

# 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

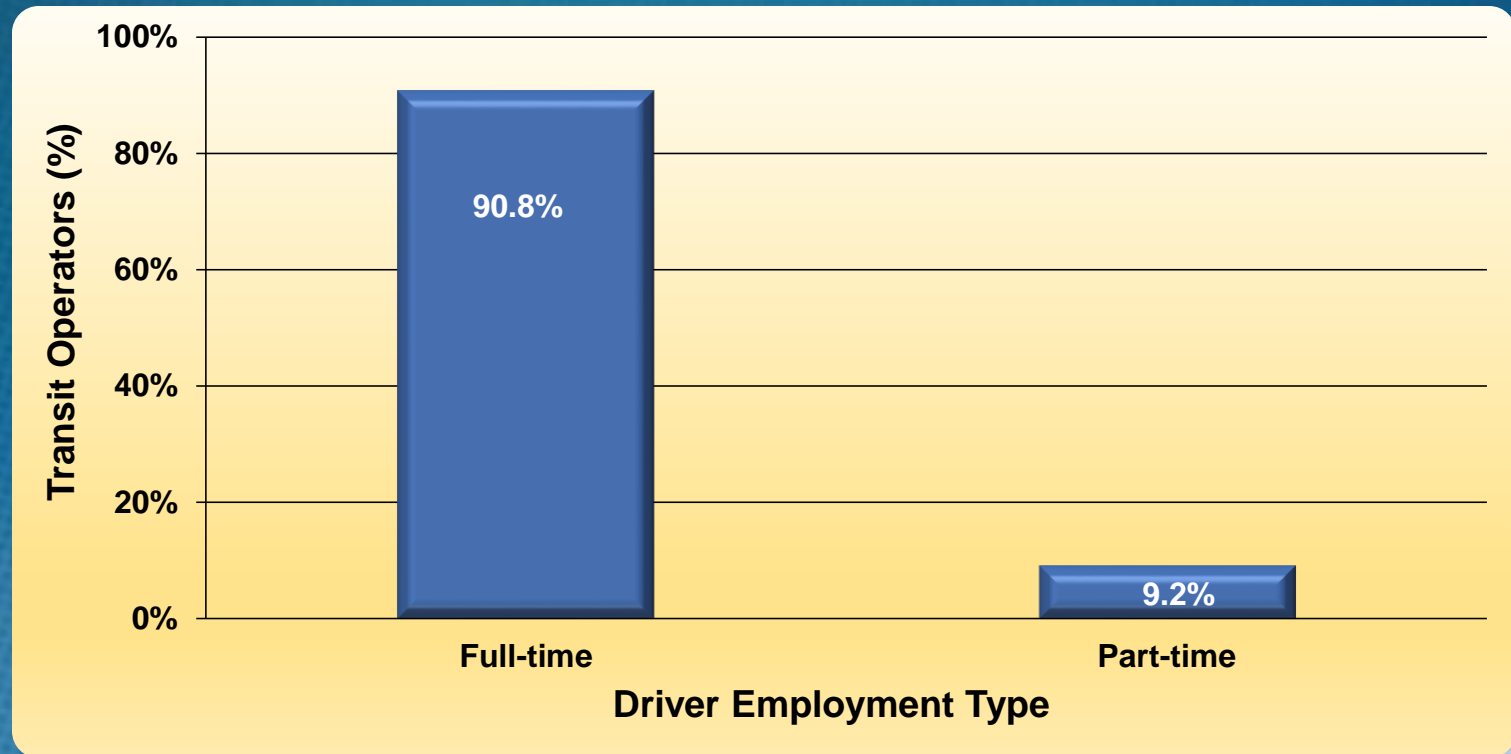
# Data Collection

## 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

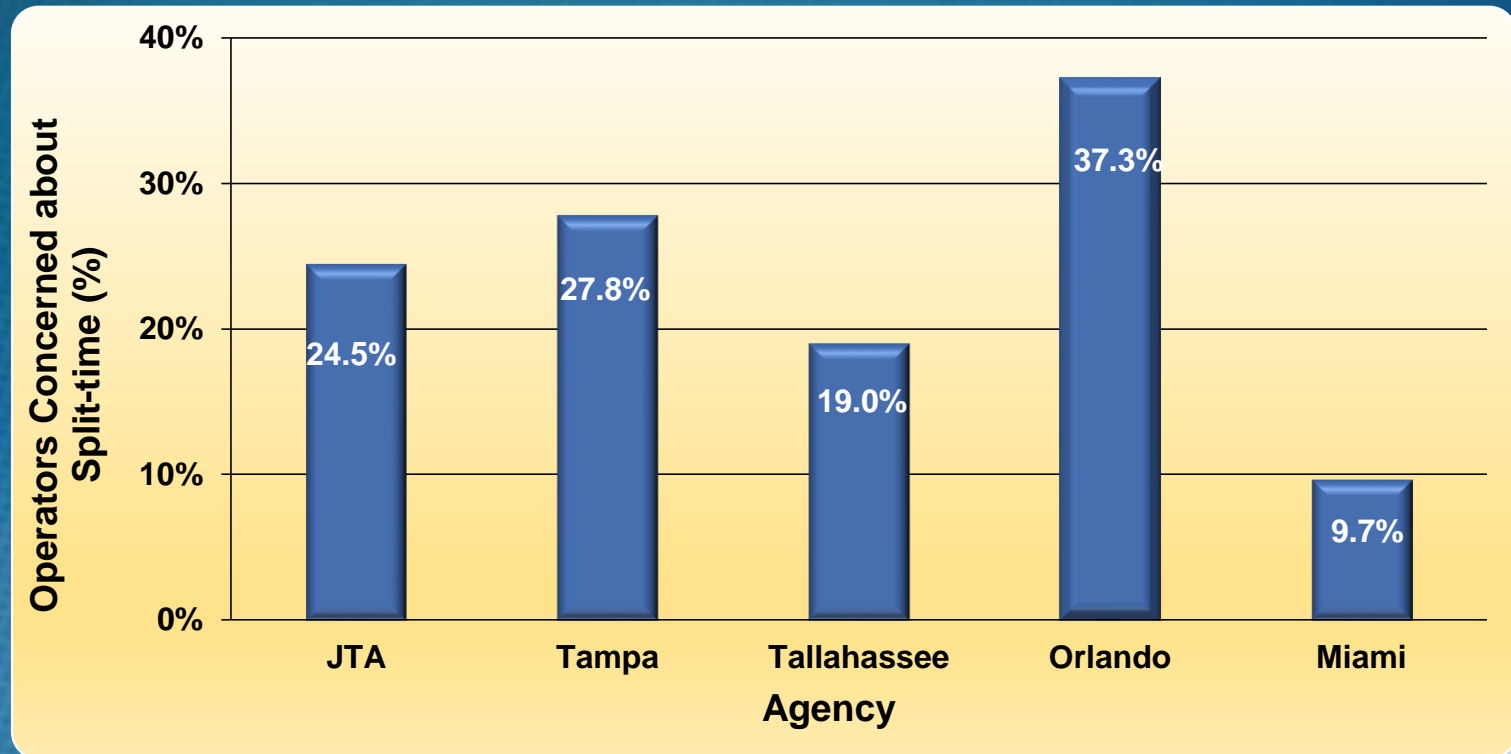
## Split-time Questionnaire Results

- 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

## Operator Concerns

- 21.1% of drivers (combined) prefer to remove or reduce split-time
- Miami Dade drivers – minimal concern about split-shifts (paid hours)
- 3 drivers in Tampa are part-time workers
- Only 1 driver in Miami is part-time

