SAFETY IMPLICATIONS OF TRANSIT OPERATOR SCHEDULE POLICIES (PHASE II)

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16. Abstract

This report presents Phase II of the Florida Transit research that was aimed at investigating the need to track external driving hours by transit operators. The same methodology used for Phase I was used with additional analysis on external driving hours. It is interesting to note that the findings of Phase II were in agreement with the results obtained in the first phase. About 15% of surveyed operators claimed to have a secondary driving job outside the transit agency. Only 17% of the operators with a secondary driving job indicated that they were part-time workers, suggesting that the majority of drivers who have external driving hours were full-time transit operators. This suggests a need to take measures to track external driving hours as the combined internal and external hours may be in violation of Rule 14-90. The study recommends implementation of an outside driving employment request form for operators to report any driving hours outside the transit agency. Consistent with Phase I of this research, it was found that operators with fewer split hours have a lower risk of being involved in preventable collisions compared to those who have longer splits between driving duties. It was observed that the collision risk doubled for each additional split hour and spiked significantly for splits of four hours or more. The study recommends that transit agencies should try to minimize the splits in order to reduce the extended long hours for transit operators. Interestingly, the study also found that fewer than 20% of operators involved in preventable collisions had fairly consistent shifts over the week leading up to the collision occurrence. Reducing the daily shift variability may enhance existing safety measures and reduce overall crash occurrences.

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EXECUTIVE SUMMARY

The Florida Department of Transportation recently sponsored a study that analyzed the safety impacts of transit operator schedule policies (Phase I). From the study, it was discovered that some operators have more than one driving job. This research (Phase II) focuses on the safety impacts of external part-time jobs where driving is the primary duty assignment. Thus, transit operators from several Florida agencies were surveyed to compile a list of drivers with part-time driving jobs apart from driving transit buses. How secondary driving jobs affect operator safety and performance is examined. The results of this research will be used in Rule 14-90, F.A.C. rule development discussions to make recommendations on tracking external driving hours by the transit agencies.

In addition to external driving hours, this project also analyzes split shifts and examines the possibility of using minimal suggested split hours as rest time. Recommendations on how and when to implement driver rest breaks are also discussed.

The research approach used in Phase I of this project was adopted for the present study. Two main research instruments were employed – questionnaire surveys and operator schedules, coupled with accident reports, from five Florida transit agencies: JTA (Jacksonville), LYNX (Orlando), HART (Tampa), MDT (Miami-Dade), StarMetro (Tallahassee). The survey was geared towards collecting information on external driving hours while the operator schedule data was used to determine the amount of split time that resulted in minimal effects on crash occurrence.

It is interesting to note that the findings of Phase II were in agreement with the results obtained in the first phase. About 15% of surveyed operators claimed to have a secondary driving job outside the transit agency. Only 17% of the operators with a secondary driving job indicated that they were part-time workers, suggesting that the majority of drivers who have external driving hours were full-time transit operators. These findings suggest a need to take measures to track external driving hours as the combined internal and external hours may be in violation of Rule 14-90. The study recommends implementation of an outside driving employment request form for operators to report any driving hours outside the transit agency. Consistent with Phase I of this research, it was found that operators with fewer split hours have a lower risk of being involved in preventable collisions compared to those who have longer splits between driving duties. It was observed that the collision risk doubled for each additional split hour and spiked significantly for splits of four hours or more. The study recommends that transit agencies should try to minimize the splits in order to reduce the extended long hours for transit operators. Interestingly, the study also found that fewer than 20% of operators involved in preventable collisions had fairly consistent shifts over the week leading up to the collision occurrence. Reducing the daily shift variability may enhance existing safety measures and reduce overall crash occurrences.

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1 INTRODUCTION

The Florida Department of Transportation recently sponsored a study that analyzed the safety impacts of transit operator schedule policies (Phase I). From the study, it was discovered that some operators have more than one driving job. A number of operators indicated that they drive school buses before starting their transit routes. Some operators also indicated that they drive other modes of transportation such as taxi cabs and UPS trucks/vans during their off-duty time. Currently, transit agencies are not required to track hours bus operators spend driving other modes of transportation as a second job. The primary concern with this practice is the additional driving hours worked outside the transit agency may result in a reduction of time available to the operator for rest. An operator can meet the on-duty maximum of 16 hours within a 24-hour period and the 12-hour driving requirement within a 24-hour period as outlined in Rule 14-90.006, Florida Administrative Code and go beyond these limits when driving for another company during their off-duty time. The focus of the present study, Phase II, is to examine the external working hours of transit operators where driving is the principal duty assignment.

In addition to tracking internal and external hours of driving, the FDOT identified a need to examine the importance of transit operator rest breaks during and between shifts extending beyond eight hours within a 24-hour period. It is widely known that driving performance (e.g., the ability to control, navigate, and guide) deteriorates after driving continuously for many hours. Literature on the length of time considered appropriate for rest breaks, intervals between breaks, and when a break should be scheduled is quite limited. This study explores the bus operator break issue and provides recommendations on how long and how often rest breaks should be, as well as when breaks should be scheduled during a transit operator's shift.

2 RESEARCH OBJECTIVE

This research focuses on the safety impacts of external part-time jobs where driving is the primary duty assignment. Thus, transit operators from several Florida agencies were surveyed to compile a list of drivers with part-time driving jobs apart from driving transit buses. How secondary driving jobs affect operator safety and performance is examined. The results of this research will be used in Rule 14-90, F.A.C. rule development discussions to make recommendations on tracking external driving hours by the transit agencies.

In addition to external driving hours, this project also analyzes split shifts and examines the possibility of using minimal suggested split hours as rest time. Recommendations on how and when to implement driver rest breaks are also discussed.

3 LITERATURE REVIEW

Literature on the effects of fatigue on transit safety is limited. However, there is a broad knowledge base on fatigue relating to other transportation modes such as rail, trucking, and aviation industries.

3.1 Effects of Fatigue in Trucking Industry

According to a study of long distance heavy vehicle drivers in Australia by Williamson et al. (2001), one fifth of the drivers reported at least one accident on their last trip related to fatigue. The study also indicated that one third of these drivers were not adhering to regulations on half of their trips.

A study by Gander et al. (2006) investigated the proportion of truck crashes involving fatigue of 130 truck drivers in New Zealand, who were involved in a total of 511 reported crashes. Drivers were asked to complete anonymous questionnaires related to their sleep history 72 hours prior to the crash occurrence. By using the statistical analysis in EPI-Info 6.04, Microsoft Access, SAS and SPSS, the author observed that approximately 11% of drivers were linked with two risk factors for fatigue, either having less than 6 hours of sleep or continuously awake for more than 12 hours in 24-hour day. Additionally, out of 102 crashes with sufficient data on physiological risk factors, 17.6% were related to at least one fatigue characteristic. However, due to the low response from the questionnaire, it was recommended that further questions about sleep habits be added to more effectively evaluate the influence of fatigue on truck crash rates.

3.2 Effects of Fatigue in Railroad Industry

Jolene Molitoris, the Administrator of the Federal Railroad Administration, indicated that approximately 33% of train incidents are caused by human factors, mostly influenced by fatigue. An interesting study conducted by Lamond et al. (2005) in Australia surveyed 15 operators on relay trips. The study found that operators working the early roster had 11.6 hours of sleep during their 42-hour relay trip while drivers working the late roster had 8.4 hours of sleep.

3.3 Effects of Fatigue in Aviation Industry

A project by the National Research Council titled “Effects of Commuting on Pilot Fatigue” outlined the correlation between fatigue and aviation accidents. A total of 863 accidents from 1982 to 2010 were recorded with about 11% of accidents involving fatigue, either as a probable cause or a contributing factor. However, due to the inadequate data about the effectiveness of regulations regarding pilot commutes, further research was recommended to harness more scientific tools and techniques to demonstrate the influence of fatigue on aviation safety.

3.4 Effects of Fatigue in Transit Industry

According to Federal Transit Administration, while accounting for 42.8% of transit passenger miles in 2007, buses were engaged in 51.9% of the industry's safety incidents, 77.8% of all collisions, and 62.3% of all injuries. Although 31.2% involving fatalities was under-represented, the bus safety incident rates has evidently increased. Strathman et al. (2010) reviewed 4,628 safety incidents from TriMet's Accident and Incident Tracking System for 2006 to 2009.

Surprisingly, the collision rate was 13.4% lower between 4 PM to 7 PM compared to other time blocks. The study indicated that maintaining schedules led to significant pressure that caused stress for the drivers. Also, the authors noted that the collision and non-collision risk is greater during overtime shift hours.

4 METHODOLOGY

The research approach used in Phase I of this project was adopted for the present study. Two main research instruments were employed – questionnaire surveys and operator schedules, coupled with accident reports, from five Florida transit agencies: JTA (Jacksonville), LYNX (Orlando), HART (Tampa), MDT (Miami-Dade), StarMetro (Tallahassee). The survey was geared towards collecting information on external driving hours while the operator schedule data was used to determine the amount of split time that resulted in minimal effects on crash occurrence. The two research methods are explained in further detail in the following sections.

