis of variance (50-50 MANOVA), is used to perform overall testing of all responses (Langsrud *et al.*, 2007). The data of our study are analyzed by 50-50 MANOVA (Langsrud, 2002; Langsrud *et al.*, 2007), which is done using R project (Ripley, 2001).

The results of 50-50 MANOVA shown in Table 2 show that the impact of position is statistically significant ($p = 0.0185 < 0.05$) and the impact of working age on total organizational environmental protection climate is statistically marginally significant ($p = 0.0926 < 0.1$). Hence, both position and working age have significant influences on total organizational environmental protection climate. The matrix of ordinary p-values from F- or t-testing is shown in Table 3. It can be inferred that:

- The impact of position on the questions of No. 122, 125, 128, 144, 148, 155 and 174 is statistically significant ($p < 0.05$).
- The impact of working age on the question of No. 125 is statistically significant ($p = 0.036515 < 0.05$).
- The interaction effect of position and working age on the questions of No. 119 is statistically significant ($p = 0.022672 < 0.05$).

However, in 50-50 MANOVA, traditional MANOVA has been modified so that collinear and several highly correlated responses are fondled in an acceptable way (Langsrud, 2002; Langsrud *et al.*, 2007). When analyzing multiple responses, a measure of explained variance associated with each model component, based on univariate sums of squares summed overall responses, is contemplated by 50-50 MANOVA (Langsrud *et al.*, 2007). The matrix of adjusted p-values according

Table 2: Results of fifty-fifty multivariate analysis of variance (18 responses)

| | df | exVarSS | nPC | nBU | exVarPC | exVarBU | p-value |
|-----------------------|----|---------|-----|-----|---------|---------|----------|
| Position | 3 | 0.12407 | 3 | 15 | 0.6413 | 1 | 0.0185 * |
| Working age | 1 | 0.01841 | 3 | 15 | 0.6280 | 1 | 0.0926 • |
| Position: working age | 3 | 0.06742 | 3 | 15 | 0.6256 | 1 | 0.5029 |
| Residuals | 45 | 0.78895 | | | | | |

Significant codes: 0, ***: 0.001, **: 0.01, *: 0.05, •: 0.1; df: Degrees of freedom, adjusted for other terms in model; exVarSS: Explained variances calculated from sums of squares summed over all responses; nPC: Number of principal components used for testing; nBU: Number of principal components used as buffer components; exVarPC: Variance explained by nPC components; exVarBU: Variance explained by (nPC + nBU) components; pValues: 50-50 MANOVA p-values

Table 3: Matrix of ordinary p-values from F- or t-testing

| | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 0.026304 | 0.443366 | 0.114203 | 0.370203 | 0.321577 | 0.201912 | 0.014027 | 0.131163 | 0.002350 |
| 0.994991 | 0.084457 | 0.560026 | 0.722144 | 0.499559 | 0.408186 | 0.957929 | 0.978263 | 0.036515 |
| 0.061756 | 0.680165 | 0.449431 | 0.477326 | 0.296802 | 0.022672 | 0.140223 | 0.146991 | 0.463923 |
| 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 0.044094 | 0.066701 | 0.012870 | 0.028358 | 0.030272 | 0.080296 | 0.775236 | 0.004574 | 0.331616 |
| 0.769130 | 0.930191 | 0.200816 | 0.968128 | 0.100788 | 0.848389 | 0.848389 | 0.489902 | 0.138754 |
| 0.114536 | 0.772205 | 0.208281 | 0.355841 | 0.074127 | 0.059230 | 0.821283 | 0.866670 | 0.778150 |

Table 4: Matrix of adjusted p-values according to family wise error rates

| | | | | | | | | |
|------|------|------|------|------|------|------|------|------|
| 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 0.18 | 0.84 | 0.52 | 0.84 | 0.84 | 0.71 | 0.13 | 0.59 | 0.03 |
| 1.00 | 0.63 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.30 |
| 0.48 | 1.00 | 0.95 | 0.96 | 0.89 | 0.31 | 0.68 | 0.69 | 0.96 |
| 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 0.27 | 0.35 | 0.13 | 0.18 | 0.18 | 0.42 | 0.84 | 0.04 | 0.84 |
| 1.00 | 1.00 | 0.85 | 1.00 | 0.65 | 1.00 | 1.00 | 1.00 | 0.71 |
| 0.62 | 1.00 | 0.76 | 0.93 | 0.51 | 0.48 | 1.00 | 1.00 | 1.00 |

