DCT 176

DART First State Transit Accident Study

A Review of Operator's Time on Duty, Rest Between Shifts, Accident Occurrence, and Policy Implications

by

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June 2005

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Abstract

This study involves an examination of the occurrence of traffic accidents experienced by the operators of the vehicles utilized by Delaware's statewide transit service, DART First State. Specifically, transit accident frequencies during FY 2003 and FY 2004 were studied in relationship to operators' length of time on duty pre-collision on the date of the accident and their numbers of hours off duty between consecutive shifts. Generally, the data available for review indicated that motor vehicle accidents were distributed rather evenly across the work day. Of the 588 accidents for which sufficient data was available for analysis, 434 accidents - or 74% - occurred sometime during the first nine hours of the involved drivers' shifts for those days. This would not be unexpected, as the majority of DART First State's operators' shifts are of nine or fewer hours' duration. However, a noticeable deviation in the characteristics that were the focus of this study was observed among drivers who had accidents after being on duty for nine or more hours. Higher-than-average hours worked during their previous shifts and lower-than-average rest time between shifts characterized this subset of accident-involved DART drivers. DART First State's policies and procedures related to operator fatigue were also reviewed in comparison to the pertinent findings of the American Public Transportation Association's *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue* published in 2002 and a survey of contemporary practices in comparable transit organizations. The findings identify a range of policy options that have been implemented by various transit operators to address the issue of driver fatigue.

Introduction and Study Approach

The stated mission of DART First State and the Delaware Transit Corporation [DTC], an operating division of the Delaware Department of Transportation, is to design and provide the highest quality public transportation services that satisfy the needs of the customer and the community. A primary goal of DTC's program of work directed toward the accomplishment of that mission is the provision of a high quality passenger transport service that is safe, reliable, and convenient. In an effort to maintain the safety of the transit program at the highest level, the Institute for Public Administration (IPA) at the University of Delaware was commissioned by the Delaware Transit Corporation and DART First State to examine the organization's accident report data for the most recent five-year period to explore the relationship, if any, between operators' hours of time on duty and accidents rates. IPA was also asked to review current transit industry practices and procedures regarding drivers' hours of work.

Literature Review

The Human Factors Subcommittee of the American Public Transportation Association's (APTA) Rail Safety Committee conducted a mail survey in 2000 to determine the status of fatigue in the transit industry, which resulted in the publication of a September, 2002, report that was entitled *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*. (http://www.apta.com/services/safety/fatigue/index.cfm) The report detailed the survey responses from a total of 155 agencies including bus, light rail, commuter rail, and rapid transit. The survey addressed a broad range of areas that affect alertness including policies and procedures, education and training, medical issues, scheduling, general work environment, emergency response requirements, and rest facilities.

Policies and Procedures

The APTA survey's Policies and Procedures section addressed agency strategies for handling fatigue related issues. The strategies addressed included internal regulations

and protocols related to the investigation of accidents/incidents, napping as a fatigue countermeasure, and secondary employment.

Scheduling

Agency scheduling practices have a direct impact on the amount of inter-shift rest time available to a driver, and must therefore be considered in any consideration of the issues of fatigue and alertness. The APTA survey examined employee scheduling practices in terms of the number of hours worked per day, minimum rest time between shifts, and any restrictions on maximum number of hours or days worked – either continuously or within a certain time period (day, week or month).

Survey of Contemporary Practice

A set of 40 transit agencies classified by APTA as operators of 200 to 499 buses was compiled and a brief survey instrument – focusing on accident investigation data and driver scheduling, and drawn from the APTA survey – was developed (see Appendix C). The intent of this survey was not to be representative of the entire industry, but rather to target transit properties across the nation that could be considered somewhat comparable to DART First State and to gain insight into their practices related to driver fatigue. In spite of follow-up contacts, only 7 usable survey responses were received from these agencies. DART First State was also asked to provide responses regarding its policies, regulations and driver scheduling practices. Although the number of responses was disappointing, the information provided a useful update to the findings reported in the APTA survey. The responses to the IPA survey questions, and their relationship to the APTA survey, are presented in both tabular and graphic formats.

Accident Data Methodology

The accident data for this study was provided in spreadsheet format by the Systems Safety unit of DART First State. Following the initiation of the project, it became

evident that significant data elements critical to the study had to be compiled by DART First State from other agency records. It was ultimately determined that it would not be practical to undertake the planned review five years' data, and that the study should be limited to an examination of DART First State transit accident data for the most recent two-year period (FY 2003 and FY 2004). This data, pertaining to a total of 604 accidents, was provided in multiple MS Excel spreadsheets and analyzed using SPSS.

The following specific data elements associated with each accident were identified for analysis:

- Number of hours on duty prior to the occurrence of the accident [computed from the reported time of day of the accident and the driver's attendance record start time for that day's shift]
- Number of hours off duty (or "rest time") between the termination of the previous day's shift and the inception of the shift driven on the day of the accident [computed from times derived from the driver's attendance record].
- Duration (in hours) of the shift worked on the day previous to the day of the accident [computed from attendance records}
- Number of hours worked during the 2-week period immediately prior to the date of the accident [computed from attendance records]

In total, for the 2-year period FY 2003 and FY 2004, this data was available for analysis in 588 of the 604 cases. Other data elements that were also available in the file but were **not** the subject of analysis for this study included the specific date of the collision, the location of occurrence, and [in most cases] a general description of weather conditions. In many cases a monetary loss amount was recorded, but it was determined that even where a value was present in the file, it only reflected the known cost of damage to DART First State equipment – not the cost of any property damage or personal injury to another party – so that data element was also excluded from consideration in this study.

To facilitate computation, all times were converted from hours and minutes to decimal hours. The accident cases were then re-coded and grouped for analysis into 3-hour time

periods on the basis of the number of hours the driver had been on duty on that day, prior to the occurrence of the collision. The detailed results of the analysis are presented in both tabular and graphic formats. In most cases, the data for FY 2003 and FY 2004 are presented separately.

Study Limitations

Because the accident data available for this study was limited to two fiscal years, no sort of trend analysis was undertaken. Although some year-to-year variation in the distribution of accident cases across shift hours was observed, the significant characteristics noted in this report apply to both years individually as well as to the 2-year period collectively. Nonetheless, caution should be exercised about drawing generalizations from time-limited data. Also, as previously noted, the limited survey responses regarding contemporary transit agency practices should be viewed as illustrative rather than representative.

Findings

DART First State, Delaware's statewide transit service provider, experiences approximately 300 motor vehicle accidents annually. This study by the Institute for Public Administration (IPA) was commissioned to examine the organization's accident report data and explore the relationship, if any, between operators' hours of time on duty and accidents rates. IPA was also asked to review current transit industry practices and procedures regarding drivers' hours of work.

Transit Industry Practices

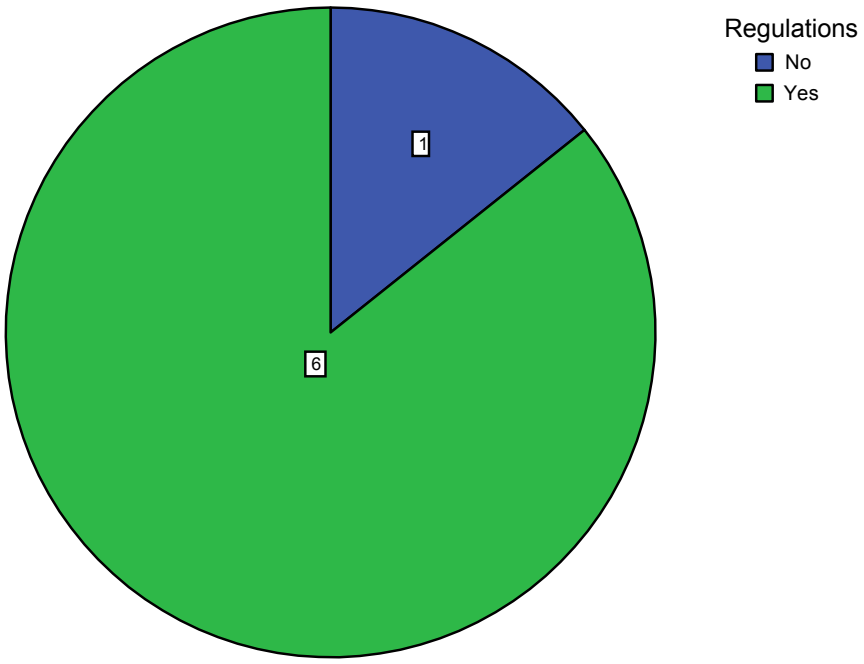
The Human Factors Subcommittee of the American Public Transportation Association's (APTA) Rail Safety Committee conducted a mail survey in 2000 to determine the status of fatigue in the transit industry, which resulted in the publication of a September, 2002, report that was entitled *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*. (http://www.apta.com/services/safety/fatigue/index.cfm) The report detailed the survey responses from a total of 155 agencies including bus, light rail, commuter rail, and rapid transit. The survey addressed a broad range of areas that affect driver alertness. Drawing from the APTA survey, IPA composed a brief survey instrument focused on accident investigation data and driver scheduling (see Appendix C). A set of 40 transit agencies classified by APTA as operators of 200 to 499 buses was compiled and invited to participate in the IPA survey (see Appendix B). The intent of this survey was not to be representative of the entire industry, but rather to target transit properties across the nation that could be considered somewhat comparable to DART First State and to gain insight into their practices related to driver fatigue. A total of seven usable survey responses were received, one from an agency that operates only fixed-route service, and six from agencies that operate both fixed-route and demand-responsive service (as does DART First State). Information regarding current policies, regulations, and driver scheduling practices was also provided by DART First State. Although the number of responses was disappointing, the information provided a useful update to the findings reported in the APTA survey.

Do agencies have regulations, policies or protocols concerning driver fatigue?

TOTAL RESPONSES	YES		NO	
	#	%	#	%
7	6	86	1	14

Survey of Comparable Transit Agencies

Agencies With or Without Regulations Concerning Driver Fatigue



MODE	TOTAL AGENCIES RESPONDING	INTERNAL REGULATIONS				NO RESPONSE
		Yes	%	No	%	
All	146	50	34	96	66	9
Bus	96	31	32	65	68	3

- The results from APTA's survey indicate that in 2000, only 32% of bus transit agencies had regulations, policies, or protocols concerning driver fatigue.
- **DART First State reports they do not currently have any regulations, policies, or protocols concerning driver fatigue.**

In investigations of on-road accidents/injuries/incidents does your agency ask questions regarding:

TOTAL	HOURS ON DUTY?				HOURS OFF SINCE PRIOR SHIFT?				HOURS WORKED IN PRIOR WEEK?				ANY OTHER FATIGUE RELATED QUESTIONS?			
	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%
7	4	56	3	44	2	29	5	71	3	43	4	57	1	14	6	86

- Four of the seven (56%) or slightly less than 2/3 of responding bus transit agencies ask questions regarding hours on duty.
- Only 2 of the 7 bus transit agencies (29%) ask questions regarding hours off duty since prior shift.
- Note: One respondent raises questions regarding medications taken.

