CALGARY TRANSIT SAFETY ASSESSMENT: EMPLOYEES' PERCEPTION

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ABSTRACT

Although work-related driving has been a topic of research interest in recent years, relatively less attention has been devoted to public transit operator. In the City of Calgary, Calgary Transit has a responsibility to not only provide a safe and secure public transportation to its users but also a safe workplace for its employees. This study aims to determine the role of safety within a public transit organization from its employees' perspective. A well established Safety Climate Questionnaire – Modified for Drivers (SCQ-MD) was administered to 110 bus drivers to its applicability to the public transit sector. It included 35 items representing six SC factors: communication, work pressures, relationships, driver training, management commitment, and safety rules. These six SC factors appeared to exhibit good internal consistency, with high degree of reliability coefficients ranging from 0.86 to 0.94. The bus drivers rated driver training, safety rules and management commitment as relatively more satisfactory than relationship, work pressure and communications. One way analyses of variances revealed that the SC factors are strongly related to employees' bus driving experience and collisions involvement but not their age, gender; or traffic violations.

Keywords: Safety Climate, Safety, Calgary Transit, Bus Drivers

1. INTRODUCTION

Transit system safety and security has been a topic of immense public and research interest in the last decade. However, much of the attention has been focused on the security of the system from external threats, with relatively little attention devoted to the safety of the system with regards to accidents such as vehicle collisions involving transit buses (Barua and Tay, 2010; Hamed et al, 1998; Zegeer et al, 1995; Evans and Courtney, 1985). These collisions not only have an effect on road safety in general, but have significant implications for occupational health and safety because transit buses are also workplaces for a large population of drivers.

Traffic crashes are a leading cause of work-related fatalities. According to the Canada Safety Council (2009), more than 2,000 deaths a year result from occupational motor vehicle crashes in the United States, half of all work-related fatalities in Australia occur on roads, and between 25%-33% of all serious and fatal collisions in the United Kingdom involve someone who is at work. These statistics suggest that job-related deaths and injuries are more likely to occur on the road than in a fixed workplace. While Canada has little data on work-related driving accidents, there is every reason to believe the situation in this country is similar in scale to the US, Australia and the UK (Canada Safety Council, 2009).

The problem of work-related vehicle crashes is large enough to be recognized as a major public health and safety issue in many countries including Australia, United States, United Kingdom, New Zealand, and Sweden (Bibbings, 1997; Bylund et al., 1997; Driscoll et al., 2005; Gregersen et al., 1996). In recent years, work related driving has received increased focus and recognition as an issue with occupational health and safety implications by industries and many large organizations (Haworth et al., 2000; Murray et al., 2002; Newnam and Tay, 2006, 2007). In Canada, for example, a recent review of worker fatalities in the oil and gas industry reveals that 50% is related to motor vehicle accidents (Tersmette and Suntrum, 2007).

Road safety is an important concern for all organizations where employees are engaged in work-related driving. However, surprisingly little research has investigated the predictors of driver safety in an organizational setting in general and in public transit organizations in particular. Hence, this study aims to explore perceptions of bus drivers on the safety culture in a public transit organization.

2. LITERATURE REVIEW

Over the past two decades, research in occupational safety sciences has focused on the importance of management practices and their impact on employees' occupational safety behaviours and safety outcomes such as injuries, fatalities, and other incidents (Wills et al. 2006; Huang et al, 2007; Neal et al, 2000). In this respect, many studies have examined the Safety Climate (SC) of organizations which can be defined as employees' shared perceptions of safety policies, procedures and practices as well as the overall importance and the priority of safety at work (Zohar, 1980). SC is a multi dimensional factor and has been found to be an important antecedent of safety in the workplace (Williamson et al, 1997; Niskanen, 1994; Gaba et al, 2003; Lu and Shang, 2005; Evans et al, 2006; Arboleda et al, 2003; Machin and de Souza, 2004; Farrington-Darby et al, 2005; Ek et al, 2007).