# Survey data

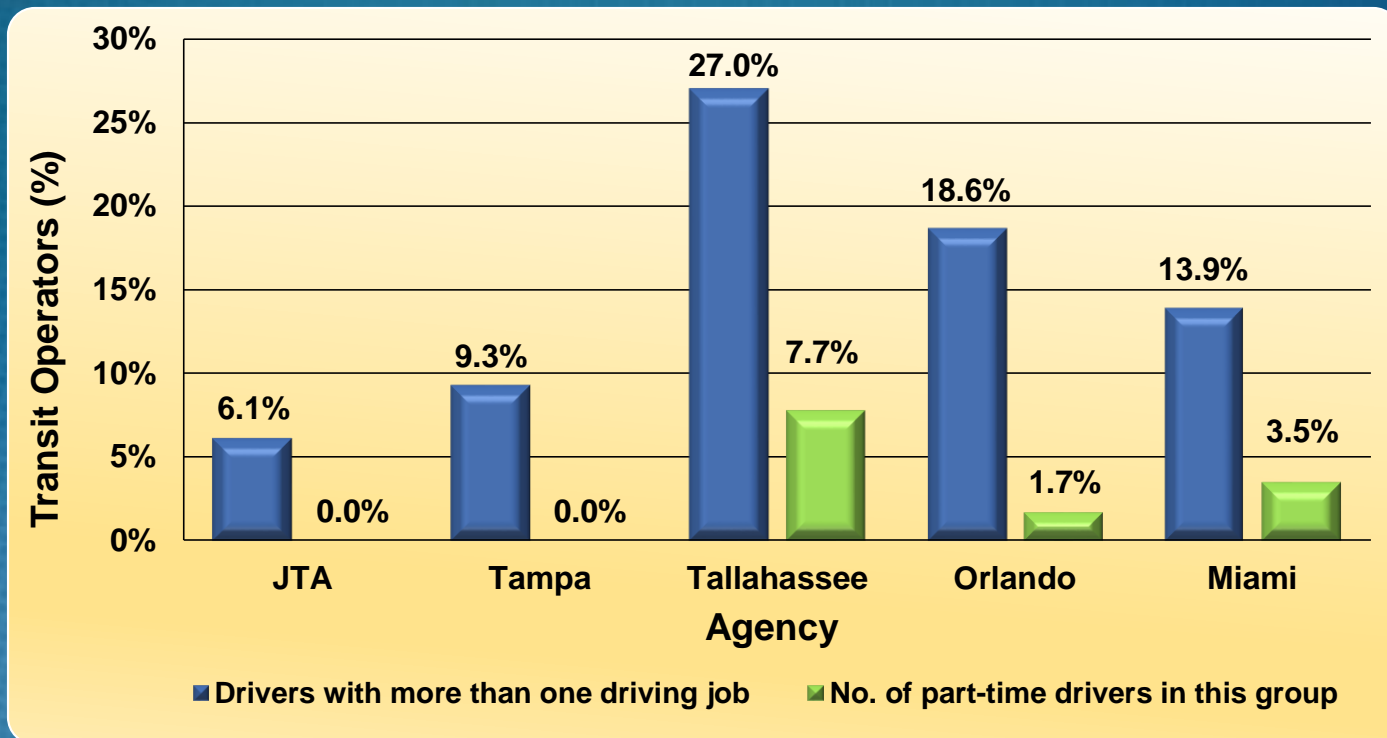
## Operators with secondary driving job

| 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                |



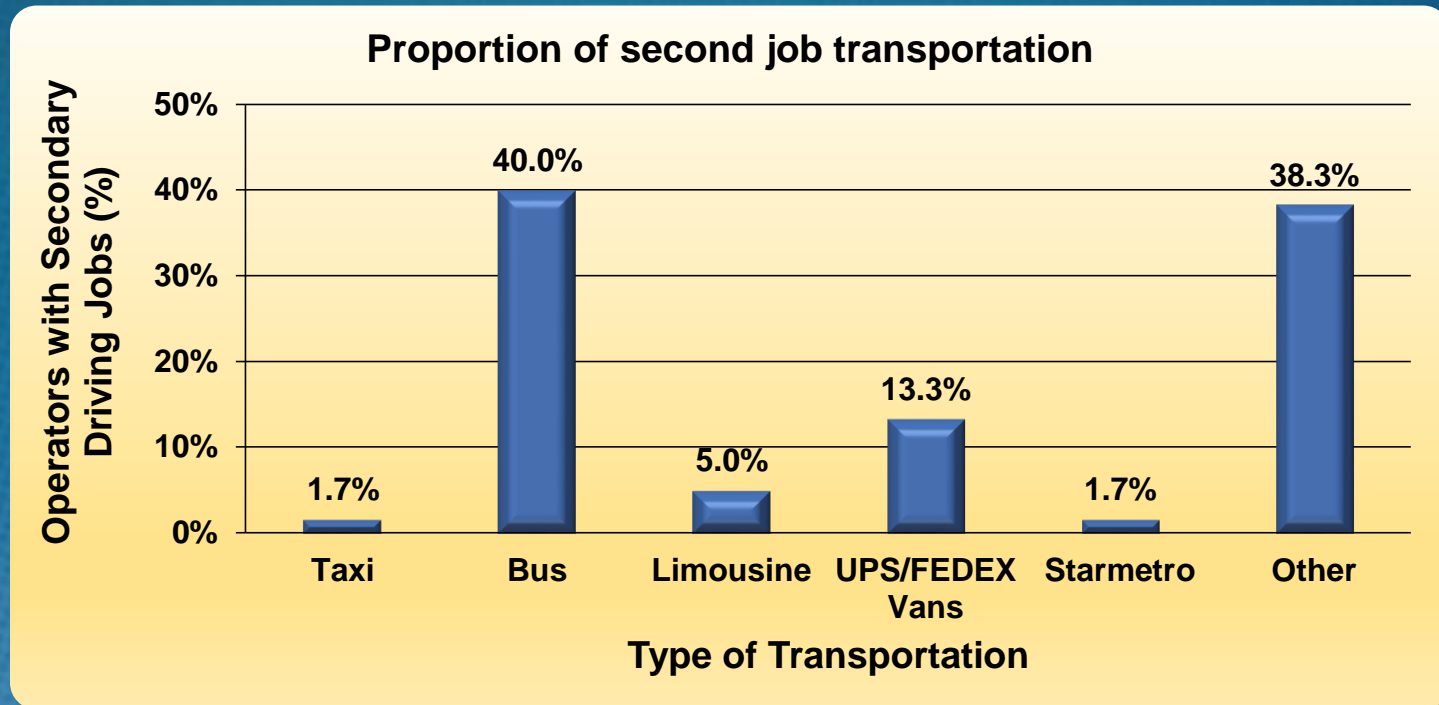