MODE	TOTAL AGENCIES RESPONDING	QUESTION RE: HOURS ON DUTY				NO RESPONSE
		Yes	%	No	%	
All	144	93	65	51	35	11
Bus	96	55	57	41	43	3

- The APTA survey reported nearly identical results to the IPA survey, showing that 55 of the 96 bus transit agencies (57%) ask questions regarding hours on duty.

MODE	TOTAL AGENCIES RESPONDING	QUESTION RE: HOURS PRIOR WEEK				NO RESPONSE
		Yes	%	No	%	
All	143	43	30	100	70	12
Bus	96	24	25	72	75	3

- Slightly more than 43% of all bus transit agencies reported asking about hours worked in the prior week. The APTA survey reports that 24 of the 96 bus transit agencies (25%) asked questions regarding hours worked in prior week.
- **DART First State reports they only ask questions concerning hours on duty and do not address hours off duty since the prior shift or hours worked during the prior week [these data elements had to be gathered from other records for the purpose of this report].**

Are drivers restricted as to the length of time they can work in a day?

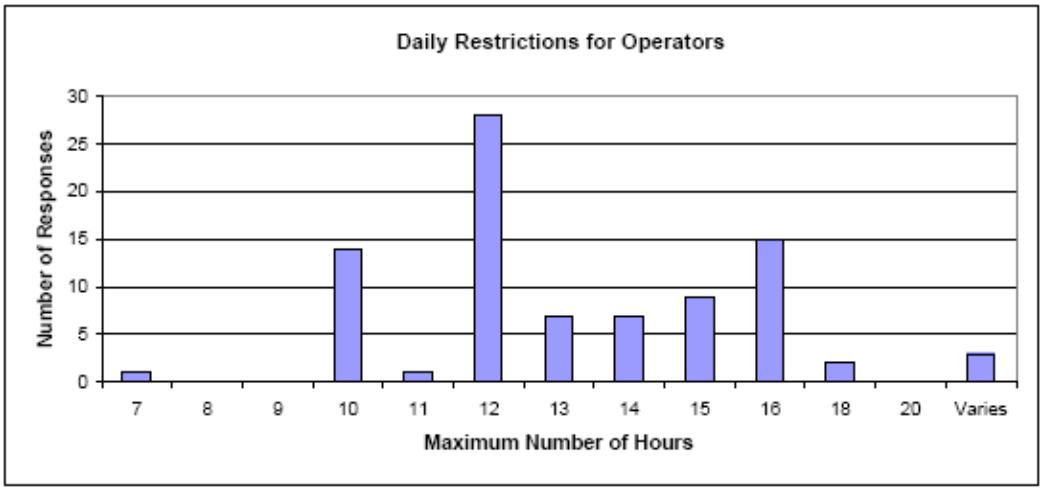
TOTAL RESPONSES	IN A DAY				IN A WEEK				IN A MONTH			
	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%
7	5	71	2	29	2	29	5	71	1	14	6	86

- Slightly more than 71% of the bus transit agencies responding to the IPA survey indicated that they place restrictions on drivers' daily work schedules. Among the five agencies with daily restrictions, those restrictions ranged from 10 to 12 hours, with 10 hours being the most common response.
- Only 2 of the 7 agencies reported having weekly restrictions and only 1 reported monthly restrictions.

Are drivers restricted as to the length of time they can work in a day?

TOTAL RESPONSES	DAILY RESTRICTIONS		WEEKLY RESTRICTIONS		MONTHLY RESTRICTIONS		NONE OF THESE	
	#	%	#	%	#	%	#	%
718	269	37	140	20	89	12	220	31

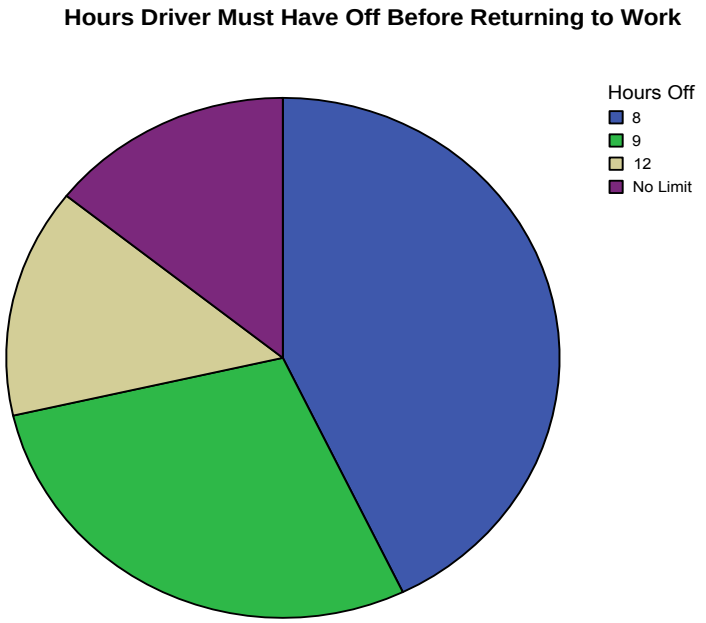
- The APTA survey indicated that nearly 70% of the bus transit agencies governed their employees by daily, weekly, or monthly length of time they can work. The most common response for daily restrictions was 12 hours per day.



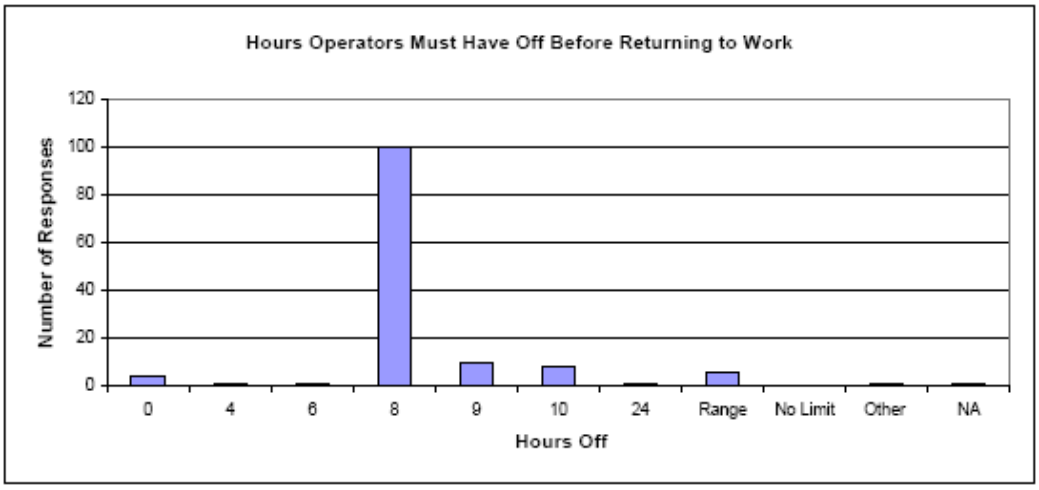
Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- The APTA survey showed that only 20% of the 718 respondents indicate governance by weekly restrictions. The weekly restrictions ranged from 20 to 112 hours per week, with 60 to 64 hours per week the most prevalent response (34% of the respondents).
- Only 11 of 89 agencies (12 %) reported having monthly restrictions, and all of those agencies indicated 140 hours per month as the ceiling.
- **DART First State has reported that their drivers are not governed by any restriction which limits the length of time they can work in a day, week, or month.**

How many hours must a driver have off before he/she can return to work?



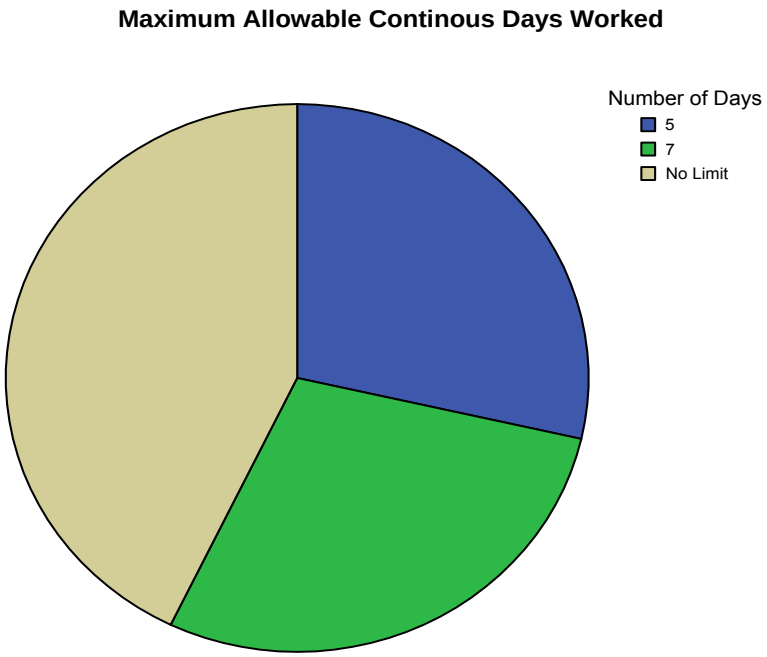
- Among the seven responding bus transit agencies, the most prevalent response was 8 hours, the maximum was 12, and only one agency did not have an established limit.



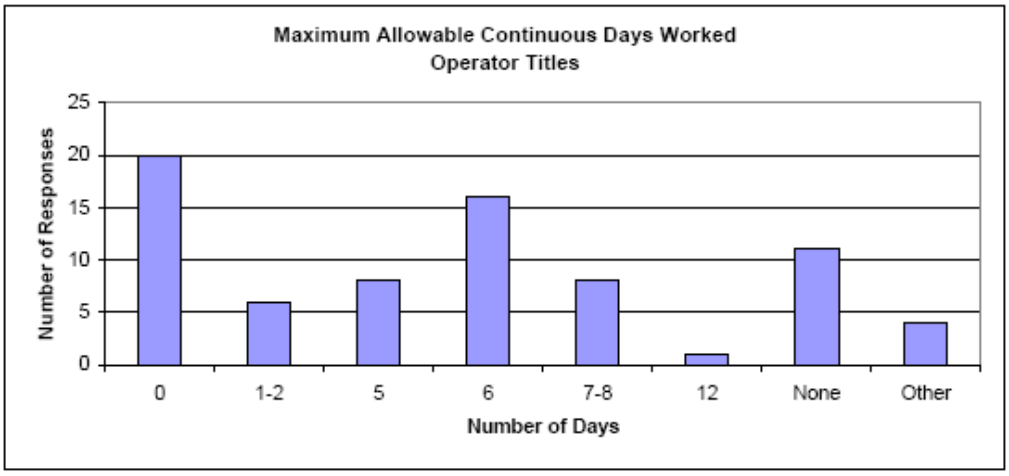
Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- In the APTA survey, the most frequent response was 8 hours, which was indicated by slightly over 75% of the respondents (100 of 133). Ninety-three percent of the respondents mandated a rest period within the range of 8 to 10 hours.
- **DART First State does not currently have a policy to regulate the hours a driver must be off duty before returning to work.**

What is the maximum allowable number of consecutive days a driver can work?