Zohar (1980) developed the first measure of safety climate using a 40 item questionnaire administered to a sample of workers in the metal fabrication, chemical, textile and food processing industries in Israel. Using factor analysis, he categorised the 40 items into eight dimensions: workers' perceptions of the importance of safety training, management attitude towards safety, effects of safe conduct on promotion, level of risk at workplace, effects of work pace on safety, status of safety officer, effects of safe conduct on social status and status of safety committee. The SC scale has since been modified and refined over the years and successfully applied to other industries in many countries (Brown and Holmes, 1986; Budworth, 1997; Dedobbeleer and Beland, 1991; Vinodkumar, 2009; Flin et al, 2000; Glendon et al., 2001; Wills et al., 2005; Glendon and Litherland, 2001).

Further investigation into SC has primarily focused on the relationship between workers' perceptions of organizational and management practices (Diaz et al., 1997); employees' behaviour (Cooper et al, 2004); self-reported occupational incident involvement frequency (Mearns et al., 2003); and self-reported occupational injury frequency and severity (Vredenburgh, 2002). In addition, O'Toole (2002) found that employees' SC scores changed with the implementation of organizational safety interventions. Recent research on SC has also started to investigate group-level climate influences on occupational safety (Zohar, 2000; Zohar et al., 2005; Newnam et al, 2008).

One emerging area in SC research is on its effects on work related driving (Murray et al, 2001; Newnam et al, 2004; Wills et al, 2006). A growing body of research has demonstrated that company vehicle drivers are at a greater risk of accident involvement, not only through

higher levels of exposure to the road environment, but also time and scheduling pressures, and other distractions (Stradling et al., 2000; Newnam et al, 2004, 2007). In addition, research on occupational driver assessment has begun to examine the relationship between driving performance and physical activity (Taylor et al., 2005), driver stress (Matthews et al., 1998), information systems (Saricks et al., 1997) as well as methods to accurately measure risk assessment (Murray and Dubens, 2001).

3. STUDY OBJECTIVES

The objectives of the study are:

- To assess applicability of the safety climate scale in a public transit organization.
- To investigate the relationship between the safety climate factors and the personal attributes of participants such as age, gender and driving experience.
- To investigate the relationship between the safety climate factors and drivers' accident involvement.

In particular, this paper examines the safety climate in Calgary Transit which is responsible for providing a safe and efficient public transportation system in the city of Calgary in Canada. This research will provide Calgary Transit and other public transportation organizations with valuable insights on employees' perception of organizational safety climate and its relationship to safety outcomes within the organization to assist them to improve the health and safety of their employees and customers as well as the safety of all road users.

4. METHOD

4.1 Procedure and Participants

The main research instrument used in this study is a questionnaire which was administered to sample of 110 bus drivers of Calgary Transit. During the research period, Calgary Transit had approximately 1700 drivers which included drivers of light rail transit (LRT), conventional 40 foot buses and community shuttle buses. As LRT and bus operations are very different, it was decided that the survey should focus on bus drivers only, since they comprise the biggest share of the employees. The survey was conducted with the support of the management of Calgary Transit and approved by the Conjoint Faculties Research Ethics Board of the University of Calgary.

The survey was administered in November, 2009. Calgary Transit drivers were contacted directly at three bus garages. They were asked to participate in a study about organisational safety and driving behaviour. Participation was strictly voluntarily and participants were free to decline or withdraw at any time. Those who volunteered to participate received an information sheet detailing the anonymous and confidential nature of the study; management's support for their participation; instructions for completing and returning the survey. Surveys were returned directly to the researchers or dispatch offices in the three locations. The data from three participants were excluded from the sample prior to analysis due to incomplete responses.

4.2 Survey Design and Measures

In addition to the standard demographic and driving information, the survey instrument gathered data on the participants' perception of the safety climate in the organization using a modified version of the Safety Climate Questionnaire – Modified for Drivers (SCQ-MD) developed by Wills et al (2005). The SCQ-MD contained items from the original SCQ developed by Zohar (1980) which were modified to increase their applicability to the context of work-related vehicle driving. The SCQ-MD was modified slightly (mainly wording and context) in this study to increase its applicability to the public transit sector. It included 35 items representing six SC factors: communication, work pressures, relationships, driver training, management commitment, and safety rules. Responses to the items were recorded using the standard 5-point Likert Scale (1=Strongly Disagree to 5=Strongly Agree).