# Survey data

Proportion of All Operators with secondary driving jobs



# Survey data

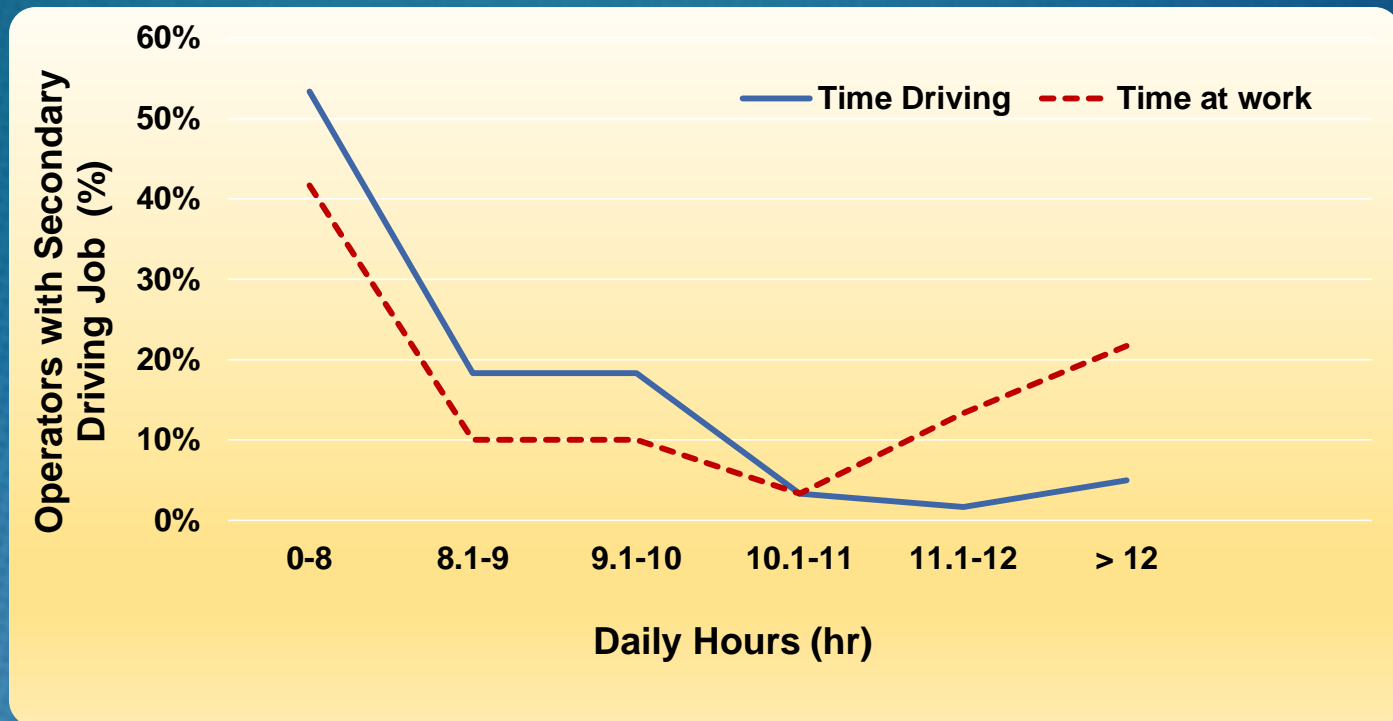
## Types of secondary driving jobs



**Bus category includes all bus types**

# Survey data

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



# Survey data - Results

- 21.1% of drivers dislike split-shift schedules (Miami Dade drivers the exception)
- A number of drivers also have secondary driving jobs
- More drivers spend longer periods at work than actual driving time