- Three of the seven bus transit agencies indicated they have no limitation on the number of consecutive days a driver can work. More than half of the respondents indicated some limitation, ranging from 5 to 7 days.



Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- Eleven of the seventy-four respondents to APTA's survey indicated they had no policy, limitation, or maximum that governed continuous days, while nearly 85% indicated they had some limitations.
- **DART First State currently has no limitation on the number of consecutive days drivers can work.**

Are drivers entitled to have a certain number of days off per week?

TOTAL RESPONSES	YES		NO	
	#	%	#	%
7	7	100	0	0

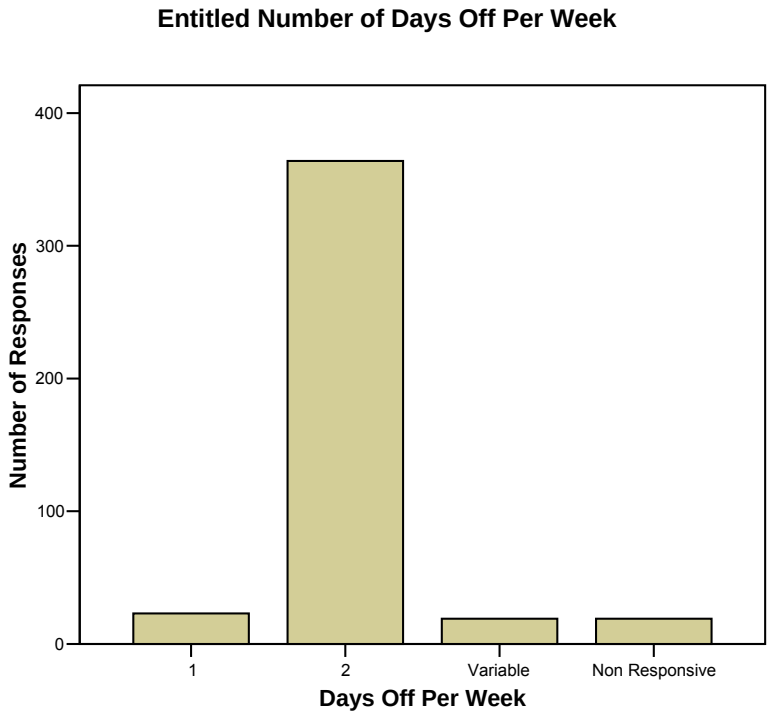
- Every IPA survey respondent indicated drivers' entitlement to a certain number of days off per week.

TOTAL RESPONSES	ENTITLED TO # DAYS OFF PER WEEK			
	Yes		No	
	#	%	#	%
513	433	84	80	16

- The APTA results were similar, in that 433 of the 513 respondents (84%) indicated that employees were entitled to a certain number of days off per week.

b) How many?

- About 71% of the IPA survey respondents' drivers are entitled to two days off per week.



- Eighty-four percent of the respondents (364 of 433) to the APTA survey indicated that their employees were entitled to two days off per week.
- **DART First State has indicated that their drivers are not entitled a certain number of days off per week.**

Are drivers entitled to have days off that are consecutive?

TOTAL RESPONSES	ENTITLED TO CONSECUTIVE DAYS OFF			
	Yes		No	
	#	%	#	%
7	5	71	2	29

- Responses to the IPA survey show that nearly 71% of the agencies entitle their drivers to consecutive days off.

TOTAL RESPONSES	ENTITLED TO CONSECUTIVE DAYS OFF				NO RESPONSE
	Yes		No		
	#	%	#	%	#
499	242	48	257	52	37

- The results from the APTA survey were nearly split, with 48% of respondents indicating drivers are entitled to have days off that are consecutive while 52% reported they are not.
- **DART First State has indicated that its employees are not entitled to have a certain number of days off that are consecutive.**

Must a driver take his/her regular days off?

TOTAL RESPONSES	REGULAR DAYS OFF REQUIRED			
	Yes		No	
	#	%	#	%
7	1	14	6	86

- Six of the seven responding agencies indicated that drivers are not required to take their regular days off.

TOTAL RESPONSES	REGULAR DAYS OFF REQUIRED				NO RESPONSE
	Yes		No		
	#	%	#	%	#
486	143	29	343	71	37

- About 30% of the respondents to APTA's survey indicated that drivers are required to take days off, while close to 70% reported that drivers were not.
- **DART First State employees are not required to take their regular days off.**

Does your agency have shifts where drivers have a break of more than one hour (sometimes referred to as split shifts or swing assignments)?

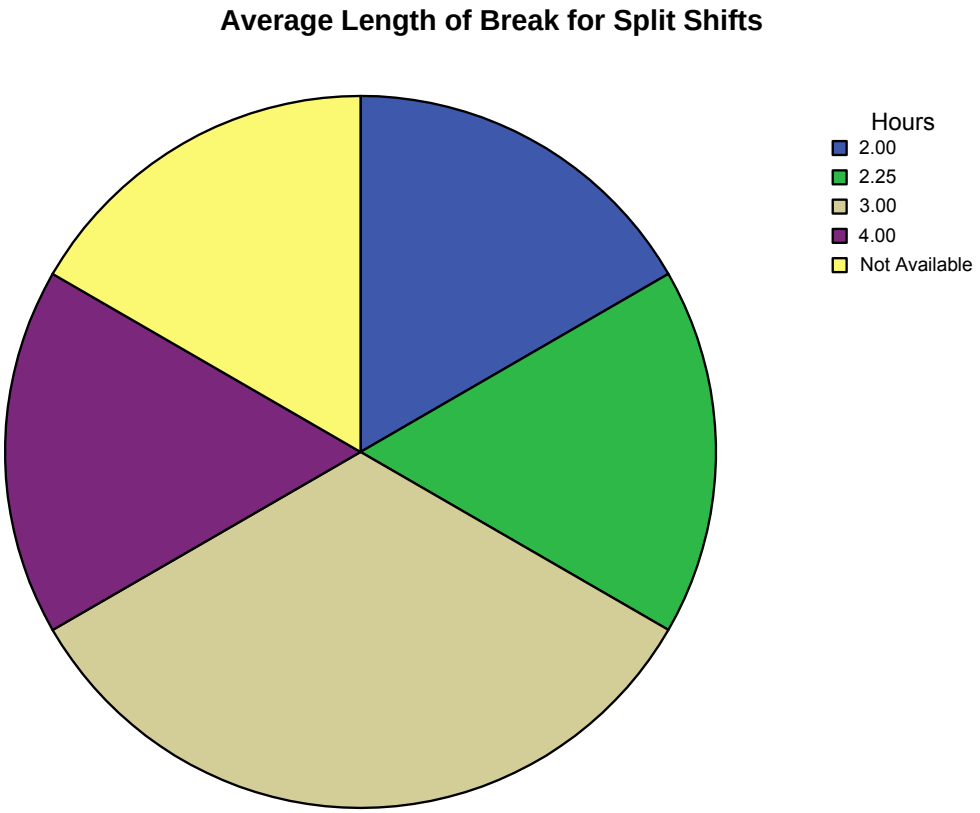
TOTAL RESPONSES	SPLIT-SHIFTS OR SWING ASSIGNMENTS			
	Yes		No	
	#	%	#	%
7	6	86	1	14

- Six of the seven respondents (86%) indicated that their drivers do have split shifts or swing assignments.

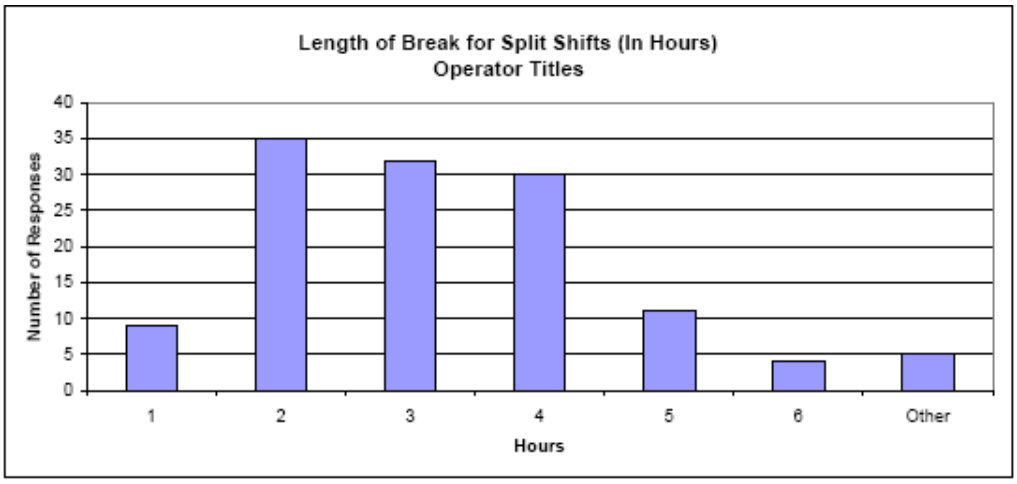
TOTAL RESPONSES	SPLIT-SHIFTS OR SWING ASSIGNMENTS				NO RESPONSE
	Yes		No		
	#	%	#	%	#
511	199	39	312	61	25

- More than 60% of the respondents to APTA's survey indicated that their employees did not have split or swing shift assignments. About 39% indicated they did have such assignments.
- **DART First State reports they do have split or swing shift assignments.**

What is the average length of the break for swing/split shift assignments?



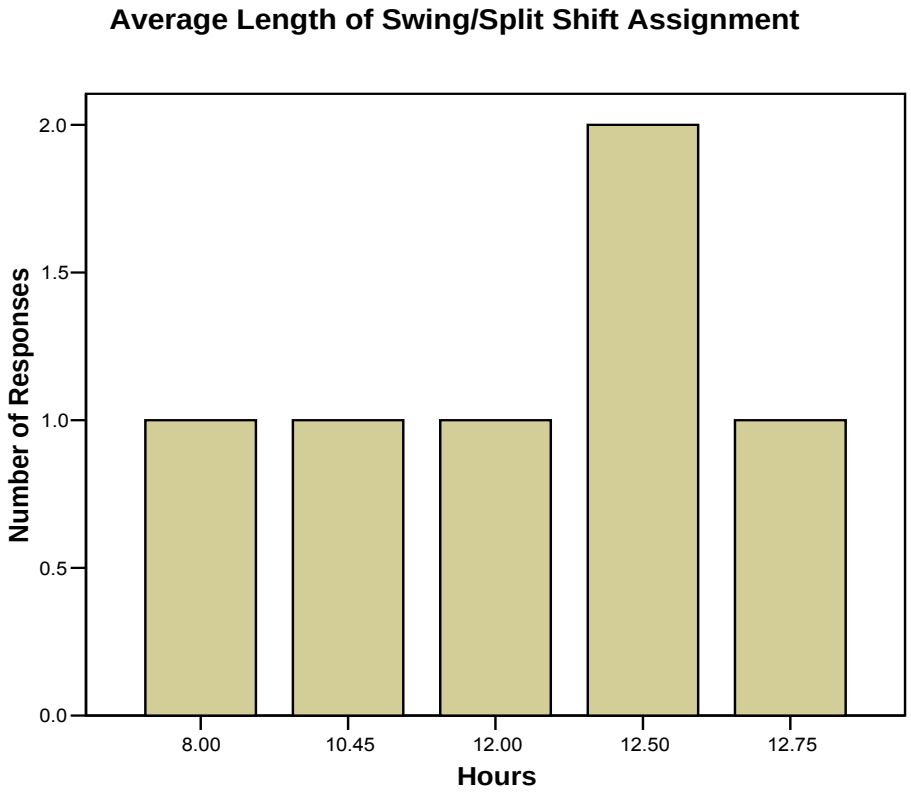
- Five of the six respondents indicated a range between 2 to 4 hours.