4.1 Questionnaire Survey

Bus operators from each agency were surveyed using a questionnaire designed to gather information of activities performed during on-duty and off-duty hours. The objective of this questionnaire was to assess the adequacy of the minimum off-duty period of eight hours. Typical activities performed during the off-duty period may include operators traveling from work to home, eating, sleeping, preparing for work, and traveling back to work from home. The amount of sleep that a bus operator realizes would depend on the time it takes to perform off-duty activities. General questions such as the distance from home to work and the average hours of sleep per day were also included in the questionnaire. In addition, the survey collected information on how operators use break time during split shifts. This was done to determine whether the split time was used for resting in order to establish the relationship between the length of the break time and type of typical activities performed during the break.

4.2 Operator Schedule

Incident reports archived electronically by each transit agency were collected. Only collisions coded as *"*preventable*"* were examined. Preventable accidents are collisions which transit agency safety officials determine could have been prevented by the bus operator, regardless of who was at fault. Pertinent collision attributes such as operator information, time of crash, date of crash, and type of crash were also collected to enable additional analysis. Secondly, schedules of operators who were involved in preventable collisions were collected for analysis. Each record included total days worked, on-duty hours, driving hours, and time of reporting on and off duty.

5 DATA ANALYSIS

5.1 Questionnaire Survey

The questionnaire surveys were conducted from November 2012 to October 2013. The research team distributed the questionnaires on site typically in the waiting lounge where drivers meet before starting their daily schedules. Surveyors described the purpose of the study and guided respondents on completing the questionnaires only when operators needed clarification to survey questions. The questions were formulated to allow respondents to provide information on their daily routine without a need to collect additional information. A blank questionnaire is shown in Appendix A, and the survey results are provided in the following sections.

5.1.1 Split Shifts

There were a total of 410 questionnaires collected from the five participating Florida transit agencies. From the surveys, it was observed that over 21% of drivers, on average, complained about split shifts. Typical comments made by the operators expressed dislike of split shifts because it meant longer work days.

Short splits provided drivers a rest before resuming driving duty, while extensive splits provided operators with opportunity to perform other activities such as running errands or working a second job. Longer split durations also increased the total time spent at work, or shift time, leading to driver fatigue after the break, as well as, less rest and recovery time before the next work day. Table 5.1 shows the percentages of operators who commented on splits for each agency.

TABLE 5.1 Surveyed operators concerned with splits

Agency	Drivers Surveyed	Split Shift Comments	Percentage
Jacksonville (JTA)	49	12	24.5%
Orlando (LYNX)	58	22	37.3%
Tampa (HART)	97	27	27.8%
Miami-Dade (MDT)	144	14	9.7%
Tallahassee (StarMetro)	62	12	19.0%
Total	410	87	21.1%

Figure 5.1 graphically presents the percentage of operators surveyed that noted concerns with split shifts. It is interesting to note that operators in Miami-Dade had the least concerns about splits. Further consultation with Miami-Dade Transit agency officials revealed that operators at MDT are somewhat compensated during the split time. The guidelines for split shift compensation at MDT are shown in Appendix B.

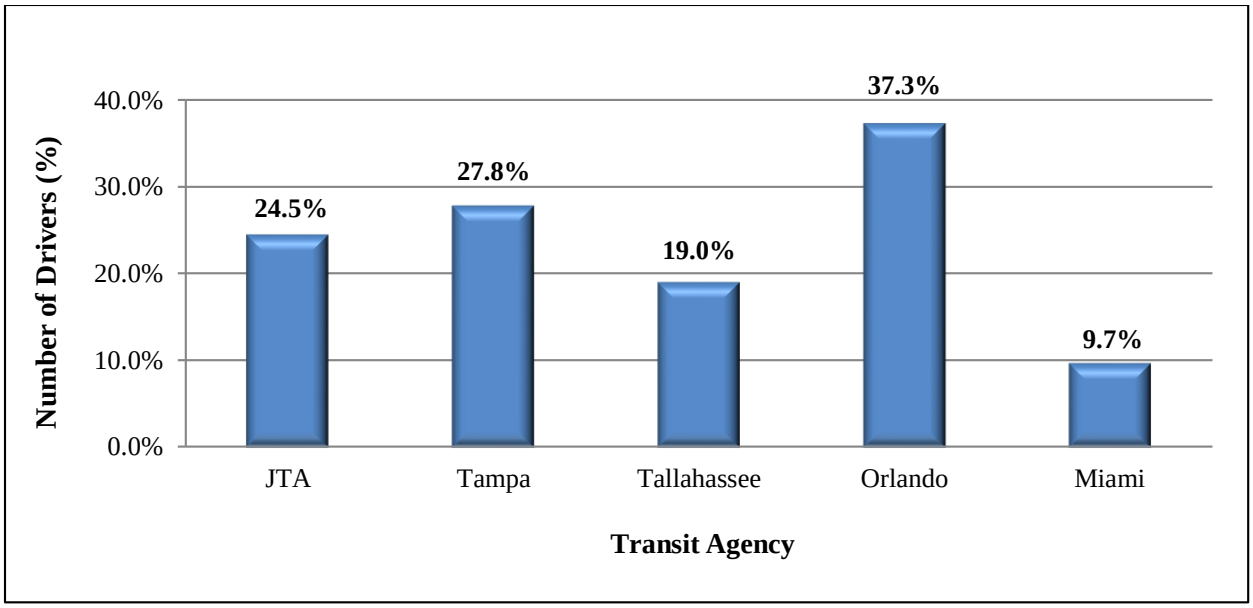

FIGURE 5.1 Percentage of divers concerned about splits

5.1.2 Operators with Secondary Driving Jobs

Responses from the survey questionnaire found that on average, about 15% of surveyed operators from the five Florida agencies also had a secondary driving job. Only 17% of the operators with a secondary driving job indicated that they were part-time workers, suggesting that the majority of drivers who had a second job, where the primary duty consisted of driving, were full time transit operators. Table 5.2 shows the number and percentage of surveyed drivers at each agency who claimed to have a second driving job. Interestingly, at StarMetro in Tallahassee, some operators listed the transit agency as being their secondary driving job.

TABLE 5.2 Percentage of drivers with secondary driving jobs

Agency	Total Surveyed	Drivers with 2nd driving job	Percentage	Part-time (drivers)	Percentage of Part-time
Jacksonville (JTA)	49	3	6.1%	0	0.0%
Orlando (LYNX)	58	11	19.0%	1	1.7%
Tampa (HART)	97	9	9.3%	0	0.0%
Miami Dade (MDT)	144	20	13.9%	5	3.5%
Tallahassee (StarMetro)	62	17	27.4%	4	6.5%
Total	410	60	14.6%	10	2.4%

Taken from the data summarized in Table 5.3, 40% of operators with external driving hours reported driving other bus types, typically school and church buses, as their secondary driving job. Secondary driving employment using delivery vehicles was reported to be just over 13%. Only a small percentage of operators reported to drive limousines and taxicabs as their second job. Moreover, 40% of surveyed operators listed the type of secondary driving job as "other".

Other modes may include driving duties such as taking seniors and disabled persons to appointments and shopping trips.

The proportion of operators who maintain a secondary driving job may be skewed in part by the operator's reluctance to list the transportation type for the secondary driving job, or may have incorrectly interpreted the question about their external work. Once analyzed, questionnaires viewed as incorrectly completed were not included in the results presented in Tables 5.2 and 5.3.

