

Safety Implications of Transit Operator Schedule Policies – Phase II



Phase I Overview

- Driver fatigue leading Bus safety issue
- 6 Florida Agencies used in Study
- Questionnaire Survey Results
 - Straight shift mean elapsed work time = 10.33 hr
 - Split-shift mean elapsed work time = 13.77 hr
 - Drivers more likely to use split-time for personal activities
 - Split-shift drivers average fewer sleeps hours

Phase I Overview

- Operator schedules collected
- Crash/Incident reports reviewed
- Analysis Results:
 - Preventable collisions more likely: 1 PM – 7 PM
 - Highest occurrence between 1 PM to 3 PM
 - Highest occurrence on Wednesdays followed by Mondays
 - Probability highest for Split-shift Weekly Driving hours > 50 hr or Daily Driving hours > 11 hr

Phase I Overview

- Recommendations
 - Minimize length of splits
 - Maximum of 10 hours per day driving
 - Maximum 60 hours per 7 consecutive day

Objective

- Examine the effects of additional hours driving outside the transit agency on fatigue
- Examine the effects of split-time schedules on Operator fatigue
- Estimate an optimum daily split-time

Research

Long Hours of Work Lead to Fatigue

- Degrades
 - Performance
 - Alertness
 - Concentration
- Increases Safety Risks

Research

Influence of Fatigue on Transit Safety

- *Federal Transit Administration (2007)*
 - Buses accounted for 51.9% of industry safety incidents
 - 77.8% of all collisions
 - 62.3% of all injuries
- *Strathman et al. (2010)*
 - Maintaining schedules resulted in significant pressure and stress for Operators

Research

Other Modes of Transportation

- Railroad and Airline Literature
- Trucking Industry
 - *Williamson et al. (2001)* – 1/5 of Drivers involved in a fatigue related collision
 - *Gander et al. (2006)* – 17.6% of collisions studied were associated with fatigue factors

Data Collection

- Florida Agencies Selected (5):
 - Jacksonville (JTA)
 - Orlando (LYNX)
 - Tampa (HART)
 - Miami Dade (MDT)
 - Tallahassee (StarMetro)

Data Collection

- Operator Schedules
 - Drivers involved in a preventable accident
 - All drivers
- Questionnaire survey

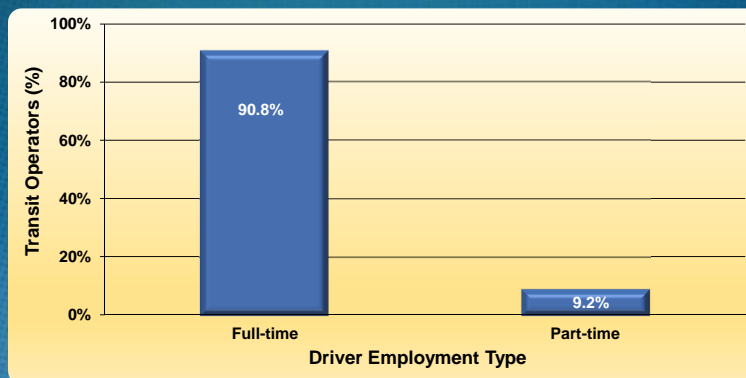
Data Collection

Collection Results

| Agency | No. of Drivers | | |
|-------------------------|-----------------------------------|------------------|-------------------|
| | Involved in Preventable Accidents | Completed Survey | Total All Drivers |
| Jacksonville (JTA) | 127 | 49 | 350 |
| Orlando (LYNX) | 137 | 58 | 363 |
| Tampa (HART) | 100 | 97 | 329 |
| Miami Dade (MDT) | 205 | 144 | 608 |
| Tallahassee (StarMetro) | 104 | 62 | -- |
| Total | 673 | 410 | 1650 |