4.3 Statistical Analyses

The survey data were entered into an Excel spreadsheet and imported into Statistical Package for Social Sciences (SPSS) version 14. The descriptive statistics of the relevant variables were computed and the difference between the mean of each item and the neutral score of three was tested using the standard t-test. The reliability of the items capturing each SC factor was checked by estimating their Cronbach Alpha. A composite score for each SC factor was then computed using the average value of the items. Finally, one-way analysis of variance was performed to test the equality of the composite means of the SC factors between different groups of participants to investigate the relationship between SC factors and participants' characteristics.

5. RESULTS

5.1 Profile of Participants

The profile of the participants is reported in Table 1. Most of the bus drivers in the sample were males (75%) and middle-aged (70% were 35-55 years). About one third of the drivers had less than two years of bus driving experience although 85% of had more than ten years of driving experience with buses or other vehicles. Interestingly, 35.5% of the participants reported having been involved in a crash within the last two years and 20.6% reported getting a ticket in the past two years. Overall, the sample is reflective of the population of driver at Calgary Transit.

Although no specific data was available on crash involvement rate among bus drivers, approximately 612 and 749 collisions were reported involving Calgary Transit vehicles in 2008 and 2009 respectively. With about 1,700 transit drivers (buses and LRT), the share of respondents in our sample who reported being involved in a collision appeared to be in the reasonable range. Approximately two-thirds of the collisions were deemed by Calgary Transit to be non-preventable, that is, the driver was found to be not responsible for the accident because another vehicle ran into one of its vehicles.

Table1
Profile of Participants

Characteristics	**Distribution (%)**
Gender	
Male	75.0
Female	25.0
Age (yrs)	
16-25	1.9
26-35	27.1
36-45	34.6
46-55	30.8
56-65	5.6
Bus driving experience (yrs)	
0-2	33.6
2-5	29.9
5-10	13.1
More than 10	23.4
Driving experience (bus or other vehicle) (yrs)	
0-2	0.9
2-5	2.8
5-10	11.2
More than 10	85.0
Involved in collision in last two years	
Yes	35.5
No	64.5

Moving Violation in last two years	
Yes	20.6
No	79.4

5.2 Employees' Perception of Safety Climate

Table 2 shows the means and standard deviations for all 35 items. Note that the mean of most of the items was relatively close to the neutral value of 3 although the means of 13 of the 35 items were found to be statistically different at the 95% confidence level. Also, about half (17) of the 35 items had a mean score that was above 3 whereas the other 18 items had a mean score that was below 3. Moreover, the overall mean score of all 35 items was 3.00. These results indicated that bus drivers at Calgary Transit were generally quite neutral in their perceptions of the safety climate in the organization.

Table 2
Summary Statistics for the Safety Climate Scale

Item	Frequency (N=107)					Mean	S.D.
	SD	D	N	A	SA		
Communication and Procedures							
Changes in working procedures and their effects on safety are effectively communicated to workers *	18	25	32	28	4	2.77	1.13
Employees are consulted when changes to driver safety practices are suggested *	26	29	28	17	7	2.53	1.21
Employees are told when changes are made to the working environment such as the vehicle, maintenance or garaging procedures	22	18	27	37	3	2.82	1.20
Safety policies relating to the use of motor vehicles are effectively communicated to workers	13	25	18	43	8	3.07	1.20
Safety procedures relating to the use of motor vehicles are complete and comprehensive	11	20	30	38	8	3.11	1.12
An effective documentation management system ensures the availability of safety procedures relating to the use of motor vehicles	9	22	39	32	5	3.02	1.02
Safety problems are openly discussed between employees and managers/supervisors	18	25	29	26	9	2.84	1.21
Safety procedures relating to the use of motor vehicles match the way tasks are done in practice	16	23	32	31	5	2.87	1.13
Employees can discuss important driver safety policy issues	11	20	31	39	6	3.08	1.09
Employees are consulted for suggested vehicle/driver safety improvements *	27	26	31	20	3	2.50	1.14
Employees can easily identify the relevant procedure for each job *	7	22	27	47	4	3.18	1.02
Employees can express views about safety problems	18	16	21	38	14	3.13	1.30
Employees are encouraged to support and look out for each other *	12	19	24	34	18	3.25	1.25
Work Pressure							
Time schedules for completing work projects are realistic *	21	25	29	25	7	2.74	1.21
There is sufficient 'thinking time' to enable employees to plan and carry out their work to an adequate standard *	17	20	26	36	8	2.98	1.21
Workload is reasonably balanced	19	22	27	35	4	2.84	1.18
There are enough employees/drivers to carry out the required work	11	17	37	36	6	3.08	1.07