TABLE 5.3 Types of the secondary driving jobs

Type of transportation	Number of Drivers with Secondary Driving Job	Proportion
Taxi	1	1.7%
Bus	24	40.70
Limousine	3	5.0%
UPS/FEDEX Vans	8	13.3%
Other	24	40.0%

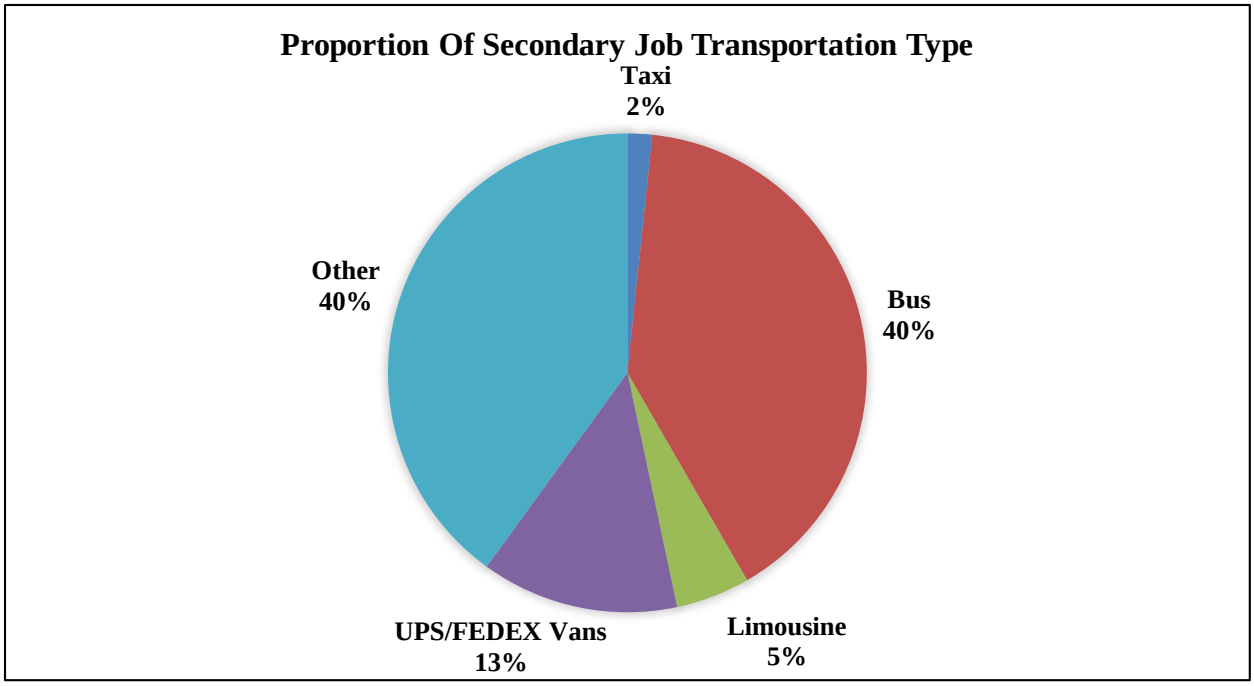

FIGURE 5.2 Reported types of secondary driving jobs

5.1.3 Daily Driving Time and Time Spent at Work

Schedules of operators with secondary driving jobs based on questionnaire responses were analyzed. Drivers in this group were then categorized in terms of daily driving hours and daily time spent at work, or shift duration, shown in Table 5.4. More than 53% of operators with external driving jobs spent eight hours or less per day driving for the transit agency, while only less than 42% of drivers spent eight hours or less per day at the transit agency. In other words, about 47% of operators with secondary driving jobs spent more than eight hours driving for the

transit agency, their primary job, and over 58% of the drivers with a secondary driving job spent more than eight hours at the transit agency. Approximately 38% of the operators in this group were at the transit agency for over 10 hours per shift while only 10% actually spent over 10 hours driving a transit bus. This trend indicates longer split times between driving duties. Overall, the data suggests that shift duration of operators with external driving jobs exceeded driving time at their primary job. Appropriately, the extended shift hours coupled with additional external driving hours generates safety concerns as to whether operators are allowing enough time to rest before the next driving day.

TABLE 5.4 Daily driving time vs. shift-time of drivers with secondary driving jobs

Daily hours	No. Drivers (Daily driving)	Proportion of Total	No. Drivers (Shift duration)	Proportion of Total
0-8	32	53.3%	25	41.7%
8.1-9	11	18.3%	6	10.0%
9.1-10	11	18.3%	6	10.0%
10.1-11	2	3.3%	2	3.3%
11.1-12	1	1.7%	8	13.3%
> 12	3	5.0%	13	21.7%

Figure 5.3 graphically illustrates the relationship between daily driving time and daily shift time for bus operators with external driving jobs. The proportion of operators on driving duty showed a decreasing trend as the number of hours increased. Alternatively, the time spent at work increased with shift durations greater than 10 hours per day. This trend depicts the effect of splits where extended work days may reduce rest time and contribute to driver fatigue.

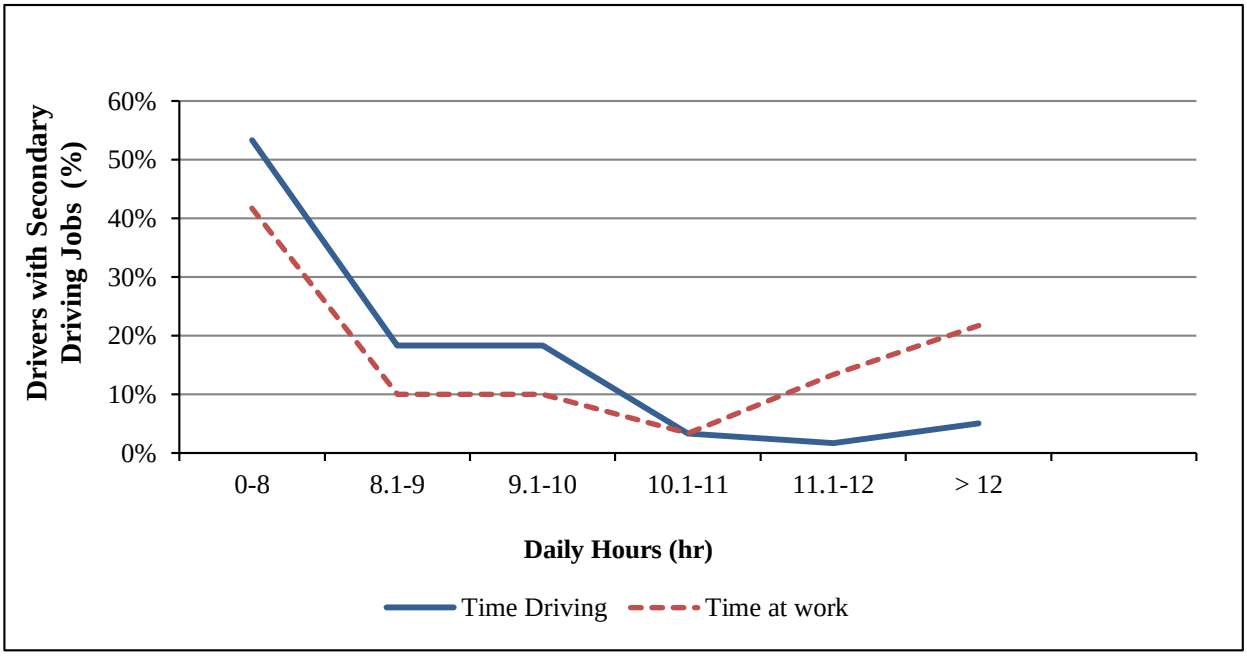

FIGURE 5.3 Surveyed drivers' shift time relative to driving time

5.2 Operator Schedule and Collision Analysis

5.2.1 Split Shifts

Collision data was collected from four Florida transit agencies (JTA, LYNX, HART, and MDT) producing a sample set of 569 bus drivers involved in preventable collisions. A comparison of the shifts operators had on the day of the collision is listed in Table 5.5. Overall, more than half (63.1%) of the operators involved in preventable collisions were working straight shifts at the time the collision occurred. Drivers working split shifts accounted for 36.9% of the sample set. This trend was present for all participating agencies except in Tampa (HART) where drivers working split shifts accounted for the majority of crash incidents. MDT displayed the largest proportion of drivers on straight-time involved in preventable accidents (69.3%) followed by the JTA at 66.1%. As shown in Figure 5.4, preventable collisions by operators working split shifts accounted for over one-third of all incidents analyzed.

TABLE 5.5 Drivers involved in preventable collisions with and without splits

Agency	Drivers Involved in Preventable Collisions				
	Total	Without split	Proportion	With split	Proportion
Jacksonville (JTA)	127	84	66.1%	43	33.9%
Orlando (LYNX)	137	88	64.2%	49	35.8%
Tampa (HART)	100	45	45.0%	55	55.0%
Miami-Dade (MDT)	205	142	69.3%	63	30.7%
Total	569	359	63.1%	210	36.9%