Data Collection

Combined Agency Operators



Survey data

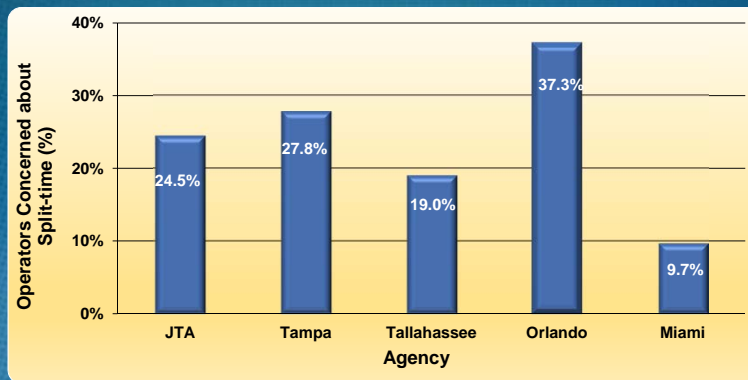
Split-time Questionnaire Results

- Noticeable concerns with Split-shifts

| Agency | Drivers Surveyed | Split-time Comments | Percentage |
|-------------------------|------------------|---------------------|------------|
| Jacksonville (JTA) | 49 | 12 | 24.5% |
| Orlando (LYNX) | 59 | 22 | 37.3% |
| Tampa (HART) | 97 | 27 | 27.8% |
| Miami Dade (MDT) | 144 | 14 | 9.7% |
| Tallahassee (StarMetro) | 63 | 12 | 19.0% |
| Total | 412 | 87 | 21.1% |

Survey data

Percentage of Drivers concerned about Split-time



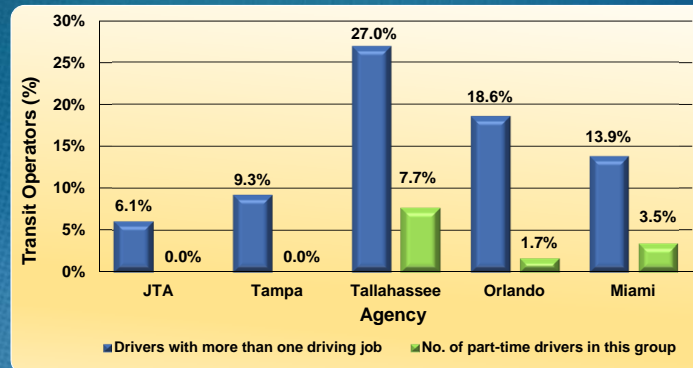
Survey data

Operators with secondary driving job

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

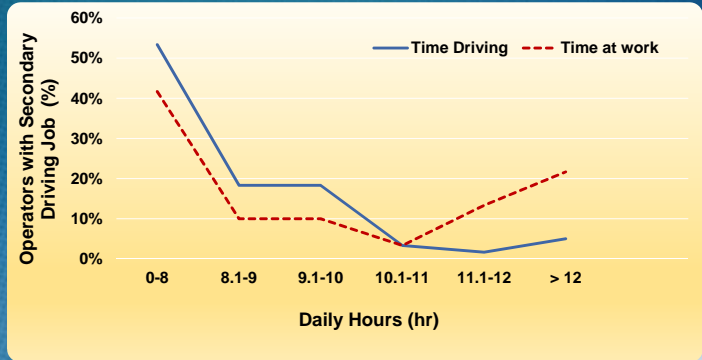
Survey data

Proportion of All Operators with secondary driving jobs



Survey data

Daily hours of driving time and time spent at work by drivers with secondary driving jobs



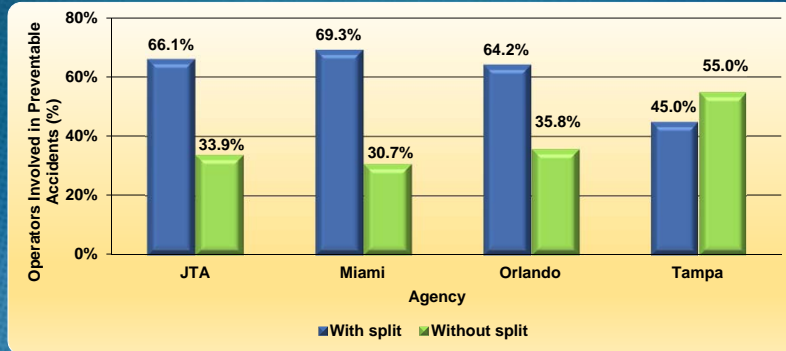
Schedule data

Drivers' schedules during week of accident occurrence

| Agency | Drivers involved in accidents | | | | |
|-------------------------|-------------------------------|------------|--------------|---------------|--------------|
| | Fleet size | With split | Proportion | Without 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% |
| Tallahassee (StarMetro) | -- | -- | -- | -- | -- |
| Total | 569 | 359 | 63.1% | 210 | 36.9% |