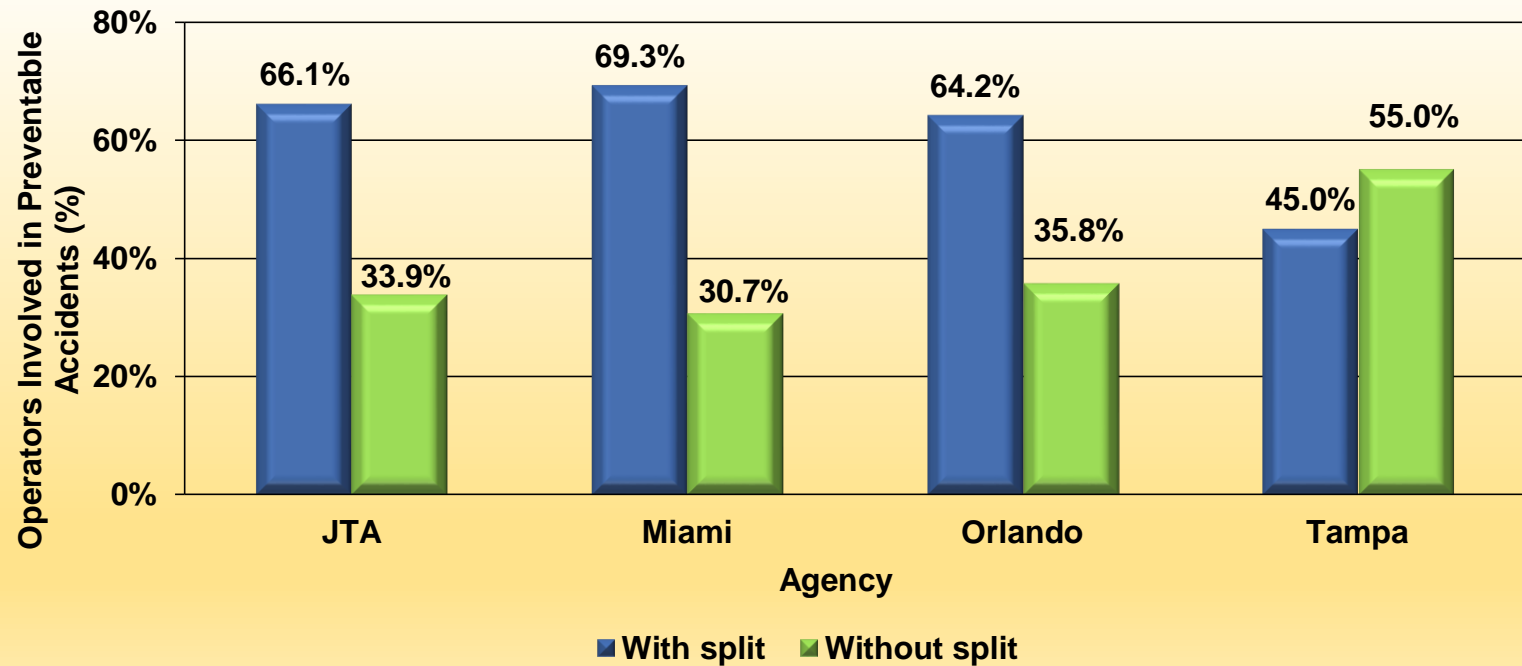
# Schedule data

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%      |

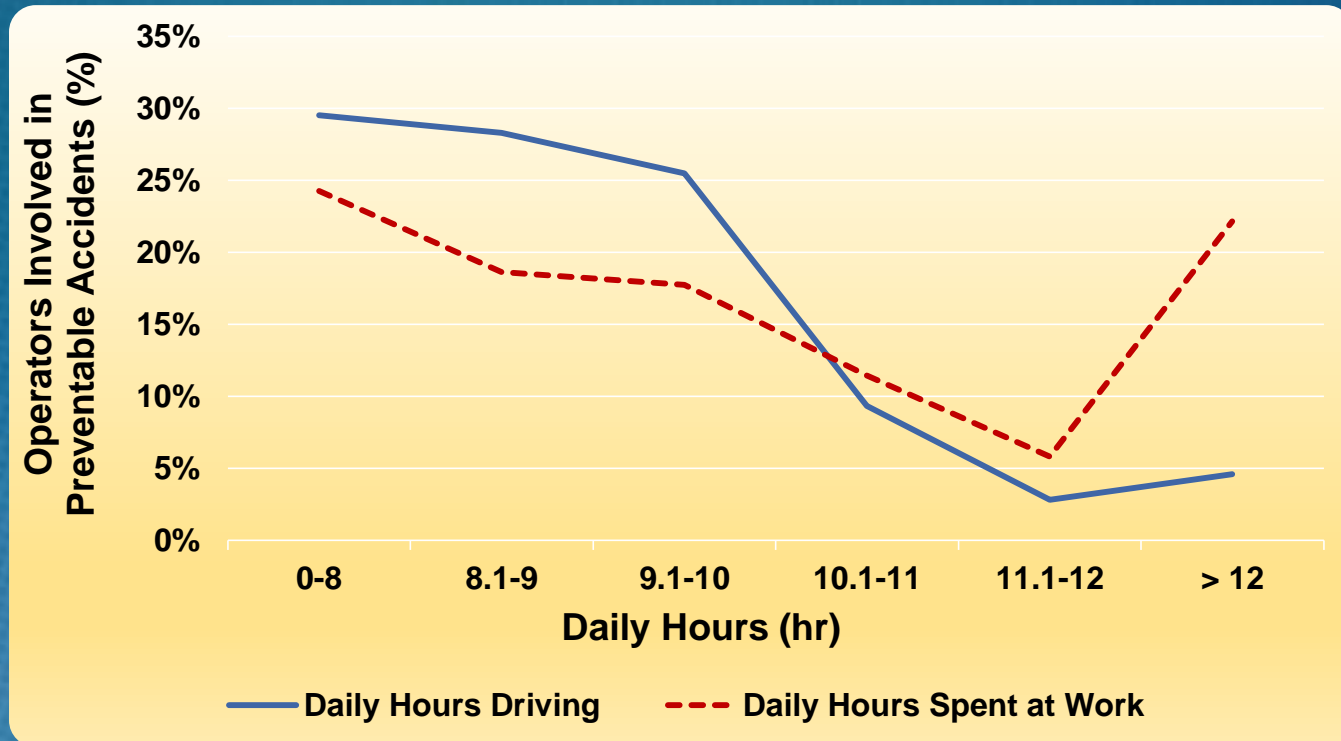