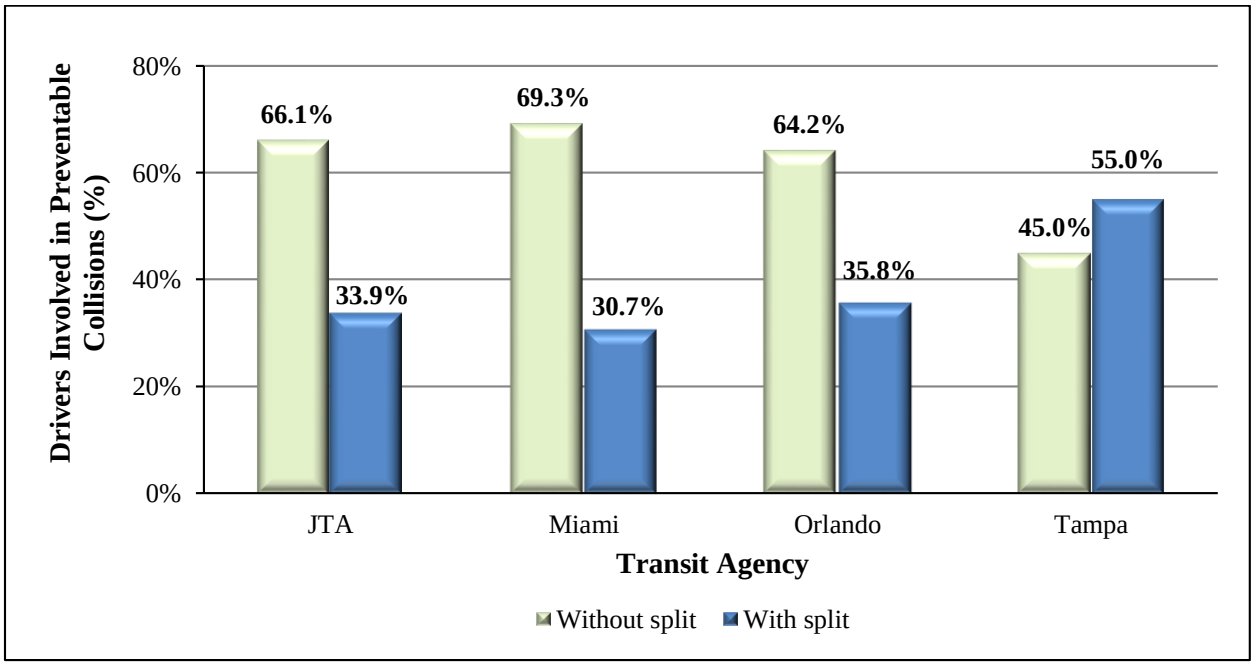

FIGURE 5.4 Drivers involved in preventable collisions with and without splits

5.2.2 Daily Driving Time and Time Spent at Work

Work schedules for the 569 bus operators involved in preventable collisions were reviewed to determine daily hours spent driving versus total recorded shift hours. The results, presented in Figure 5.5, show similarities to surveyed drivers with secondary driving jobs (Figure 5.3). Nearly 30% of operators had eight hours or less of daily drive time, and approximately 24% of drivers had eight hours or less recorded daily shift time. As shown in Figure 5.5, as the number of daily hours spent driving or at work increased, the percentage of drivers decreased. This result was expected since roughly 83% of the drivers involved in preventable collisions spent 10 hours or less driving per shift. However, 22.7% of the operators generally recorded shift hours greater than 10 hours per day. This variation suggests that split schedules with longer shift durations may increase driver fatigue and the propensity of bus collisions.

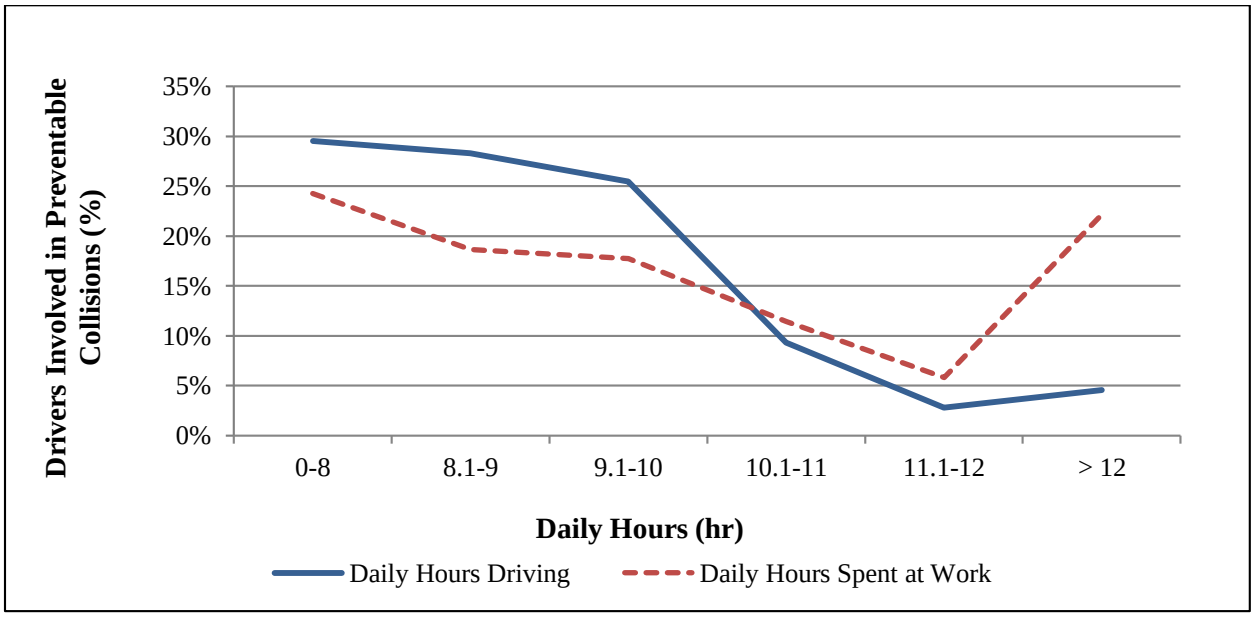

FIGURE 5.5 Daily working hours vs. total daily shift time

5.2.3 Time of Day

Collision data was analyzed by time of day and presented in Figure 5.6. The greatest percentage of preventable collisions (28.3%) occurred between the hours of 4 PM to 8 PM. Evening peak traffic volumes typically occur during these hours, yet fewer preventable collisions (16%) occurred during morning peak traffic volumes (4 AM to 8 AM) suggesting that fatigue may be a contributing factor in the higher rate of collisions that occurred later in the day. Drivers may become more tired as the day progresses, thus affecting their focus and reaction times. The lowest portion of preventable collisions (2.1%) occurred from midnight to 4 AM. This result appears reasonable since traffic volumes are generally lower during this period and fewer stops are required.

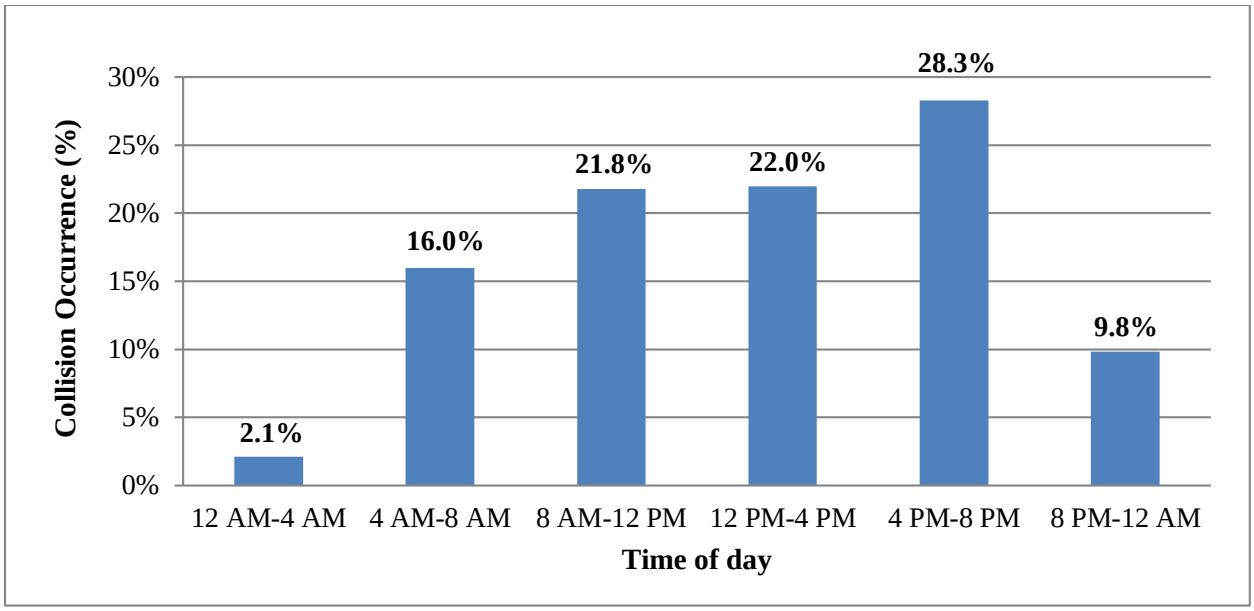

FIGURE 5.6 Collision occurrence by time of day

5.2.4 Day of Week

Collision data was also analyzed by day of week of occurrence. The results presented in Figure 5.7 indicate that preventable collisions occurred most often on a Monday, Friday, and Wednesday at 19.5%, 18.1%, and 16.0% respectively. Weekend days exhibited a comparable total of 19.4% of collisions combined reflecting a reduction in exposure. Interestingly, the number of crashes experienced on a Sunday almost equaled that of a Tuesday, and was double the number of collisions that occurred on a Saturday.