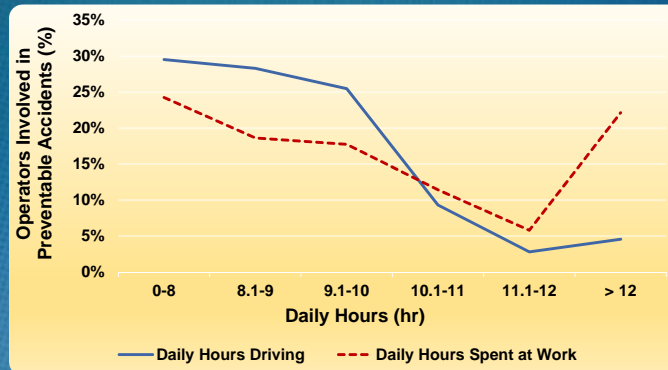
Schedule data

Drivers involved in accidents with and without split-shifts



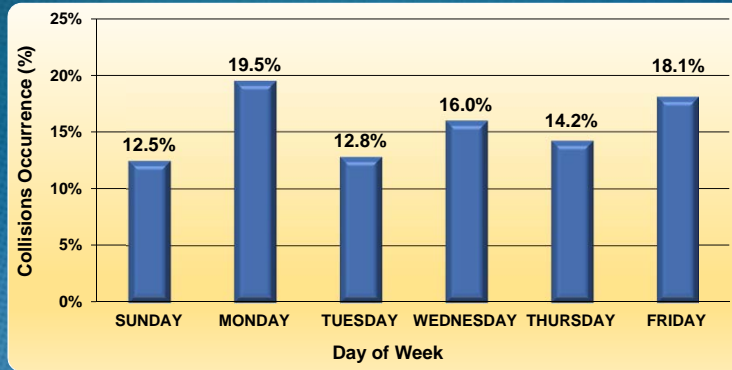
Schedule data

Daily Hours spent Driving compared to Daily Hours Spent at Work



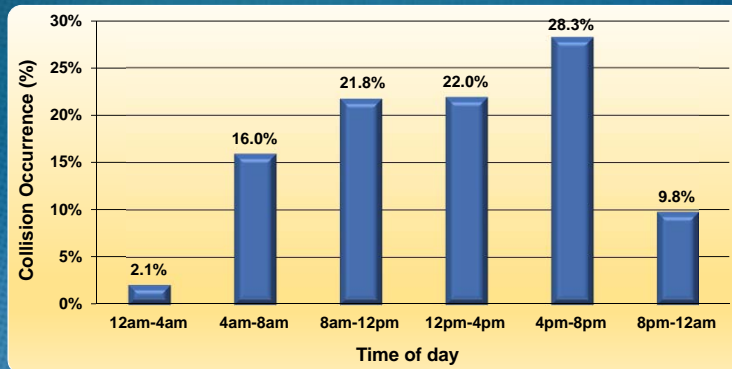
Schedule data

Collision Occurrences by Day of Week



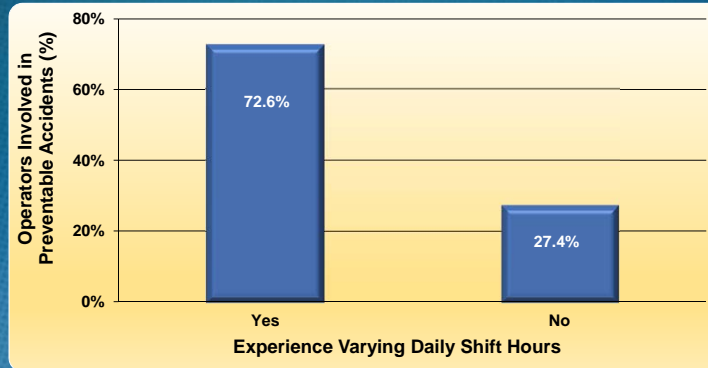
Schedule data

Collision Occurrences by Time of Day



Schedule data

Operators with Varying Daily Shift Hours



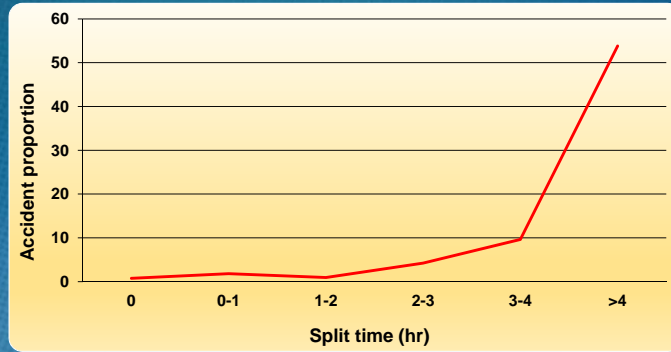
Schedule data

Accident Proportion Relative to Driving Time Proportion

| Split time (hr) | Number of Accidents | Accident proportion | Total Driving time (hr) | Time proportion | Accident proportion relative to time proportion |
|-----------------|---------------------|---------------------|-------------------------|-----------------|---|
| 0 | 359 | 0.63 | 8959.6 | 0.85 | 0.74 |