# Schedule data

Drivers involved in accidents with and without split-shifts



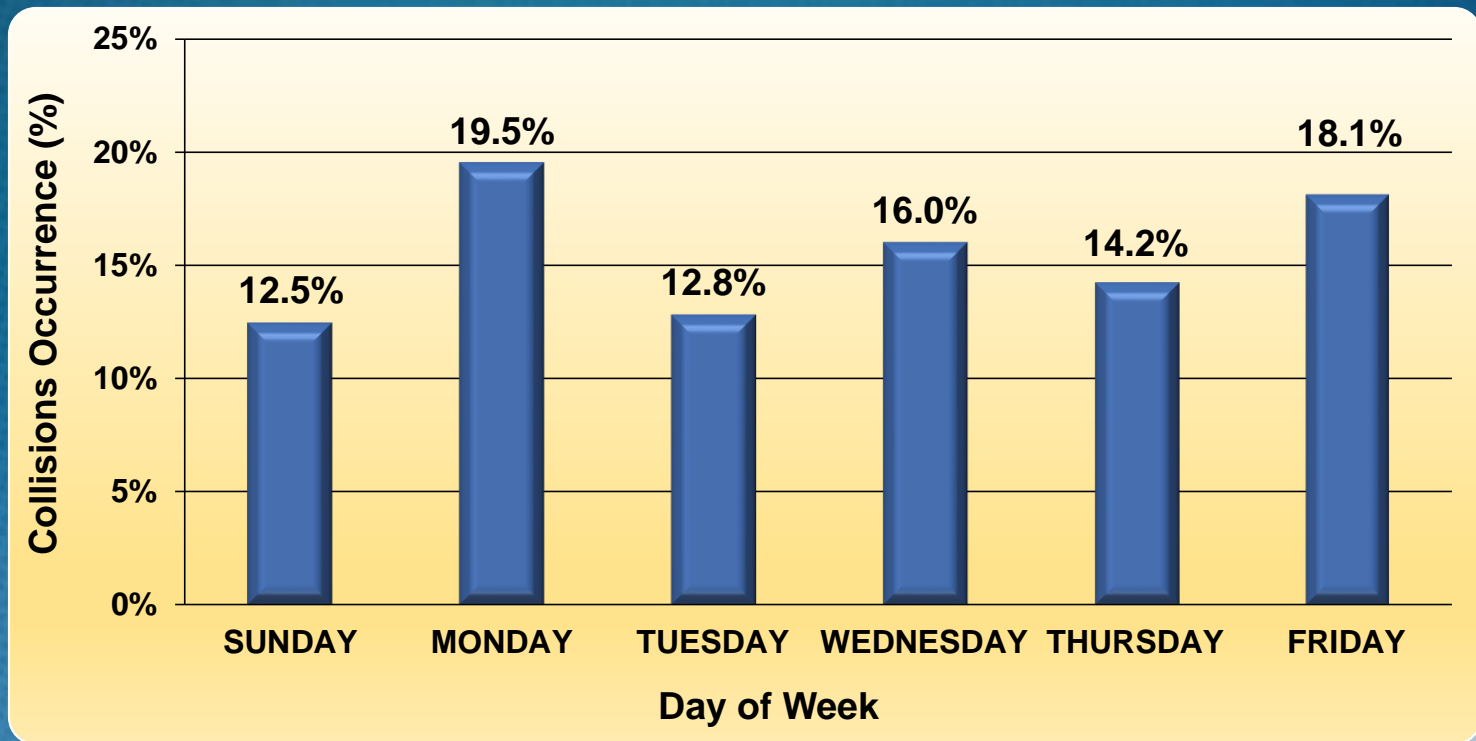
# Schedule data

Daily Hours