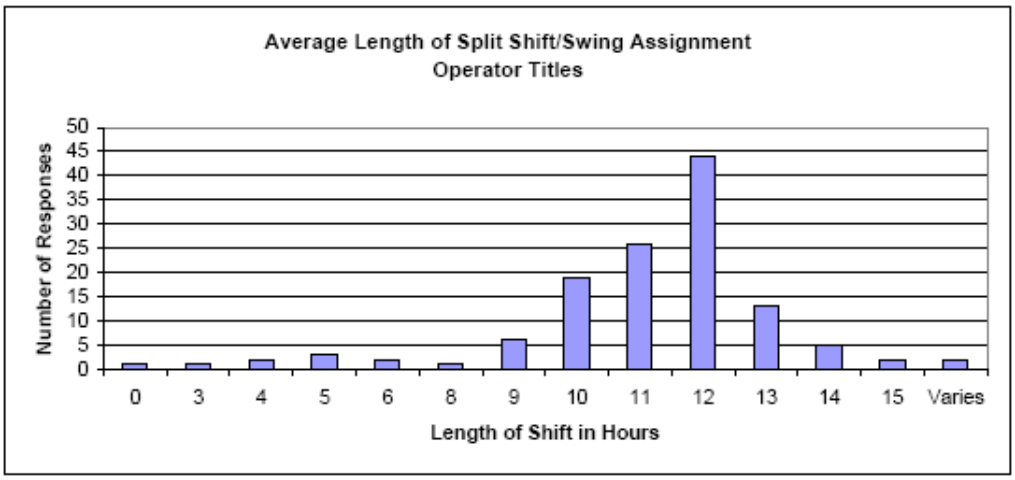
Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- The results from the APTA survey were similar. Seventy-seven percent of the respondents indicated that the length of the break was between 2 and 4 hours.
- **DART First State indicates an average break length for split shifts of 1 hour.**

What is the average length of a split shift/swing assignment (from start to finish)?



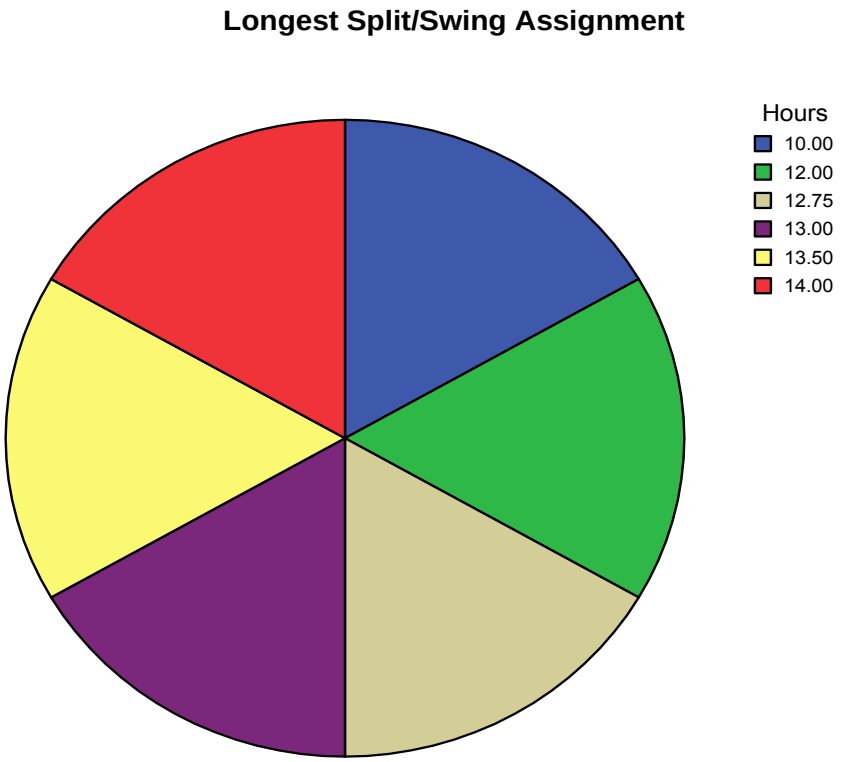
- The mean length of a swing/split shift assignment for the six respondents was 11.36 hours. The responses ranged between 8 and 12.75 hours.



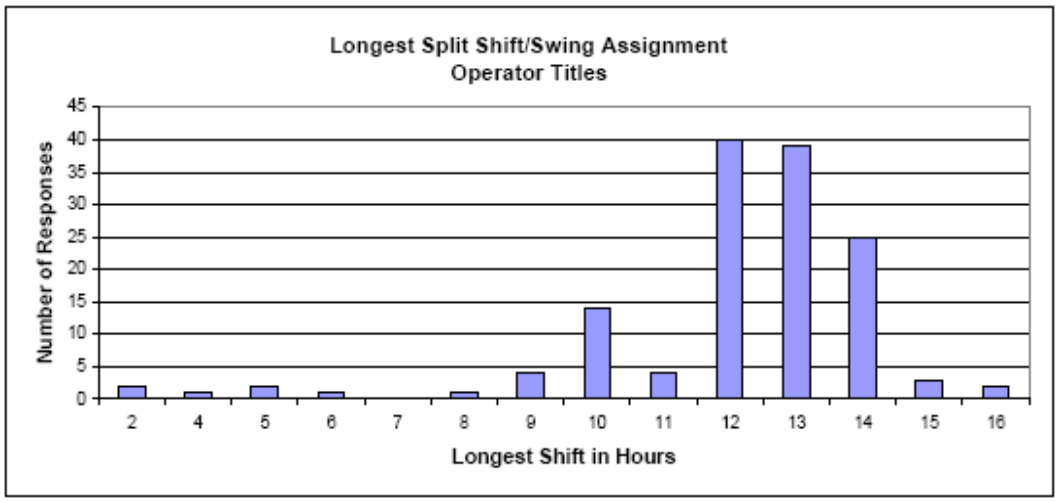
Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- Nearly seventy percent of the respondents to the APTA survey indicated an average length of swing/split assignments between 10 and 12 hours.
- **DART First State's average length of a split/swing shift assignment varies.**

What is the longest split shift/swing assignment (total from start to finish)?



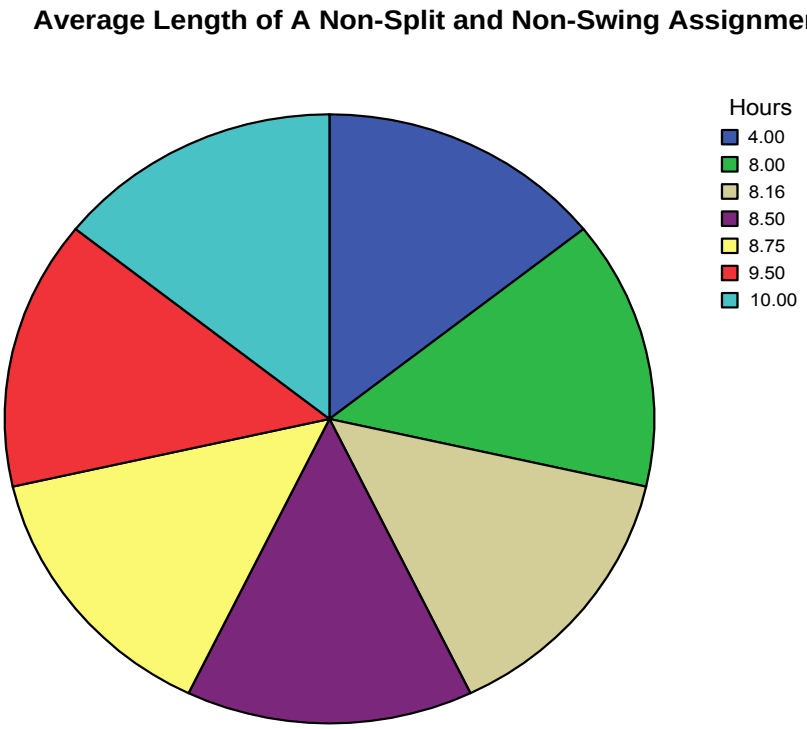
- The six respondents indicated that their longest split shift/swing assignment ranged from 10 to 14 hours, with the mean being 12.54 hours.



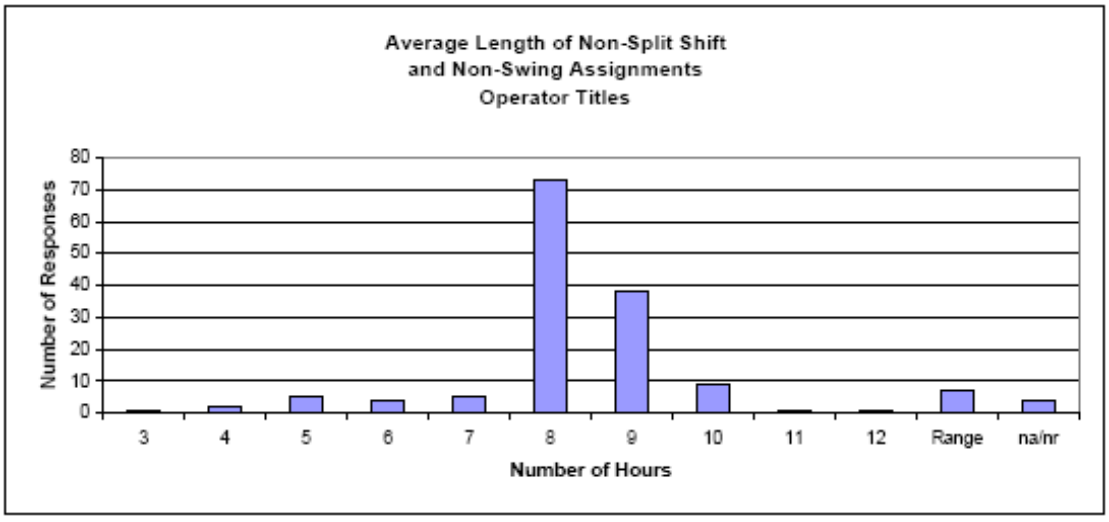
Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- Seventy-five percent of respondents to the APTA survey indicated their longest split shift/swing assignments were between 12 and 14 hours.
- **DART First State's longest split/swing shift assignment varies.**

What is the average length of a non-split shift assignment (from start to finish)?