Changes in workload, which have been made at short notice, can be dealt with in a way that does not affect driver safety	14	23	27	37	6	2.98	1.15
When driving employees have enough time to carry out their tasks	13	23	32	34	5	2.95	1.10
Problems that arise outside of employees' control can be dealt with in a way that does not affect driver safety	14	23	39	26	5	2.86	1.08
Management and Commitment							
Management are committed to driver safety	14	21	29	36	7	3.01	1.15
Management are committed to motor vehicle safety	14	17	30	39	7	3.07	1.15
Driver safety is central to management's values and philosophies	15	23	37	24	8	2.88	1.14
Driver safety is seen as an important part of fleet management in this organisation	12	15	39	31	10	3.11	1.12
Relationships							
Good working relationships exist in this organisation	16	21	32	31	7	2.93	1.16
Employees are confident about their future with the organisation	10	21	30	36	10	3.14	1.13
Morale is good	22	16	31	31	7	2.86	1.23
Employees trust management	26	25	34	18	4	2.52	1.14
Management trust employees *	24	25	38	16	4	2.54	1.11
Driver Training							
Potential risks and consequences are identified in driver training *	9	7	26	52	13	3.50	1.07
Driver training is provided on skills specific to the type of vehicle driven for work *	6	9	15	58	19	3.70	1.04
Motor vehicle training is carried out by people with relevant experience *	4	9	19	55	20	3.73	0.99
Safety Rules							
Safety rules relating to the use of motor vehicles can be followed without conflicting with work practices*	11	14	31	41	10	3.23	1.12
Safety rules relating to the use of motor vehicles are followed when a job is rushed *	15	24	28	31	9	2.95	1.19
Safety rules relating to the use of motor vehicles are always practical	11	18	35	32	11	3.13	1.13
Note: Means and standard deviations calculated using: SD (strongly disagree) = 1; D (disagree) = 2; N (Neutral) = 3; A (agree) = 4; SA (strongly agree) = 5; Items with * denotes that the mean ≠ 3 at the 95% confidence level.							

5.3 Composite Score and Reliability

The internal consistencies of the items for each of the SC factor were examined by calculating the Cronbach Alpha reliability coefficients. Of the various methods used for measuring reliability, the internal consistency method is considered to be the most effective method, especially in field studies, with values above 0.6 considered as acceptable (Hair et al, 1995). As shown in Table 3, the factors appeared to exhibit very good internal consistency, with reliability coefficients ranging from 0.86 to 0.94. Overall, the safety climate scale used had a high degree of reliability and further analyses using the SC factors would be valid. In particular, the mean of the items in each SC factor can be used to as a composite measure for the factor.

Table 3
Summary of Safety Climate Subscales

Subscale	Mean	Std Dev	Alpha
Communication and Procedures	2.94	0.88	0.94
Work Pressure	2.92	0.88	0.88
Management and Commitment	3.02	1.02	0.92
Relationships *	2.80	0.98	0.90
Driver Training *	3.64	0.93	0.89
Safety Rules	3.11	1.02	0.86
Note: * denotes mean is different from the neutral score of 3 at the 95% confidence level			

Also shown in Table 3 were the mean and standard deviation for composite score of the six factors. The three factors with mean scores that were higher than 3 were driver training (M = 3.64, SD = 0 .93), safety rules (M = 3.11, SD = 1.02) and management commitment (M = 3.02, SD = 1.02) while the three factors with mean scores that were lower than 3 were communication (M = 2.94, SD = 0.88), work pressure (M = 2.92, SD = 0.88) and relationships (M = 2.80, SD = 0.98). However, only the mean scores of two (relationships and driver training) of the six SC factors were statistically different from the neutral score of 3.