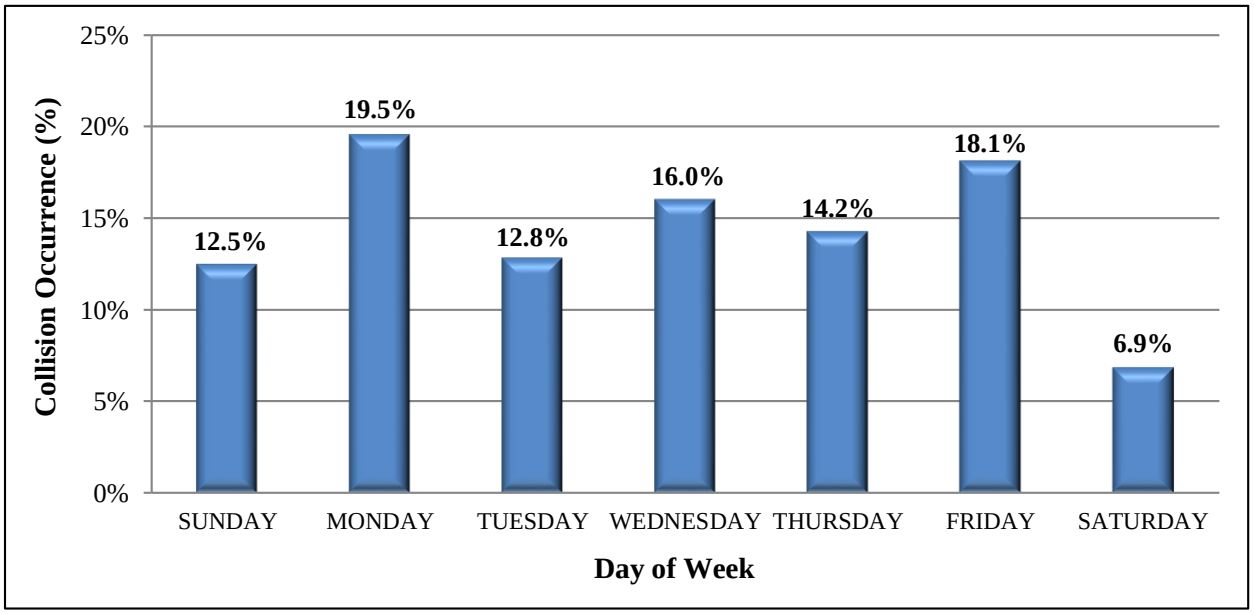

FIGURE 5.7 Collision occurrence by day of week

5.2.5 Split Time

To measure the consistency of split times, data was also obtained to analyze the number of similar split shifts operators involved in preventable collisions worked the week prior to the collision. Actual driving hours extracted from operator schedules archived at transit agencies were used for this analysis. Samples of operator schedules from each agency are shown in Appendix C. Figure 5.8 displays the frequency of split shifts worked the preceding week. Almost half (48.1%) of drivers worked only straight shifts (no split-time) the week before the collision. Of operators that worked splits, 12.4% had one or four similar split shifts the preceding week, and only a small fraction of drivers, 1.0%, worked consistent split shifts over six work days. Figure 5.8 illustrates the variation in operator shift schedules. Refer to Section 5.2.7 for further discussion on varying shifts.

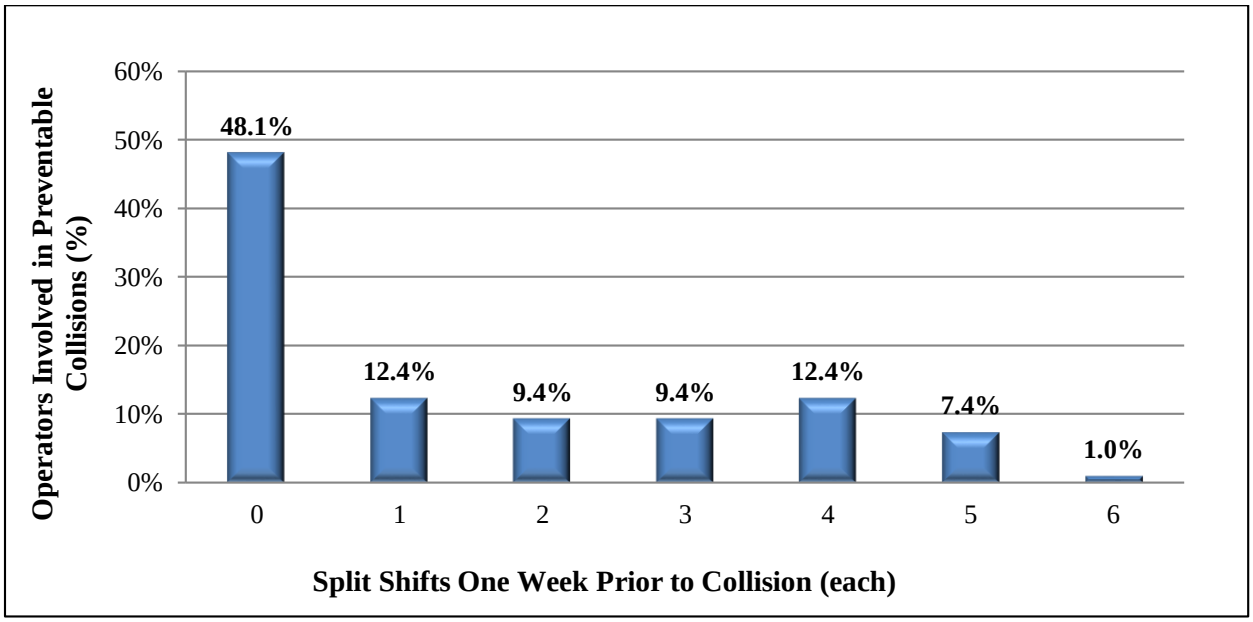

FIGURE 5.8 Split shifts the week before the collision

Work shifts on the day of the collision were also analyzed. As shown in Figure 5.9, over 63% of the operators involved in preventable collisions worked a straight shift on the day of the collision. The distribution of collision occurrences for drivers working split shifts was approximately normal, similar to one week prior to the collision. However, 15% of operators were working a straight shift at the time of the collision that had primarily worked split shifts the week before. Preventable collisions were less frequent when splits were less than one hour or four or more hours between driving periods.

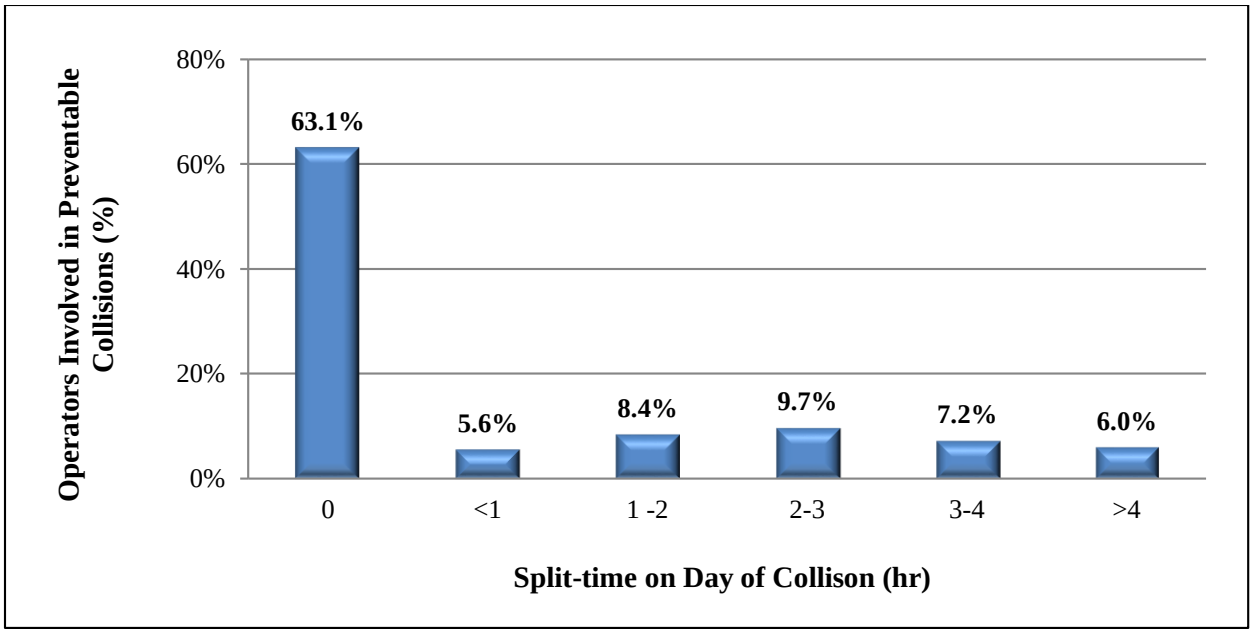

FIGURE 5.9 Split hours during the day of collision

5.2.6 Overrepresentation Analysis

An overrepresentation analysis was performed to compare the proportion of preventable collisions to the total driving hours by all operators for various splits. The results listed in Table 5.6, indicate that collision occurrences relative to total driving time generally increased with increasing split time. Although a low percentage (5.6%) of preventable collisions occurred during split shifts with one hour or less time between driving, shown in Figure 5.9, the ratio computed to be 1.81 due to the lower total driving hours. In other words, preventable collisions are 1.81 times more likely to occur during split shifts with a one hour or less between driving. The risk of crash occurrence increases dramatically for split times of four or more hours. Splits between one to two hours presented the lowest crash risk (0.94) outside of working straight shifts. Figure 5.10 graphically illustrates the collision rates relative to total daily driving hours.