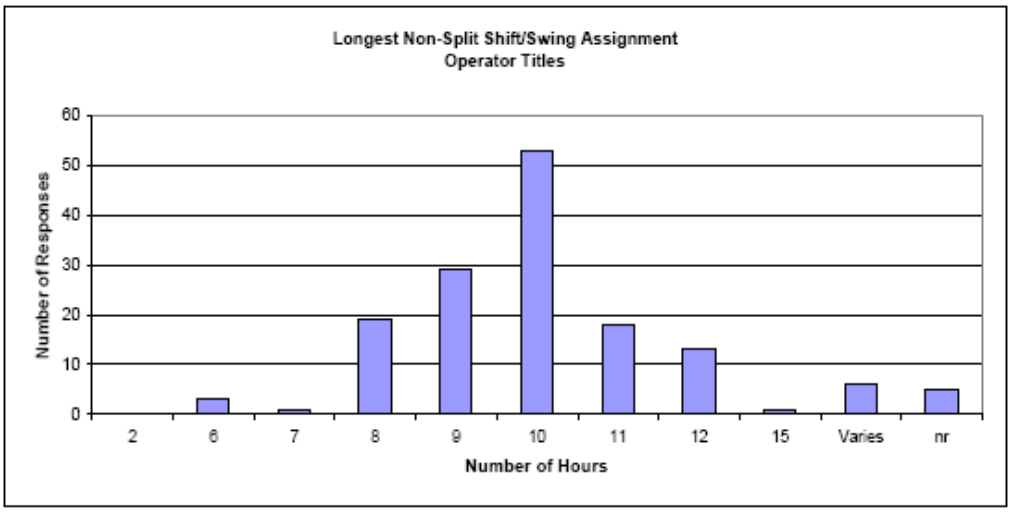
- The mean length of non-split or swing shift assignments for the bus transit agencies IPA surveyed was 8.13 hours.



Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- Forty-nine percent of respondents to the APTA survey indicated an average non-split shift assignment of 8 hours.
- **DART First State's average non-split/swing assignment is 8 hours.**

What is the longest non-split shift/swing assignment (total from start to finish)?



Source: APTA, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*

- The APTA survey indicated 10 hours was the most frequent shift length (identified by 36% of the respondents).
- **DART First State has indicated that its longest non-split shift and non-swing assignment is 12 hours.**

In making regular work assignments, is priority given by seniority?

TOTAL RESPONSES	SENIORITY PRIORITY IN REGULAR ASSIGNMENTS			
	Yes		No	
	#	%	#	%
7`	6	86	1	14

- Six of seven transit agencies surveyed indicated that priority is given by seniority.

TOTAL RESPONSES	SENIORITY PRIORITY IN REGULAR ASSIGNMENTS				NO RESPONSE
	Yes		No		
	#	%	#	%	#
459	353	77	106	23	77

- The APTA survey indicated that 77% of the respondents based their employees' regular work assignments on seniority.
- **DART First State indicates that they assign regular work schedules based on seniority.**

Is unscheduled overtime usually assigned according to seniority, or is it equally distributed?

TOTAL RESPONSES	BY SENIORITY		EQUALLY DISTRIBUTED		OTHER	
	#	%	#	%	#	%
7	6	86	0	0	1	14

- Six of seven respondents indicated that unscheduled overtime was assigned according to seniority, while none indicated that it was equally distributed. One agency indicated that another system was employed when making this decision.

TOTAL RESPONSES	BY SENIORITY		EQUALLY DISTRIBUTED		OTHER		NO RESPONSE
	#	%	#	%	#	%	#
443	175	40	208	47	60	14	93

- The APTA survey showed that slightly less than 50% of the respondents distributed unscheduled overtime equally, while 40% used seniority.
- **DART First State distributes its unscheduled overtime according to seniority.**

DART Transit Accident Data Analysis

The subject of this study was DART First State's transit accident data for the most recent two-year period (FY 2003 and FY 2004). This data, pertaining to a total of 604 accidents, was provided in multiple MS Excel spreadsheets and analyzed using SPSS.

The following specific data elements associated with each accident were identified for analysis:

- Number of hours on duty prior to the occurrence of the accident [computed from the reported time of day of the accident and the driver's attendance record start time for that day's shift]
- Number of hours off duty (or "rest time") between the termination of the previous day's shift and the inception of the shift driven on the day of the accident [computed from times derived from the driver's attendance record].
- Duration (in hours) of the shift worked on the day previous to the day of the accident [computed from attendance records}
- Number of hours worked during the 2-week period immediately prior to the date of the accident [computed from attendance records]

In total, for the 2-year period FY 2003 and FY 2004, this data was available for analysis in 588 of the 604 cases. To facilitate computation, all times were converted from hours and minutes to decimal hours. The accident cases were then re-coded and grouped for analysis into 3-hour time periods on the basis of the number of hours the driver had been on duty on that day, prior to the occurrence of the collision. The detailed results of the analysis are presented in both tabular and graphic formats. In most cases, the data for FY 2003 and FY 2004 are presented separately.

The table below presents the summary data for the 2-year period that was the subject of this review. Note the deviations from the mean for Hours of Rest Between Shifts and Prior Shift Hours Worked among accidents that occurred during the first 9 hours of the shift (the time period that represents the majority of DART operators' scheduled shifts) as compared to accidents that occurred more than 9 hours into the shift worked on the day of the accident. Specifically, the average period of rest since the prior day's shift among all 435 drivers who had worked during the previous day was 12.45 hours [the other 153 accidents involved drivers who had the prior day off, and were evenly distributed at 26% each between the 0-9 and 9+ groups]. Drivers whose accidents occurred during their first 9 hours on duty had an average rest period of 12.81 hours – while those who were involved in collisions after being on duty for more than 9 hours had an average inter-shift rest period of only 11.42 hours. Hours worked during the prior day are also disparately distributed: an overall average of 11.41, with the 0-9 hour group having worked an average of 11.07 hours the day before – versus an average prior shift of 12.38 hours for the 9+ group. There is, however, no significant variation between the groups in terms of average hours worked during the previous 2-week period. Data for each year follows.

Study Total							
Hours Driver Was on Duty Prior to Accident	All Accidents		Mean Hours Worked During Prior 2-Week Period	Drivers With Prior Day Off		Mean Hours of Rest Between Shifts	Mean Hours Worked During Prior Shift
Hours	#	%	Average	#	%	Average	Average
0-3	115/588	26	110.76	41/155	26	12.56	11.29
3-6	162/588	28	112.36	38/162	23	13.02	10.90
6-9	117/588	20	108.11	34/117	29	12.84	11.03
9-12	103/588	18	115.79	29/103	28	11.90	11.91
12-15	51/588	9	106.22	11/51	22	10.50	13.26
0-9	434/588	74	110.70	113/434	26	12.81	11.07
9-15	154/588	26	112.41	40/154	26	11.42	12.38
0-15	**588/588**	**100**	**111.15**	**153/588**	**26**	**12.45**	**11.41**

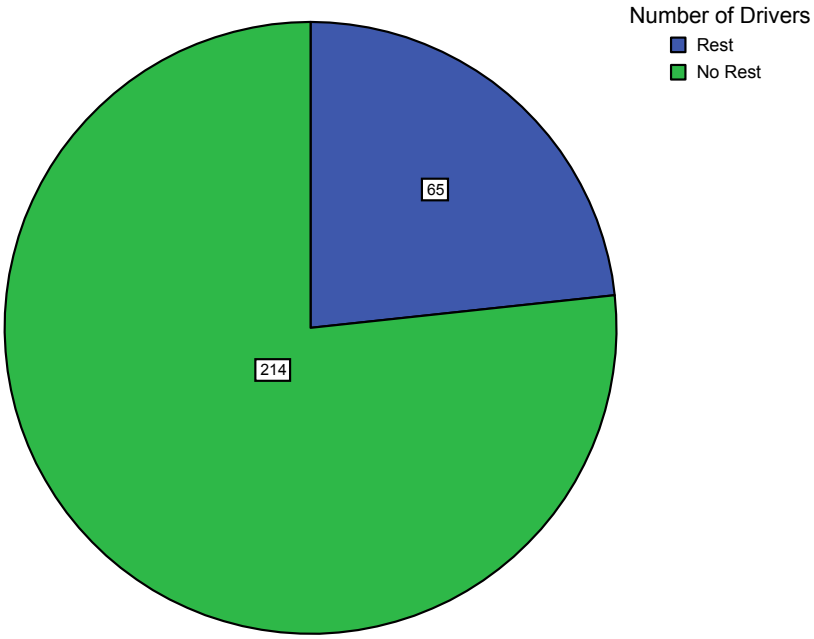
Fiscal Year 2003							
Hours Driver Was on Duty Prior to Accident	All Accidents		Mean Hours Worked During Prior 2-Week Period	Drivers With Prior Day Off		Mean Hours of Rest Between Shifts	Mean Hours Worked During Prior Shift
Hours	#	%	Average	#	%	Average	Average
0-3	78/279	28	112.73	19/78	24	12.61	11.08
3-6	82/279	29	117.42	16/82	20	13.21	11.07
6-9	51/279	18	107.50	12/51	24	12.57	11.22
9-12	49/279	18	119.43	16/49	33	11.66	12.55
12-15	19/279	7	99.62	2/19	11	11.06	12.85
0-9	211/279	75	113.37	47/211	22	12.84	11.11
9-15	68/279	25	112.69	18/68	26	11.46	12.65
0-15	**279/279**	**100**	**113.21**	**65/279**	**23**	**12.53**	**11.46**

Fiscal Year 2004							
Hours Driver Was on Duty Prior to Accident	All Accidents		Mean Hours Worked During Prior 2-Week Period	Drivers With Prior Day Off		Mean Hours of Rest Between Shifts	Mean Hours Worked During Prior Shift
Hours	#	%	Average	#	%	Average	Average
0-3	77/309	25	108.64	22/77	28	12.51	11.51
3-6	80/309	26	106.61	22/80	29	12.80	10.70
6-9	66/309	21	108.65	22/66	33	13.08	10.87
9-12	54/309	17	112.86	13/54	24	12.10	11.40
12-15	32/309	710	111.09	9/32	28	10.09	13.56
0-9	223/309	72	107.91	66/223	29	12.78	11.03
9-15	86/309	28	112.20	22/86	25	11.38	12.17
0-15	**309/309**	**100**	**109.15**	**88/309**	**28**	**12.37**	**11.36**

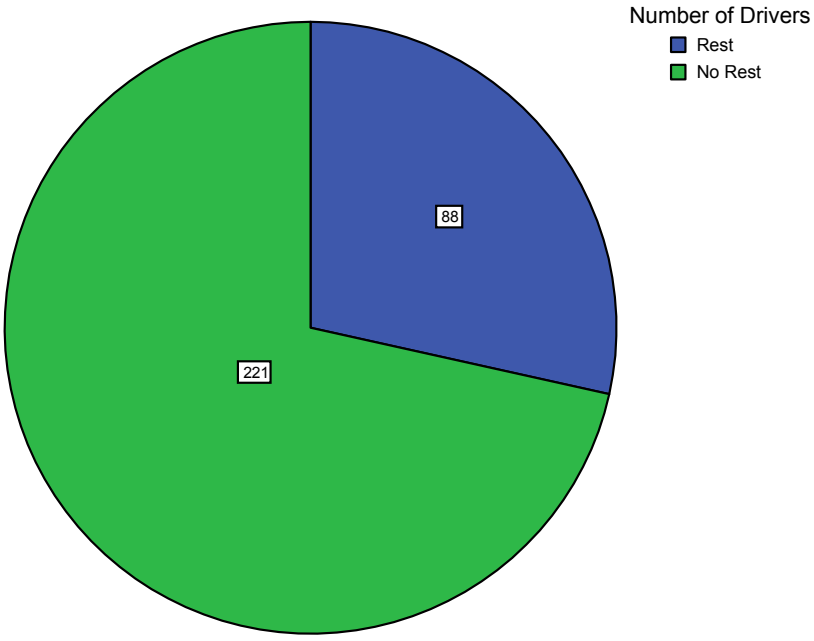
As noted in the APTA report *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*, "Employee schedules play an important role in any consideration of fatigue and alertness. The number of hours worked, when they are worked and how frequently or greatly those hours vary all interact with the individual's personal life to influence the amount of rest and the quality of rest the person gets in a day or a week". (APTA, p.5) This analysis focuses specifically on drivers' hours of rest between the previous shift and the shift when their accident occurred, the duration of that previous day's shift, and the total number of hours worked during the previous 2-week period, as measures of potential fatigue. It should be recognized, however, that many motor vehicle accidents result from factors other than fatigue – and that accident-related fatigue may be the result of personal lifestyle choices on the part of the driver that have little or nothing to do with his or her DART First State work schedule.