| 0-1 | 32 | 0.06 | 329.1 | 0.03 | 1.81 |
| 1-2 | 48 | 0.08 | 943.3 | 0.09 | 0.94 |
| 2-3 | 55 | 0.10 | 242.6 | 0.02 | 4.21 |
| 3-4 | 41 | 0.07 | 79.0 | 0.01 | 9.64 |
| >4 | 34 | 0.06 | 11.7 | 0.00 | 53.82 |
| Total | 569 | 1.00 | 10565 | 1.00 | |

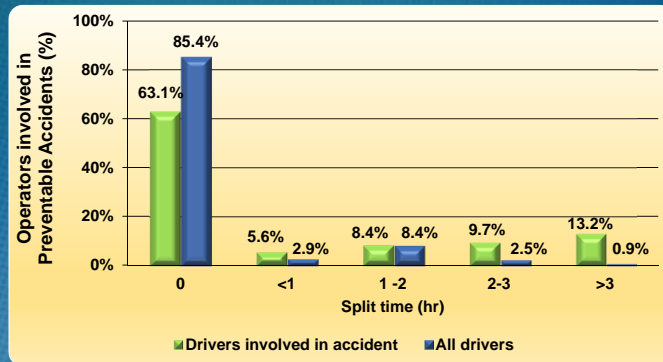
Schedule data

Accident Proportion Relative to Exposure by Daily Split-time



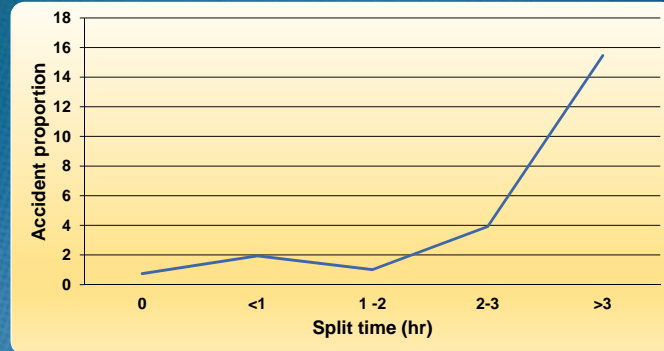
Schedule data

Operators involved in Accidents Relative to Split-time



Schedule data

Operators Involved in Accident Relative to Exposure by Daily Split-time

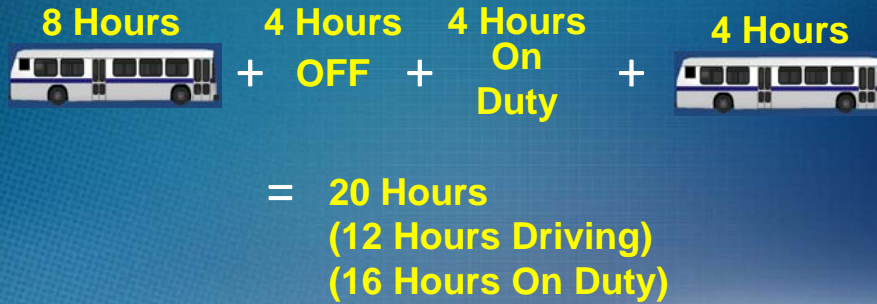


Schedule data - Remarks

- Operators involved in accidents spend longer hours at work than actual driving time
- Collisions occurred most frequently between 4 PM – 6 PM
- Greater propensity for accidents with different shifts
- Longer shifts increase accident rate
- Favorable split-time duration of 1 to 2 hours