TABLE 5.6 Collision proportion relative to driving time proportion

Split (hours)	Number of collisions	Collision Proportion	Total driving time (hours)	Time proportion	Collision proportion relative to driving time proportion
0	359	0.631	8959.6	0.848	0.74
0-1	32	0.056	329.1	0.031	1.81
1-2	48	0.084	943.3	0.089	0.94
2-3	55	0.097	242.6	0.023	4.21
3-4	41	0.072	79.0	0.007	9.64
>4	34	0.060	11.7	0.001	53.82
Total	569	1.00	10565	1.00	

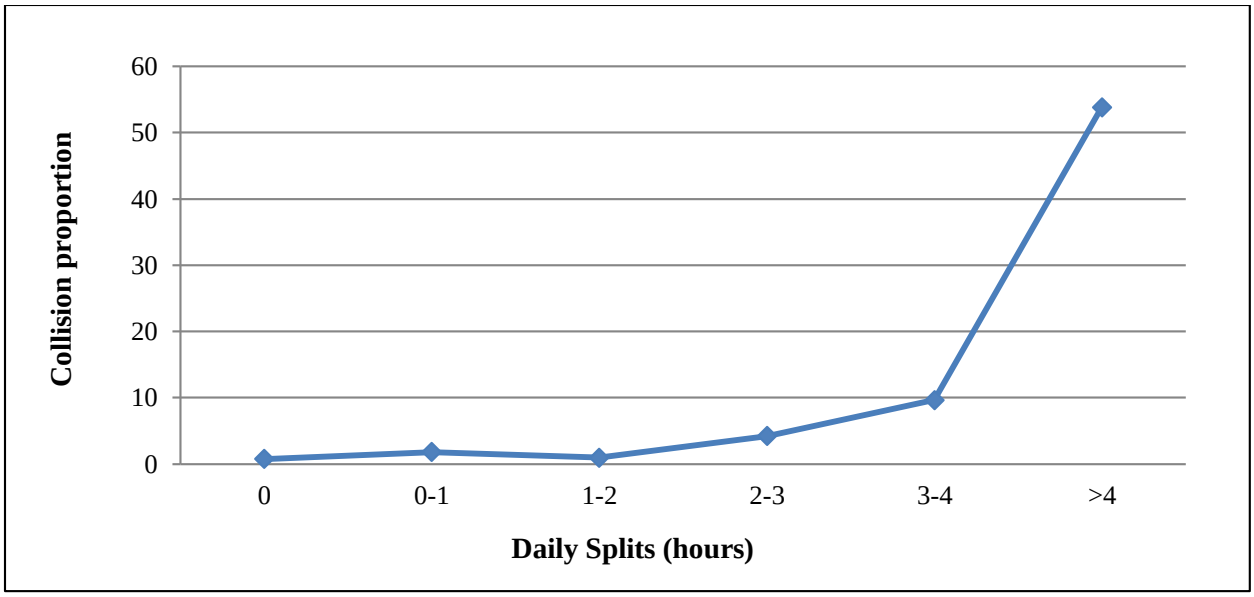

FIGURE 5.10 Collision proportion relative to exposure by daily split time

5.2.7 Shift Variance

From the descriptive analysis conducted on operator schedules one week prior to the collision (Section 5.2.5), it was observed that operator shifts greatly vary by day. Further analysis revealed that 72.6% of drivers involved in preventable collisions worked shifts that varied considerably each day. Less than one-third of drivers maintained consistent shift schedules. These findings are illustrated in Figure 5.11. More research is needed to examine the effects shift variance may present on collision occurrence.

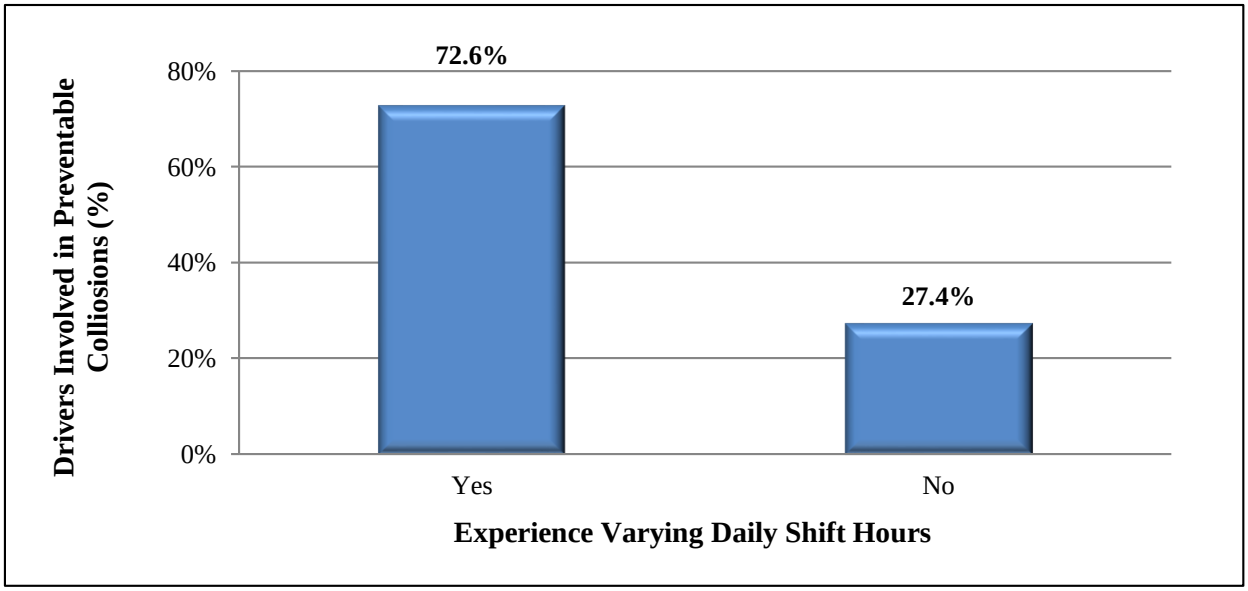

FIGURE 5.11 Operators with varying daily shift hours

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This research focuses on several issues concerning the transit industry today: the safety impacts of external part-time jobs where driving is the primary duty assignment and the effects of split shifts on bus operator rest time. Data was collected for the study from five transit agencies throughout the state of Florida, and included operator questionnaire surveys, collision data, and archived operator schedule data. Multiple analyses were applied to evaluate the influence of driving hours and splits on operators involved in preventable collisions. Study findings are summarized in the following sections.

6.1.1 Questionnaire Survey

A total of 410 survey questionnaires were obtained from operators at five Florida transit agencies. Over 21% of the drivers expressed dislike with split shifts primarily due to the extended work hours. The analysis also revealed that approximately 15% of operators surveyed claimed to have a secondary driving job outside the transit agency. School and church bus driving jobs constituted 40% of the external jobs while taxicabs, limousines, and delivery vans accounted for only 12%.

Only 17% of the operators with a secondary driving job indicated that they were part-time workers, suggesting that the majority of drivers who have external driving jobs were full time transit operators. The extended shift hours coupled with additional external driving hours can greatly reduce operator rest time, thus contributing to driver fatigue and collision occurrence. This suggests a need to take measures to track external driving hours as the combined internal and external hours may be in violation of Rule 14-90.

6.1.2 Operator Schedules and Collision Analysis

Shift schedules of operators involved in preventable collisions were analyzed using data obtained from four of the five participating Florida transit agencies contributing to this study. Findings revealed that preventable collisions by operators working split shifts accounted for over one-third (36.9%) of all incidents analyzed, with the majority of collisions occurring during straight shifts. Roughly 83% of the drivers involved in preventable collisions spent 10 hours or less driving per shift, yet 22.7% of the operators generally recorded shift durations greater than 10 hours per day. The data suggests that split schedules with longer shift durations may increase driver fatigue and the propensity of bus collisions. Further analyses determined that preventable collisions were more frequent late in the day between the hours of 4 PM to 8 PM where driver fatigue appears to be a plausible contributing factor. Preventable collisions also occurred most frequently on a Monday or a Friday during the week.

After examining the schedules from the day of the collision and one week prior, the degree of variability of daily shift schedules experienced by bus operators was discovered. Fewer than 20% of operators involved in preventable collisions had fairly consistent shifts over the week leading up to the collision occurrence. Although on the day of the collision, 63.1% of operators were working a straight shift, an overrepresentation analysis determined shifts with no splits held the lowest collision risk relative to total driving hours. For shifts containing splits, the collision risk generally doubled for each additional hour between driving duties, and spikes to five times

greater than the preceding hour risk for splits of four hours or more. Interestingly, splits over one hour but less than two hours in duration offer the least collision risk at 0.94 for split shifts.