Recall that 26%, or about one out of four, of all accidents that occurred during FY 2003 and FY 2004 involved drivers who had not been at work (at least, not as a driver at DART First State) during the previous day. These accidents were excluded from the calculation of the number hours off duty between the termination of the previous day's shift and the inception of the shift driven on the day of the accident, as well as the calculation of the duration of the shift worked during the day previous to the accident. The specific annual distributions of drivers whose accidents followed one or more days off (from DART First State employment) were 23% in FY 2003 and 28% in FY 2004.

Distribution of Drivers Who Had at Least the Previous Day off & Those Who Did Not FY03

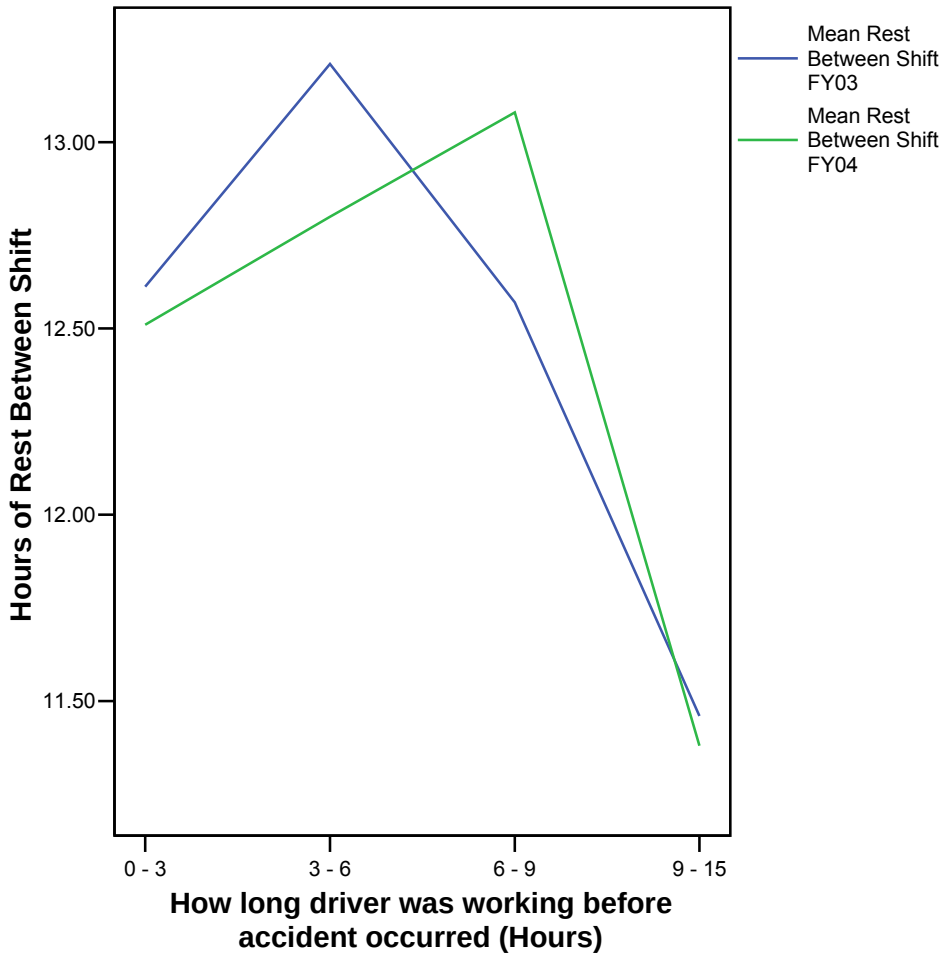


Distribution of Drivers Who Had at Least the Previous Day off & Those Who Did Not FY04



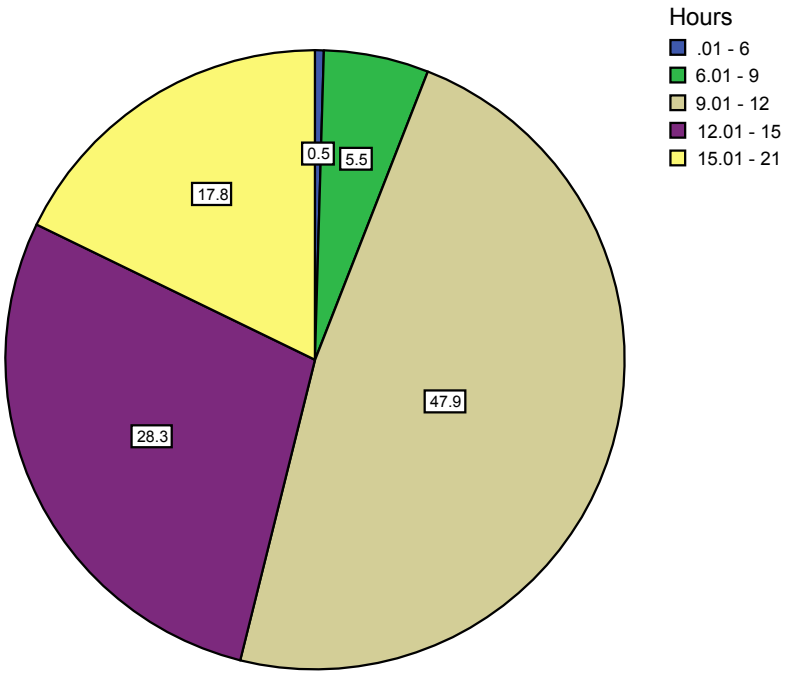
Rest Between Shifts

Among drivers who had worked a shift at DART First State during the day prior to their accident, the overall average rest between shifts was 12.45 hours for the 2-year period. As previously noted, drivers whose accidents occurred during their first 9 hours on duty had an average rest period of 12.81 hours – while those who were involved in collisions after being on duty for more than 9 hours had an average inter-shift rest period of only 11.42 hours. The relationship between the number of hours of inter-shift rest and the length of time on duty on the day of the accident prior to the collision is illustrated below.

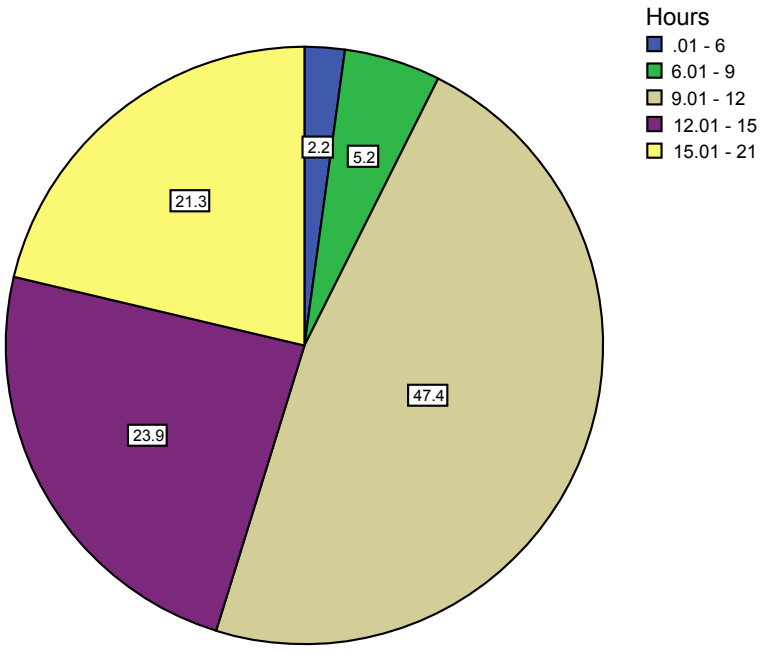


The actual number of hours of rest ranged from a high of 15.66 to a low of 5.33. The percentage distributions of driver's hours of rest between shifts for each fiscal year follow.