Table 5: Matrix of adjusted p-values according to false discovery rates

| | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 |
| 0.065714 | 0.431765 | 0.179091 | 0.385000 | 0.370000 | 0.256154 | 0.065714 | 0.187500 | 0.030000 |
| 0.996111 | 0.420000 | 0.902222 | 0.975833 | 0.881250 | 0.868333 | 0.994706 | 0.994706 | 0.300000 |
| 0.282500 | 0.835000 | 0.636923 | 0.636923 | 0.558889 | 0.282500 | 0.361429 | 0.361429 | 0.636923 |
| 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 | 0.010000 |
| 0.092500 | 0.123333 | 0.065714 | 0.065714 | 0.065714 | 0.141000 | 0.733889 | 0.030000 | 0.370000 |
| 0.975833 | 0.994706 | 0.592000 | 0.994706 | 0.420000 | 0.990769 | 0.937000 | 0.881250 | 0.46750 |
| 0.356000 | 0.866250 | 0.430000 | 0.605000 | 0.282500 | 0.282500 | 0.868333 | 0.868333 | 0.86625 |

Table 6: The means of answering the environmental protection related questions by various positions

| | Q27 | Q30 | Q35 | Q36 | Q117 | Q119 | Q122 | Q124 | Q125 |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| W | 4.048780 | 2.146341 | 4.121951 | 4.073171 | 2.780488 | 3.926829 | 4.097561 | 3.951220 | 3.829268 |
| S | 3.500000 | 2.000000 | 3.000000 | 3.500000 | 4.000000 | 3.000000 | 3.000000 | 3.500000 | 1.500000 |
| P | 3.285714 | 3.000000 | 3.285714 | 3.857143 | 2.428571 | 3.571429 | 3.142857 | 3.428571 | 3.428571 |
| M | 4.000000 | 2.000000 | 3.333333 | 3.666667 | 3.333333 | 4.333333 | 4.000000 | 3.333333 | 4.000000 |
| | Q128 | Q130 | Q144 | Q148 | Q155 | Q158 | Q167 | Q174 | Q178 |
| W | 4.146341 | 4.073171 | 4.170732 | 4.390244 | 4.317073 | 3.731707 | 3.756098 | 4.219512 | 3.975610 |
| S | 4.000000 | 3.000000 | 4.000000 | 3.000000 | 3.500000 | 3.500000 | 3.500000 | 5.000000 | 3.000000 |
| P | 3.428571 | 3.142857 | 3.142857 | 3.714286 | 3.428571 | 2.714286 | 3.285714 | 3.428571 | 3.714286 |
| M | 3.333333 | 5.000000 | 3.666667 | 3.333333 | 3.000000 | 3.333333 | 3.666667 | 4.666667 | 3.666667 |

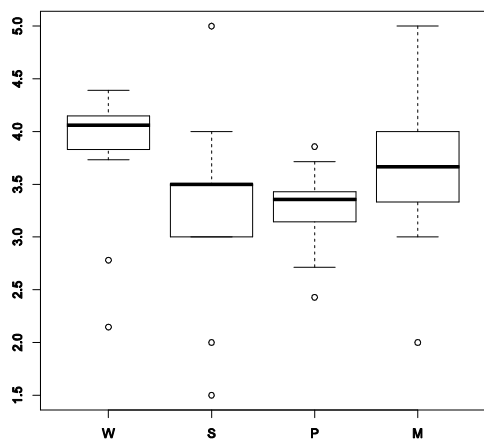


Fig. 1: Box-and-whisker plots of the means of answering the environmental protection related questions

to family-wise error rates (Table 4) and the matrix of adjusted p-values according to false discovery rates (Table 5) are produced by rotating simulations (simN = 99)¹ (Langsrud, 2005; Langsrudet *al.*, 2007). Obviously, the deductions according to Table 4 and 5 are different from the deduction according to Table 3.

According to Table 4 and 5, only the impact of position on the questions of No. 125 and 174 is statistically significant ($p < 0.05$). Objectives in efferent position have significant dissimilar perceptions in:

- The performance of environmental protection of the organization
- The priority of environmental protection when the organization suffers from stress of production tasks

Means of answering the environmental protection-related questions by various positions is shown in Table 6. Box-and-whisker plots of the means of answering the environmental protection-related questions are shown in Fig. 1.

CONCLUSION

The major findings reported in the paper are listed below:

- The factor of position affects total environmental protection climate in the Chinese rubber products factory.
- Objectives in efferent position have significant dissimilar perceptions in the performance of environmental protection of the Chinese rubber products factory.
- Objectives in efferent position have significant dissimilar perceptions in the priority of environmental protection when the organization suffers from stress of production tasks in the Chinese rubber products factory.

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End note:

- 1 sim N means the number of simulations performed for each term.