6.2 Recommendations

6.2.1 Secondary Driving Jobs

The effects external driving jobs may have on allowing operators adequate time for rest and recovery is a valid concern for transit safety. However, tracking external job hours may prove difficult. The questionnaire survey employed in this study relied on voluntary submissions with the understanding that some drivers may not feel comfortable responding honestly to questions relating to secondary jobs. Therefore, it is recommended that each agency introduce a system allowing operators to declare secondary driving jobs and hours spent driving without repercussion. A sample outside employment request form used at Broward County Transit Authority is shown in Appendix D. Also, a special bidding process for drivers with external driving jobs can be established to enable operators and management to properly arrange shifts that allow for adequate rest and recovery time.

6.2.2 Split Time

Phase I of this study indicated that nearly 50% of bus operators use splits for purposes other than resting. Thus, long split times allow drivers to perform personal errands or secondary duties resulting in longer work days and less time for rest and recovery. In an effort to reduce driver fatigue, and consequently reduce the risk of collisions, findings from this study suggest splits between one to two hours in length. Additionally, reducing the daily shift variability may enhance existing safety measures and reduce overall crash occurrences.

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Appendix A

A Blank Questionnaire Survey

A Blank Questionnaire Survey

Questionnaire to solicit information on external hours - Hours working outside the transit agency

Survey guide for transit operators

The Florida Department of Transportation is sponsoring a follow up research project to evaluate the safety implications of transit operator schedule policies. The main objective of this study is to examine bus operator schedules to determine their duration length, length between split shifts, and layover durations to assess their impacts on transit vehicle accidents. Also, this research will evaluate the influence of external driving hours on transit safety.

FDOT Project Manager: Victor Wiley; Contact Info: victor.wiley@dot.state.fl.us; (850) 414-4525
Principal Investigator: Thobias Sando; Contact Info: t.sando@unf.edu; (904) 620-1142

This questionnaire is designed to guide a bus operator to provide his/her best knowledge on how he/she uses her time on a typical work day/week.

1. Are you a full time or part time employee? Full time ___Part time ___
2. How many hours during a 7-day work week are you on duty at the transit agency? _____;
3. How long is your average scheduled work day at the transit agency? (total hours from driving schedule)
4. How many hours, on average, do you spend at the transit agency? (include all time spent at the transit agency; route schedule, breaks, splits, layovers)
5. How many days during a 7-day work week are you on duty at the transit agency? _____;
6. How many hours per day do you perform other (employment related) driving duties outside the transit agency? _____. (2nd employment info; does not include personal driving time)
7. How many days per week do you perform other driving duties outside the transit agency? _____.
8. What type of external driving do you perform? Taxi [ ] School bus [ ] Limousine [ ] UPS/FEDEX Vans [ ] Other [ ] _____
9. Is your schedule fairly the same throughout the week? Yes_____ No_____
10. Do you work different shifts? Yes_____ No_____
11. Do you work split schedule? Yes_____ No_____
12. On average, how long is your split time between shifts? _____hours
13. How far from work do you live? _____ Miles (information requested in #5)
14. On average, how long does it take for you to travel from home to work? ____ Min/Hours (#5)
15. On average, how long does it take for you to travel from work to home? ____ Min/Hours
16. Any Comments/Remarks

_____
_____
_____
_____

Thank you for your participation in this important research aimed at enhancing safety and improving transit operations in the state of Florida.

Rule 14.90 F.A.C.-Definitions

"On Duty" means the status of the driver from the time he or she begins work, or is required to be in readiness to work, until the time the driver is relieved from work and all responsibility for performing work. "On Duty" includes all time spent by the driver as follows:

a) Waiting to be dispatched at bus transit system terminals, facilities, or other private or public property, unless the driver has been completely relieved from duty by the bus transit system.
(b) Inspecting, servicing, or conditioning any vehicle.
(c) Driving.
(d) Remaining in readiness to operate a vehicle (stand-by).
(e) Repairing, obtaining assistance, or remaining in attendance in or about a disabled vehicle.

"Drive" or "Operate" are terms which include all time spent at the controls of a bus in operation.

INFORMED CONSENT FORM

The Florida Department of Transportation is sponsoring a research project to evaluate the safety implications of transit operator schedule policies. The main objective of this research is to evaluate the influence of external driving hours on transit safety. Also, this study will examine bus operator schedules to determine their duration length, length between split shifts, and layover durations to assess their impacts on transit vehicle accidents. The outcome of this study will be used by transportation officials from state to local transit agencies in determining how best to schedule bus operator hours in order to improve highway safety. Please complete a short survey which should take less than 5 minutes.

The University of North Florida (UNF) is the source of this research. Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits to which you are entitled. The information you are providing is anonymous. More information about the project is available from the project manager and the principal investigator who can be reached using the following email addresses and phone numbers.

FDOT Project Manager: Victor Wiley; Contact Info: victor.wiley@dot.state.fl.us; (850) 414-4525
Principal Investigator: Thobias Sando; Contact Info: t.sando@unf.edu; (904) 620-1142

For questions regarding the rights of research subjects feel free to contact the chair of the UNF Institutional Review Board, (904) 620-2498. There are no reasonably foreseeable risks or discomforts to the subject. Your participation will potentially contribute to a body of knowledge. No monetary or other compensation or inducements will be awarded. By participating in this survey you certify that you are over 18 years old.

If you wish to participate, please tell the researcher or please take a survey and put it in the box when you are done.

Appendix B

Miami-Dade Split-time Pay Description

Miami-Dade Split-time Pay Description

From: Perez, Joel (MDT)
Sent: Thursday, October 17, 2013 12:20 PM
To: Smerling, Barry (MDT)
Cc: sando@unf.edu
Subject: RE: Question on Split schedules

Below is the portion of the contract that explains the difference between a split and a combination. We pay for the time in between a split if the intervene time is greater than 90 minutes

A **split run** consists of two parts and each part may be on a different route. On split runs, intervening time in excess of 90 minutes will be paid at straight time. The minimum unpaid intervening time will be 30 minutes.

Wait and travel on a split run where each part is on a different route will be based on last available bus plus wait time at relief point for next bus.

Eighty (80) per cent of the regular runs shall be straight runs and twenty (20) per cent may be splits.

(o) **Combination Runs** --It is the expressed intend of the parties to develop additional work schedule procedures which will result in pre-assigning as much work as practical on a daily or weekly basis.

M.D.T. will develop, in addition to the regular runs heretofore described, a group of Combination Runs. These runs shall be scheduled and paid as follows:

Runs shall include fifteen (15) minutes bus preparation time for each piece of work comprising the combination plus a maximum of eight and one-half (8 ½) platform hours within a total elapsed time of twelve hours.

Work beyond the twelfth hour will be at overtime in all cases.

When platform time within the 12 hour spread exceeds 8 hours, daily overtime guarantee applies. Pay for combination runs will be a minimum of 45 hours of pay at straight time rate.

For example, the pay for a week could be made up of the following:

(1)	41.25	Hours of work time
	2.50	Hours of report time
	1.25	Hours overtime premium pay
	45.00	Hours at straight time rate
(2)	37.00	Hours of work time
	2.50	Hours of report time
	5.50	Hours of paid unassigned time
	45.00	Hours of straight time rate

Should an operator with paid unassigned time in his/her daily work schedule desire to work during the intervening period of his/her combination run, overtime or added pay will begin after paid unassigned time for that day is made up by work time. Any work performed at either end of the combination run will come under the daily overtime provision of this Agreement.

If an operator with a combination run, which has paid unassigned time, works an assignment which is authorized by the Dispatcher, a Supervisor or Starter during his/her intervening period, payment for such work will be above his/her run pay at the applicable rate of pay. If an operator is late returning to the garage at the end of his/her combination, he shall be paid above his/her run pay at the applicable rate of pay.