% Hours of Rest Since Prior Shift FY 2003

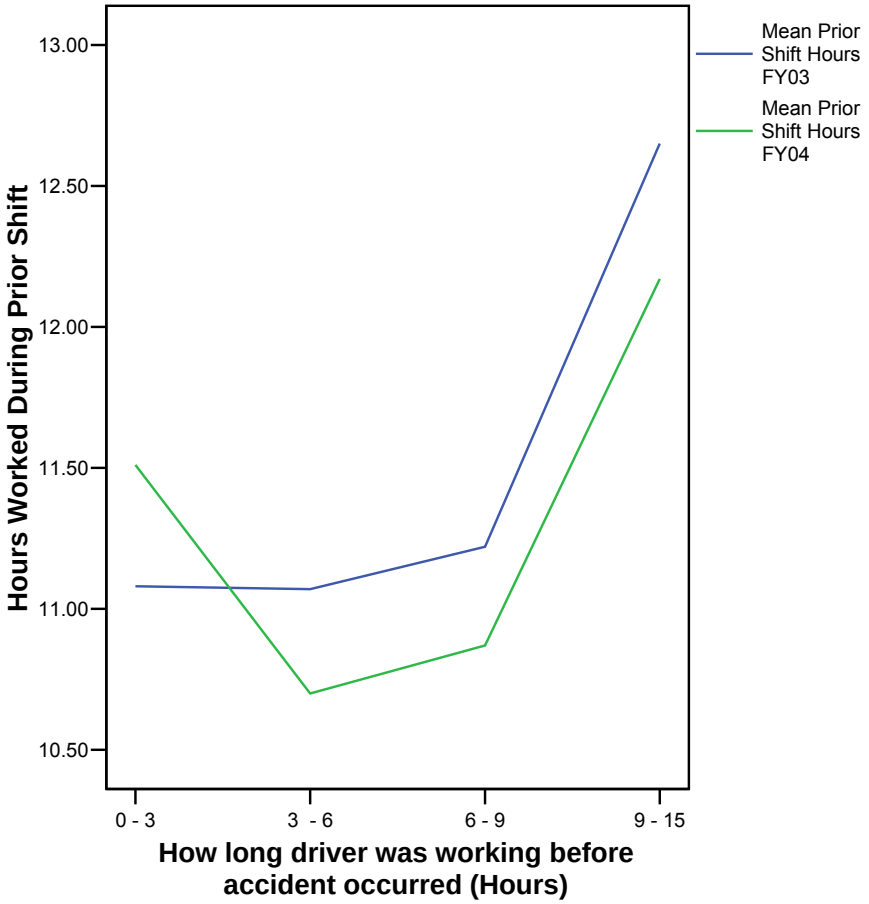


% Hours of Rest Since Prior Shift FY 2004



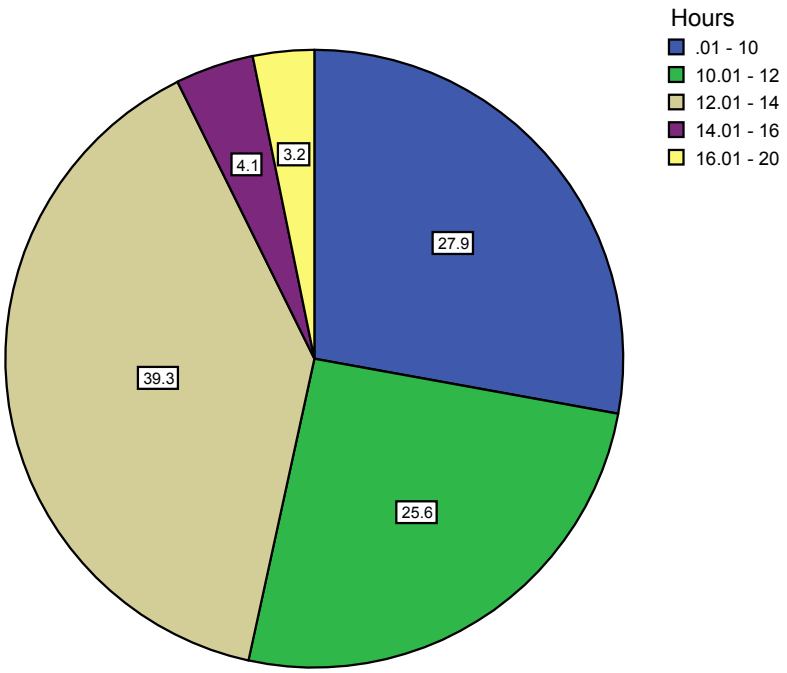
Duration of the Previous Day's Shift

Among drivers who had worked a shift at DART First State during the pay prior to their accident, the overall average duration of the previous day's shift was 11.41 hours for the 2-year period. Drivers whose accidents occurred during their first 9 hours on duty had worked an average of 11.07 during the previous day – while those who were involved in collisions after being on duty for more than 9 hours had worked shifts averaging 12.38 hours in duration during the previous day. The relationship between the number of hours worked during the previous day's shift and the length of time on duty on the day of the accident prior to the collision is illustrated below.

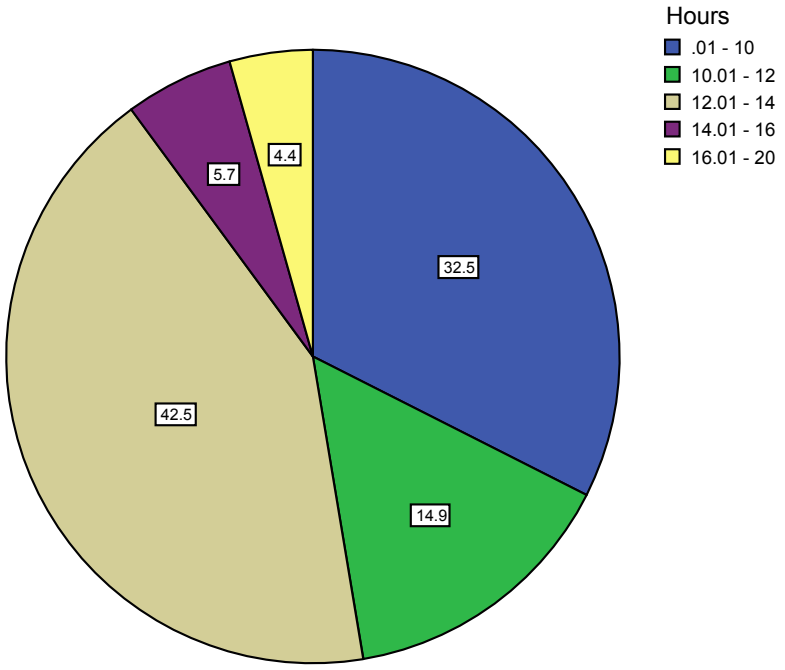


The actual number of hours worked during the prior shift ranged from a low of 2.5 to a high of 19. The percentage distributions of driver's hours of work during the previous days' shifts for each fiscal year follow.

% Hours Worked During Prior Shift FY 2003

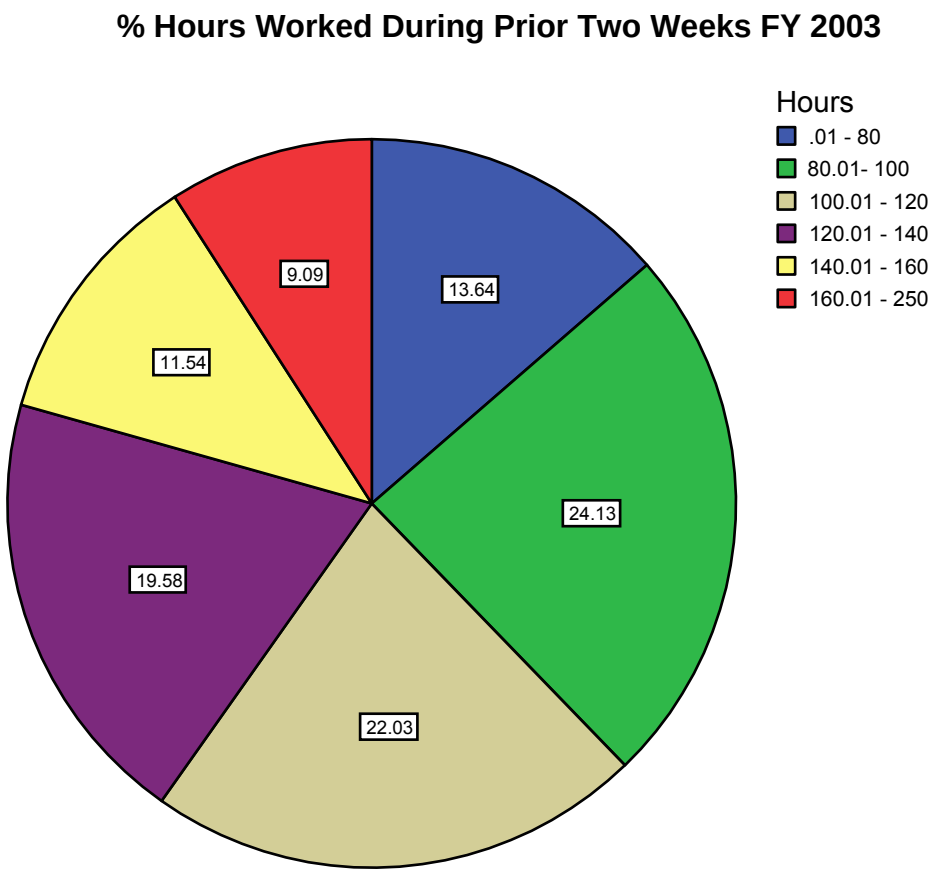


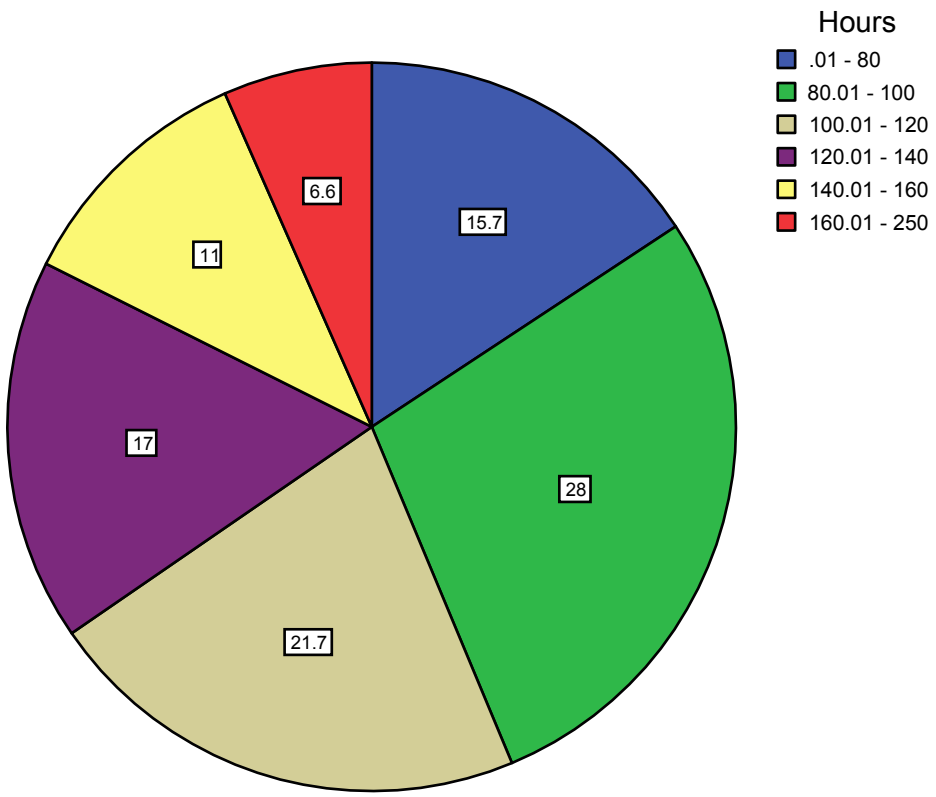
% Hours Worked During Prior Shift FY 2004



Hours Worked During Previous 2-week Period

The average for the 2-week period immediately prior to the day of the collision – including both those drivers who had one or more days of rest prior to accident and those who did not, was 111.15 hours worked. The specific FY 2003 and FY 2004 averages were 113.21 and 109.15 hours, respectively. Despite this consistency in overall annual average values, the actual number of hours worked by any individual driver during the previous 2-week period varied significantly – ranging from a low of 3.26 to a high of 244.5 (which would equate to a rather astonishing work record of nearly 17.5 hours per day, every day, for the entire two weeks). As illustrated in the following figures, the majority of drivers who were involved in collisions had worked more than 100 hours during the prior two weeks, and nearly one in five had worked in excess of 140 hours.