5.4 Safety Climate and Employees' Characteristics

A series of one-way analysis-of-variance (ANOVA) tests were conducted to examine the effects of driver characteristics on each of the six SC factors. The results showed that gender, age, general driving experience and traffic violation did not have any significant effect on employees' perceptions of the safety climate within the organization However, bus driving experience showed some relationship with the SC factors. The mean scores of five of the six factors were statistically different at the 95% confidence level for the different groups of drivers while the remaining SC factor (safety rules) was only marginally significant at the 90% confidence level. Interestingly, the mean scores showed in Table 4 depicted a non linear relationship between employees' perceptions and bus driving experience.

Table 4
Safety Climate and Bus Driving Experience

	0-2 yrs		2-5 yrs		5-10 yrs		> 10 yrs	
Subscale	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Communications and Procedures *	3.18	0.80	2.86	0.72	3.38	0.83	2.44	0.99
Work Pressure *	3.15	0.80	2.69	0.79	3.50	0.92	2.55	0.85
Management and Commitment *	3.35	0.87	2.84	0.93	3.48	1.14	2.50	1.02
Relationships *	3.17	0.84	2.75	0.91	3.12	1.02	2.14	0.94
Driver Training *	3.94	0.89	3.44	0.92	3.86	1.01	3.36	0.85
Safety Rules	3.27	0.91	3.02	0.99	3.54	0.91	2.72	1.14
Note: * denotes statistically significant at 95% confidence level								

5.5 Safety Climate and Crash Involvement

Among all the driver characteristics included in the survey, self-reported crash involvement of the respondents was the best indicator of safety outcome. Hence, it would insightful to determine if a relationship existed between crash involvement and the SC factors. As shown in Table 5, the scores for all SC factors for the no collision group were higher than the corresponding scores for the collision involved group. The score for two SC factors (work pressure and safety rules) were significantly different between those who reported being involved in a crash in the last two years and those who reported no involvement. In addition, the SC factor, management commitment, was found to marginally significant at the 90% confidence level. These results indicate that SC within the organization had a significant effect the collision of the drivers.

Table 5
Safety Climate and Collision Involvement

	Collision		No Collision	
Subscale	**Mean**	**Std Dev**	**Mean**	**Std Dev**
Communications and Procedures	2.77	0.81	3.02	0.92
Work Pressure *	2.65	0.80	3.07	2.65
Management and Commitment	2.78	1.03	3.14	1.00
Relationships	2.64	0.89	2.88	1.02
Driver Training	3.60	1.06	3.66	0.86
Safety Rules *	2.85	1.02	3.24	0.99
Note: * denotes statistically significant at 95% confidence level				

6. DISCUSSION

The safety and security of public transit systems has been topic of immense research interest in recent years. However, much of the research has been directed towards the security of the system, especially the security of the system from external threats, since September 2001. Relatively less attention has been focused on the safety of system from simple everyday accidents such as motor vehicle collisions involving public transit buses (Barua and Tay, 2010; Hamed et al, 1998; Zegeer et al, 1995; Evans and Courtney, 1985).

Besides safety of its customers and the public road users, Calgary Transit is also very concerned about the safety of its employees and their workplaces. Even though the majority of the bus collisions are "non preventable" (mostly involved another vehicle hitting its buses), research into the underlying causes and contributors to these collisions will still be valuable to assist Calgary Transit to improve its safety performance.

The one main purpose of this study is to explore the applicability of the safety climate scale in a public transportation organization. The results in this study suggest that the scale used can measure the various safety constructs with a high degree of reliability. It also has some discriminatory validity when tested using a sample of drivers with no collision against one with self-reported collision involvement. Hence, the scale developed can be used to measure the safety climate in a public transportation organization.