Appendix C

Sample Operator Schedule Format

Sample Operator Schedule Format

05/17/2011 Tuesday FT FT5 Scheduled to work

09:45M 11:28M 1.63 0.08 0.00 0.00 1.72

14:33M 21:38M 6.83 0.25 0.00 0.00 7.08

----- ----- ----- ----- -----

8.47 0.33 0.00 0.00 8.80

Piece Details: Platform: 8.47 Report: 0.25 Travel : 0.08

Run Totals: Overtime: 0.40 (0.80)

Total Work Pay: 9.20

--> Total of time entries using (whole) times: 9.60

FIGURE A.1 A Sample of Operator's Driving Schedule at JTA

Division	Work Type	Run Type	Work Name	Piece Num	Sign On	From Time	To Time	Sign Off	Date	Work Time	Platform Time	Report Time	Comments	
	Day Off		Day Off						2010-10-10					
			UnAssigned						2010-10-11	0	0			
			UnAssigned						2010-10-12	0	0			
	Run	AM STR		1	4:17a	4:27a	11:46a	11:46a	2010-10-13	7h29	7h19	10		Bid
			Total						2010-10-13	7h29	7h19	10		
	Run	AM STR		1	4:17a	4:27a	11:46a	11:46a	2010-10-14	7h29	7h19	10		Bid
			Total						2010-10-14	7h29	7h19	10		
	Run	10 AM STR		1	5:08a	5:18a	3:21p	3:21p	2010-10-15	10h13	10h03	10		Bid
	ExtraPay			1		3:21p	3:27p		2010-10-15	6	6		Heavy Traffic	
			Total						2010-10-15	10h19	10h09	10		
	Day Off		Day Off						2010-10-16					
	Day Off		Day Off						2010-10-17					
	Run	AM STR		1	4:18a	4:28a	12:01p	12:01p	2010-10-18	7h43	7h33	10		Bid
	ExtraPay		OTHER	1		12:01p	12:07p		2010-10-18	6	6		Other Time	
			Total						2010-10-18	7h49	7h39	10		
	Run	AM STR		1	4:17a	4:27a	11:46a	11:46a	2010-10-19	7h29	7h19	10		Bid
			Total						2010-10-19	7h29	7h19	10		
	Run	AM STR		1	4:17a	4:27a	11:46a	11:46a	2010-10-20	7h29	7h19	10		Bid
			Total						2010-10-20	7h29	7h19	10		
	Run	AM STR		1	4:17a	4:27a	11:46a	11:46a	2010-10-21	7h29	7h19	10		Bid
	ExtraPay			1		11:46a	12:01p		2010-10-21	15			Accident ReportTime	
			Total						2010-10-21	7h44	7h19	10		
	Run	10 AM STR		1	5:08a	5:18a	3:21p	3:21p	2010-10-22	10h13	10h03	10		Bid
			Total						2010-10-22	10h13	10h03	10		
	Day Off		Day Off						2010-10-23					

FIGURE A.2 A Sample of Operator's Driving Schedule at LYNX

```
02/21/2010 Sunday  FT  FTXB  Regular Day Off
(Extraboard)
Daily P/R Totals not created for this employee on this day
-------------------------------------------------------------------------------
02/22/2010 Monday  FT  FTXB  Scheduled to work
(Extraboard)
                           01:05P 04:15P        3:00  0:00  0:10  0:00  3:10
                           06:15P 11:00P        4:30  0:15  0:00  0:00  4:45
 -->Actual where different:                                          0:30  5:15

                                                ----- ----- ----- ----- -----
                                                7:30  0:15  0:10  0:30  8:25
Piece Details:  Accident/Incident:   0:30  Platform:   7:30  Report:   0:15
      Travel:   0:10
Run Totals: Make Up (Pad):   0:05
Calculated Totals: Accident/Incident OT:  00:15.00 ( 0:30)
                                                        Total Work Pay:  8:45
```

FIGURE A.3 A Sample of Operator's Driving Schedule at HART

Dispatch Date	Garage Nbr	Badge Nbr	Route Nbr		Run Nbr	Run Type	Start Time	End Time	Finished Time	Report Time		Micl Time
26-Apr-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	9966
27-Apr-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	9966
28-Apr-12	NE		3	05966-02	05	12.38	16.19	16.19	12.23		-	2136
28-Apr-12	NE		H	05966-01	05	6.14	11.06	11.06	5.59		-	2136
29-Apr-12	NE		17	06257-01	05	6.42	12.33	12.33	6.27		-	9966
1-May-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	9967
2-May-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	9966
3-May-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	9966
4-May-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	2137
5-May-12	NE		77	05952-02	05	16.52	19.09	19.09	16.37		-	0
5-May-12	NE		3	05966-02	05	12.38	16.19	16.19	12.23		-	9977
5-May-12	NE		H	05966-01	05	6.14	11.06	11.06	5.59		-	9977
8-May-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	9966
9-May-12	NE		75	05183-01	03	5.32	14.47	14.57	5.17		-	9966
10-May-12	NE		75	05183-	03	11.06	14.47	14.57	11.06		-	9966
10-May-12	NE		75	05183-01	03	5.32	11.06	11.06	5.17		-	9966

Records Count: 16

FIGURE A.4 A Sample of Operator's Driving Schedule at MIAMI-DADE

Appendix D

Sample Broward External Work Form

Sample Broward External Work Form

Board of County Commissioners, Broward County, Florida
HUMAN RESOURCES DIVISION

OUTSIDE EMPLOYMENT REQUEST FORM

TO: _____
DIVISION/OFFICE/DEPARTMENT DIRECTOR

FROM: _____ _____ _____
NAME OF EMPLOYEE TITLE DIVISION/OFFICE/DEPARTMENT

ALL EMPLOYEES MUST COMPLETE THIS FORM, WHETHER OR NOT THEY SEEK TO ENGAGE IN OUTSIDE EMPLOYMENT.

County employees who seek to engage in outside employment may do so upon completing this form and obtaining the written approval of their division, department, or office director (as applicable). For purposes of this form, "outside employment" means:

1. Any compensated employment performed by a County employee aside from his or her employment with the County, including any part-time employment, self-employment, or consultant-related employment; or

2. Serving as an officer, director, or registered agent, or in any similar capacity, with or without compensation, for any for-profit or not-for-profit business entity that:
   a. Is a County vendor under contract with the County, or a prospective vendor seeking to do business with the County; or
   b. Receives, directly or indirectly, any grants, loans, or other County funds that are made available through any agency of the County, or is an applicant for any such County funds.

Please place a checkmark next to the applicable provision below:

○ (1) I am not engaged in any outside employment as defined above. Should I wish to engage in any outside employment at any time in the future, I will complete and submit an updated Outside Employment Request Form to my supervisor prior to engaging in such outside employment.

○ (2) I request permission to engage in outside employment as defined above.

If you checked provision (1), please proceed to the back of this form and sign on the "employee signature' line. If you checked provision (2), you must provide the following information (attach additional sheets if necessary), proceed to the back of this page and sign.

Name of Firm: _____

Location of Outside Employment: _____

Outside Employment Contact Telephone Number: _____

Type of Outside Employment:

☐ Compensated or ☐ Uncompensated

Period of Outside Employment: Start: _____ End: _____

My Hours of Outside Work: _____

Brief Statement of Outside Duties: _____

_____

Outside Employment Position/Title: _____

Form 102-113 (rev 5/11) Page 1 of 2

The undersigned understands that the following provisions relate to outside employment and conflicts of interest of County employees:

1. Florida Statutes, Sections 112.311 to 112.326, Code of Ethics for Public Officers and Employees.
2. Broward County Code of Ordinances, Sections 26-67 through 26.80.
3. Broward County Administrative Code, Section 14.249 through 14.253, Ethics and Conflict of Interest for the County Civil Service Rules and Regulations.
4. Broward County Administrative Code, Section 1.11(v).
5. Administrative Order #400, Human Resources Internal Control Handbook.

The undersigned represents and acknowledges that:

1. Any proposed outside employment will not interfere with the efficient performance of the undersigned's regular County duties, and will not occur during regular or assigned working hours unless applicable leave is requested and approved to cover the absence.
2. Any proposed outside employment will not involve a conflict of interest or otherwise conflict with any of the undersigned's responsibilities as a County employee.
3. Any proposed outside employment will not involve the performance of maintenance or other work to the personal or real property of a managerial-level County employee or County elected official or anyone in the employee's chain of command.
4. Any proposed outside employment does not involve the undersigned lobbying, on behalf of an outside principal or employer for compensation, County Commissioners, members of any County Selection/Evaluation committee, or the governmental unit in which he or she is employed.
5. Approvals of any proposed outside employment are only for the specific employer and type of work disclosed by the undersigned. If any change in employer or type of work (including a change in hours) occurs, a new Outside Employment Request Form must be completed, submitted and approved. An employee wishing to engage in more than one form of outside employment must complete a separate Outside Employment Request Form for each form of outside employment being requested.
6. The County has the right to rescind outside employment approval at any time upon written notice.
7. Any violation of the above provisions, including any of the provisions of the laws or rules applicable to outside employment, is subject to appropriate corrective and/or disciplinary action including, where appropriate, discharge from County employment.

For further information or questions, please contact the Broward County Human Resources Division.

I represent that the information provided above is true and correct, and that I understand all applicable laws, rules, procedures, policies and other provisions governing outside employment. I also understand that any approval of this request for outside employment cancels all other approvals for outside employment unless expressly stated herein.

Employee Signature:_____ **Date:** _____

Division/Office/Department Director: Check one of the three options below:

☐ Approved ☐ Approved with Restrictions ☐ Denied

Signature:_____ Date: _____

RESTRICTIONS OF APPROVAL (if any):

REASON FOR DENIAL (if applicable):