% Hours Worked During Prior Two Weeks FY 2004
Hours
.01 - 80
80.01 - 100
100.01 - 120
120.01 - 140
140.01 - 160
160.01 - 250
15.7
28
21.7
17
11
6.6

Discussion of Policy Options

The undertaking of this study is indicative of a proactive approach on the part of DART First State toward the identification of factors related to transit accident prevention. The findings suggest several opportunities for policy development or enhancement.

Accident Investigation

Studies of data collection efforts concerning transit accidents have typically focused on such characteristics such as time of day, day of the week, type of weather, type/condition of roadway, lighting conditions, and operators' years of experience. (Analysis of Florida Transit Bus Crashes; National Transit Bus Accident Data) These are among the data elements that have traditionally – and appropriately – been captured on accident investigation report forms. Although the majority of the respondents to the APTA and IPA surveys indicated that their transit agencies gathered information about hours on duty prior the occurrence of an accident, standardized questions concerning periods of rest or total hours worked during the previous week were much less common. For purposes of this study, DART First State compiled the data concerning previous shifts worked from attendance records. It is recommended that this data be gathered routinely in the course of future accident investigations. While questioning the driver as to the end time and duration of his or her previous shift would be reasonable, consideration should be give to the implementation of a protocol whereby that data was later verified, and prior work period total hours determined, from a check of the agency's attendance records.

Work Day Limitations

DART First State does not currently limit the number of hours that a driver can work in any given period of time, be it a day, a week, or a month. The specification of work hour limitations was reported by a majority of the respondents to the APTA and IPA surveys, however, with daily limits of 10 to 12 hours being most common. As detailed in the figures on page 29 of this report, approximately half of the DART First State drivers who had been on duty during the day immediately prior to their accident had worked a shift of 12 or more hours on that day.

DART First State does not currently regulate the number of hours that a driver must be off duty between consecutive days of work. The specification of non-work hour limitations was reported by most of the respondents to the APTA and IPA surveys, however, with rest periods of 8 to 10 hours being most common. As detailed in the figures on page 27 of this report, only one in fifteen of the DART First State drivers who had been on duty during the day immediately prior to their accident had an off-duty rest time interval of 9 hours or less between their shifts.

When considering all of the accidents experienced by DART First State during FY 2003 and FY 2004, regardless of whether the driver had been on duty during the previous day, nearly one in five involved drivers who had worked in excess of 140 hours during the previous two weeks. This equates to a schedule of consistent 14-hour days (assuming 2 days off per week), or consistent 12-hour days with one day off per week, or consistent 10-hour days with no days off. Any of those permutations could reasonably result in a heightened level of fatigue.

From an operational perspective, if some consideration was to be given to the establishment of any limit on the number of hours worked, a driver's hours on duty during a given day or over two consecutive days would be more easily monitored than the hours worked over a one or two week period of time – especially a "rolling" time period of 7 or 14 days prior to the instant date. If consideration was to be given to specifying a minimum inter-shift rest period, it should be recognized that simply prohibiting a driver from being at work does not guarantee that he or she is truly "resting" during those hours.

Suggestions for Future Research

The lack of readily available accident data for prior years limited the scope of the data analysis conducted for this report. DART First State has since revised their accident report form to capture more data, including the variables we examined. For future research, DART First State's accident data for fiscal year 2005 and beyond could be collected and examined to determine long-term trends and the possible impact of any policy changes that may be implemented following this study.

Upon examining the accident data, the researchers noted some recurrence of accident locations. As noted, fatigue is far from the only cause of accidents. A GIS mapping analysis of accident locations may prove beneficial in helping to identify physical or traffic-related issues that result in recurrent collisions.

References

American Public Transportation Association, *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*, September 2002, retrieved from http://www.apta.com/services/safety/fatigue/index.cfm, September 14, 2004.

National Center for Transportation Research, *Analysis of Florida Transit Bus Crashes*, June 2001, retrieved from http://ntl.bts.gov/lib/12000/12000/12048/Florida_Bus_Crash_Report.pdf , October 13, 2004.

National Center for Transportation Research, *National Transit Bus Accident Data Collection & Analysis*, retrieved from http://www.nctr.usf.edu/pdf/Nationa%20Transit%20Bus%20Accident%20Data%20Collection%20Analysis.pdf , October 19, 2004.

Appendix A

Implementation Plan

This study has addressed the safety implications of a matter of organizational policy, rather than a technical or engineering issue. As summarized on page 1 of the Polices and Procedures Section of the APTA report *Analysis of the Survey to Determine Status of the Transit Industry with Regard to Fatigue*, "Accident investigations are a way to uncover the extent to which fatigue may be a causal or contributing factor, but must contain questions to gather the appropriate information". It has been noted that, contemporaneous with this review, the DART First State accident investigation report form was amended to capture additional hours-worked and rest time data. The quality of the data derived from subsequent accident investigation reports should routinely be reviewed to ensure completeness and consistency.

In terms of scheduling, the responses to the APTA and IPA surveys cited in this report present clear evidence that the regulation of hours worked and/or hours of rest between shifts is prevalent in the transit industry. DART First State currently has no such limitations, and given that both scheduled and unscheduled overtime hours are currently distributed on the basis of seniority, the implementation of any work rules restricting access to overtime will undoubtedly be met with resistance. Operational necessity must also be accommodated. Absent a significant increase in the DART First State workforce, the need for overtime labor will continue to be a regular occurrence. It is therefore recommended that the focus of any policy change be clearly centered on the issue of accident prevention through driver fatigue reduction. Rather than implementing across-the-board limitations on the number of hours worked in a day or the number of off-duty hours between shifts, it may be more practical to amend current practice by limiting the scheduling of consecutive long-hour work days. A work day of 12 hours or more may be determined to be acceptable following an 8-hour day of work, or following or one or more days off, but would not be scheduled immediately following another long day. Hours worked during the previous day, or the previous 48-hour period, should also considered as a potential disqualifier for the assignment of unscheduled overtime.

Appendix B

Comparable Transit Operators Identified for Survey
(200-499 buses)

Albany, NY	CDTA (Capital District Transportation Authority)
Buffalo, NY	Metro (Niagara Frontier Transit Metro System, NFTMS)
Charlotte, NC	CATS (Charlotte Area Transit System)
Cincinnati, OH	SORTA/Metro (Southwest Ohio Regional Transit Authority)
Columbus, OH	COTA (Central Ohio Transit Authority)
Dayton, OH	**RTA (Greater Dayton Regional Transit Authority)**
Detroit, MI	SMART (Suburban Mobility Authority for Regional Transit)
Everett, WA	Community Transit (Snohomish County Public Transportation Benefit Area Corporation, CT)
Flint, MI	MTA (Mass Transportation Authority)
Garden City, NY	LIB (MTA Long Island Bus)
Hampton, VA	HRT (Transportation District Commission of Hampton Roads, Hampton Roads Transit)
Hartford, CT	Connecticut Transit (CTT)
Indianapolis, IN	IndyGo (Indianapolis Public Transportation Corporation)
Jacksonville, FL	JTA (Jacksonville Transportation Authority)
Kansas City, MO	ATA (Kansas City Area Transportation Authority)
Las Vegas, NV	CAT (Regional Transportation Commission of Southern Nevada, Citizens Area Transit)

Long Beach, CA	LBT (Long Beach Transit)
Louisville, KY	**TARC (Transit Authority of River City)**
Madison, WI	**Madison Metro (MM)**
Memphis, TN	MATA (Memphis Area Transit Authority)
Mount Vernon, NY	Bee Line (Westchester County Department of Transportation)
New Orleans, LA	RTA (New Orleans Regional Transit Authority)
Orlando, FL	LYNX (Central Florida Regional Transportation Authority)
Phoenix, AZ	PTD (City of Phoenix Public Transit Department)
Pompano Beach, FL	BCT (Broward County Division of Mass Transit)
Providence, RI	RIPTA (Rhode Island Public Transit Authority)
Rochester, NY	RTS (Regional Transit Service)
Rockville, MD	Ride On (Montgomery County Transit Services Division)
Sacramento, CA	**SRTD (Sacramento Regional Transit District)**
San Carlos, CA	SamTrans (San Mateo County Transit District)
San Diego, CA	**SDTC (San Diego Transit Corporation)**
San Francisco, CA	**GGT (Golden Gate Bridge, Highway & Transportation District)**
San Juan, PR	MBA (Metropolitan Bus Authority)
Santa Monica, CA	Big Blue Bus (Santa Monica's Big Blue Bus, BBB)
Tampa, FL	**Hartline (Hillsborough Area Regional Transit Authority)**
Toldeo, OH	TARTA- Toledo Area Regional Transit Authority

Tucson, AZ	SUN TRAN
West Covina, CA	Foothill Transit (FT)
Wichita, KS	Wichita Transit
Youngstown, OH	WRTA Youngstown

[**Bold Text** indicates respondents to the IPA survey]

Appendix C

Transit Accident Study Questionnaire

Administered by the University of Delaware's Institute for Public Administration (IPA) in conjunction with the Delaware Transit Corporation

1. What are the hours and days of operation for transit service?
2. Does the agency have fixed route and demand responsive transit service?
3. Does your agency have regulations, policies or protocols concerning driver fatigue?

   Yes □ No □
4. In investigations of on-road accidents/injuries/incidents does your agency ask questions regarding

   a) Hours on duty? .....Yes □ No □

   b) Hours off duty since prior shift? .....Yes □ No □

   c) Hours worked in prior week? .....Yes □ No □

   d) Any other fatigue-related questions? .....Yes □ No □

   If yes, please specify and/or attach questions:

   _____

   _____
5. a) Are your drivers restricted as to the length of time they can work in a day?

   Yes □ No □

   b) In a week?

   Yes □ No □

   c) In a month?

   Yes □ No □

   d) If yes, indicate the number of hours per period a driver can work.

   Day _____

   Week _____

   Month _____

   e) How many hours must a driver have off before he/she can return to work?

   _____

   f) What is the maximum allowable number of consecutive days a driver can work (if any)?

   _____

   g) Indicate the regulatory body, policy or statue that governs (a) through (f) above.
6. a) Are drivers entitled to have a certain number of days off per week?

Yes □ No □

b) How many?

_____

c) Are drivers entitled to have a certain number of days off per month?

Yes □ No □

d) How many?

_____

e) Are drivers entitled to have days off that are consecutive?

Yes □ No □

7. Must a driver take his/her regular days off?

Yes □ No □

8. a) Does your agency have shifts where drivers have a break of more than one hour (sometimes referred to as split shifts or swing assignments)?

If no, skip to question 9

Yes □ No □

b) What is the average length of the break for such assignments?

_____ hrs.

c) What is the average length of a split shift/swing assignment (total from start to finish)?

_____ hrs.

d) What is the longest split shift/swing assignment (total from start to finish)?

_____ hrs.

9. a) What is the average length of a non-split shift/swing assignment (total from start to finish)?

_____ hrs

b) What is the longest non-split shift/swing assignment (total from start to finish)?

_____ hrs

10. a) In making regular work assignment, is priority given by seniority?

Yes □ No □

b) Is unscheduled overtime usually assigned according to seniority, or is it equally distributed?

By seniority □ Equally distributed □ Other: □

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