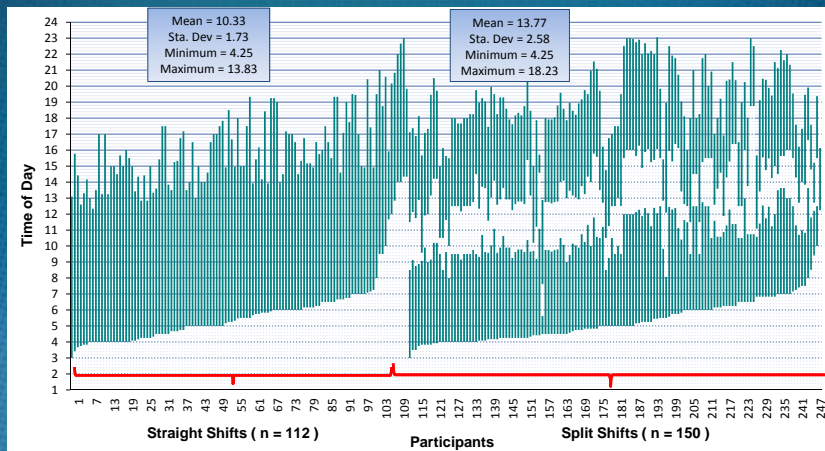
Regulations

Worst Case Scenario



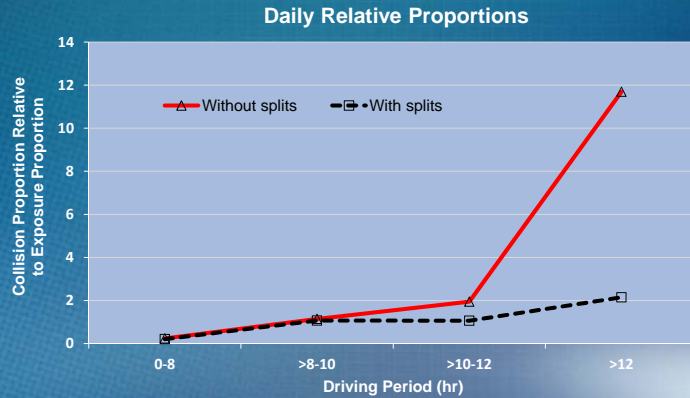
Questionnaire

Elapsed Time Arriving to Leaving from Work



Overrepresentation

A Spike is Observed for Driving hrs > 10 hrs per Day



Research

| Federal regulation for property-carrying CMV drivers | Federal regulation for interstate passenger-carrying CMV drivers | Florida Regulation for bus transit (Rule 14-90) |
|---|--|--|
| 11-Hour Driving Limit May drive a maximum of 11 hours after 10 consecutive hours off duty. | 10-Hour Driving Limit May drive a maximum of 10 hours after 8 consecutive hours off duty. | 12-hour driving limit a driver shall not be permitted or required to drive more than 12-hours in any one 24-hour period |
| 14-Hour On-Duty Limit May not drive beyond the 14th consecutive hour after coming on duty, following 10 consecutive hours off duty. Off-duty time does not extend the 14-hour period. | 15-Hour On-Duty Limit May not drive after having been on duty for 15 hours, following 8 consecutive hours off duty. Off-duty time is not included in the 15-hour period. | 16-Hour On-Duty Limit May not drive after having been on duty for 16 hours, in any one 24-hour period. Off-duty time is not included in the 15-hour period. |
| 60/70-Hour On-Duty Limit May not drive after 60/70 hours on duty in 7/8 consecutive days. A driver may restart a 7/8 consecutive day period after taking 34 or more consecutive hours off duty. | 60/70-Hour On-Duty Limit May not drive after 60/70 hours on duty in 7/8 consecutive days. | 72-Hour On-Duty Limit A driver who has reached the maximum 72 hours of on duty time during the seven consecutive days shall be required to have a minimum of 24 consecutive hours off duty prior to returning to on duty status. |

Recommendations

- A system allowing Operators to declare secondary driving jobs
- Special bidding process for Operators with secondary driving jobs
- Minimize split-times for longer shifts

Questions