Another objective of this study was to measure level of safety climate in a public transportation organization. The results in this study showed that employees' perceptions were relatively neutral (mean = 3.00) and comparable those obtained in other organizations. For example, Morrow et al. (2010) found an overall mean score of 2.67 in the rail industry, indicating weaker safety climate. In a Norwegian continental shelf study (Tharaldsen et al, 2008), the mean score found was 3.14 (falling very close to "neither agree nor disagree" in their scale used), indicating a fairly neutral safety climate. In a Chinese manufacturing industry study (Ma and Yuan, 2009), the mean score estimated was 3.60 (falling between ''Neither agree nor disagree" and ''agree" in their scale used).

With respect to SC factors, the statistically significant mean scores in this results are 2.80 (Relationships) and 3.64 (Driver Training). The first score indicates that transit bus drivers perceived a weak relationship with management, which is contradictory to the result obtained by Wills et al. (2005) on a wider sample of occupational vehicle drivers in Australia. In Wills et al (2005) study, mean scores in Relationships is 3.16 and Driver training is 2.83. In our study, the Driver Training SC factor has the highest score, indicating a stronger safety training culture in Calgary Transit. Hence, there may be differences on the perceived roles and influences on employees' safety across different types of work-related driving.

In terms of employees' characteristics, our study found that the mean SC factor scores did not differ due to employees' age, gender, general driving experience and traffic violation. The results were in contrast to Vinodkumar et al. (2009) who found SC to differ significantly among respondents in different age groups working in the chemical industry. On the other hand, our results showed that the SC factor scores differed due to different bus driving experience and this result was consistent with Vinodkumar et al. (2009) who found that employees' perceptions on safety climate differed significantly among workers with different lengths of work experience. Hence, there might be differences in the effects of age and experience on safety climate across different industries.

With regards to safety performance, our study found that transit employees' perception of the safety climate within the organization was significantly related to their self-reported collision involvement. More specifically, perceptions of work pressure and safety rules, and to lesser extent, management commitment, were significant influences on safety performance. Our results were in contrast to Varonen and Mattila (2000) who reported a non-significant relation between workers' attitudes towards safety and occupational accidents in wood processing plants, but were consistent with the results obtained by Wills et al (2004) and Newnam et al (2008) for work related driving in Australia.

Overall, our results suggest that public transit organisations can have a direct effect on their safety performance in general and vehicle collisions in particular by enhancing their organisational safety climate. Hence, public transit organisations may wish to consider their roles in influencing driver and workplace safety by creating more positive safety climates within their organizations. More specifically, they should consider approaches that may reduce work pressures and stress as well as enhancing their safety rules and strengthening management's commitment to driver and workplace safety. More efforts should also be devoted to improving SC in terms of relationships between transit drivers and management. In a practical sense, policies and procedures should be designed not only to enhance safety, but should also be implemented in a way that ensures that employees perceived them as practical. Steps should also be taken to openly promote or publicise their commitment to safety to develop and create a more positive safety climate.

7. CONCLUSIONS

Improving the safety and security of our public transit systems is a priority of many government agencies around the world. In The City of Calgary, Calgary Transit has been moving passengers for a century, with an excellent safety record. Despite the very low accident rate per distance travelled, the absolute number of motor vehicle collisions involving buses is still sizeable and more research need to be conducted to assist the organization in improving its safety performances.

This study determined the safety climate in Calgary Transit as perceived by a sample of bus drivers, a population that was new to organizational safety research, using a modified version of a well established safety climate scale (Wills et al, 2005). The study found that the SC factors included had a significant relationship with self reported collision involvement. This finding suggested that public transit organisations could play an important role in reducing crashes by enhancing their safety climate. Transit organisations should monitor the

workloads of their drivers as well as involve their workforce in developing and implementing clear procedures relating to work-related driving. Moreover, managers in such organisations should not only take an active role in formulating safety policies, but also demonstrate the organisation's commitment to the safety of their employees and workplaces by enhancing their communications and improving their relationships with the employees.

In conclusion, this study supports the expected benefits of adopting a multi-dimensional approach to driver safety management in Calgary Transit. Future research may enhance the depth and richness of knowledge regarding the interaction between organizational SC factors and its impact on bus driver safety by incorporating a more comprehensive conceptual framework and theory-based model.

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