spent Driving compared to Daily Hours Spent at Work



# Schedule data

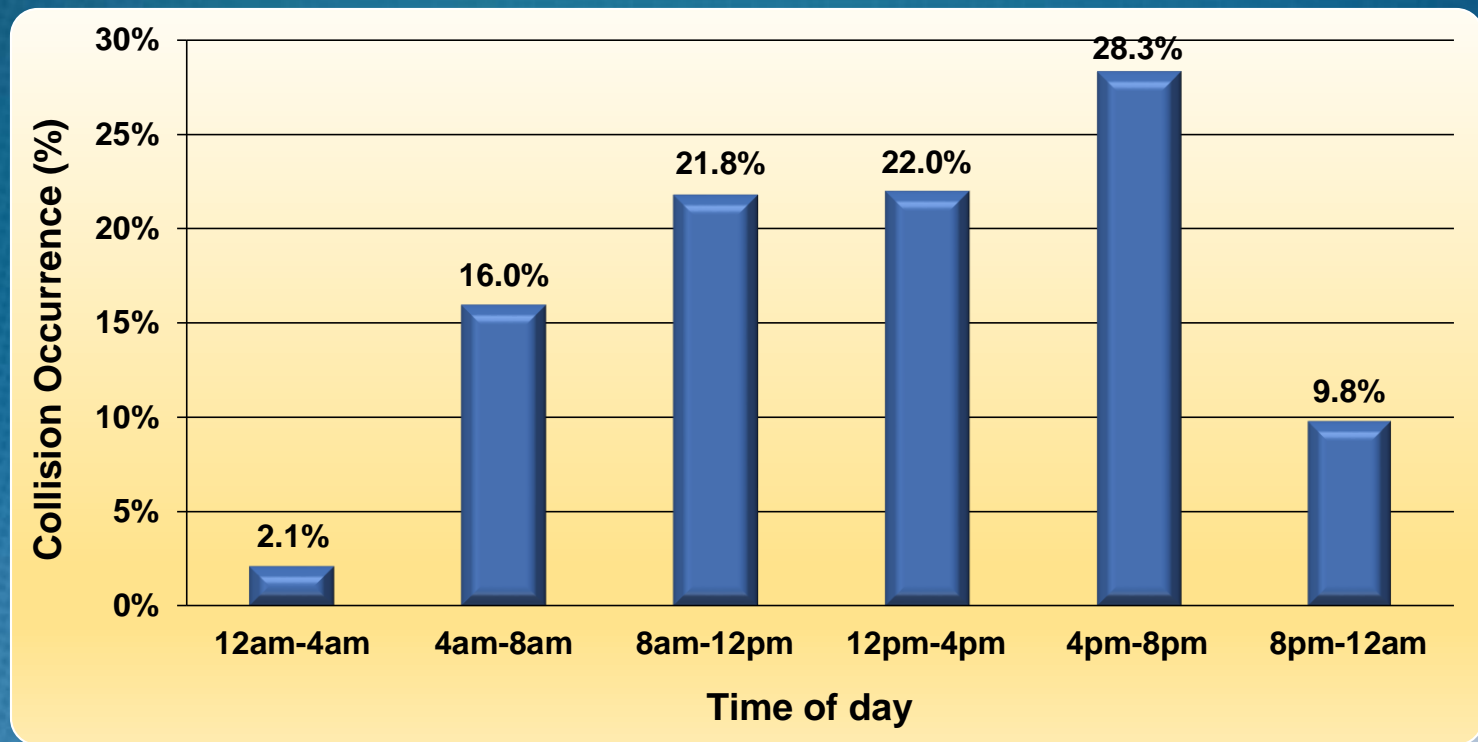
## Collision Occurrences by Day of Week





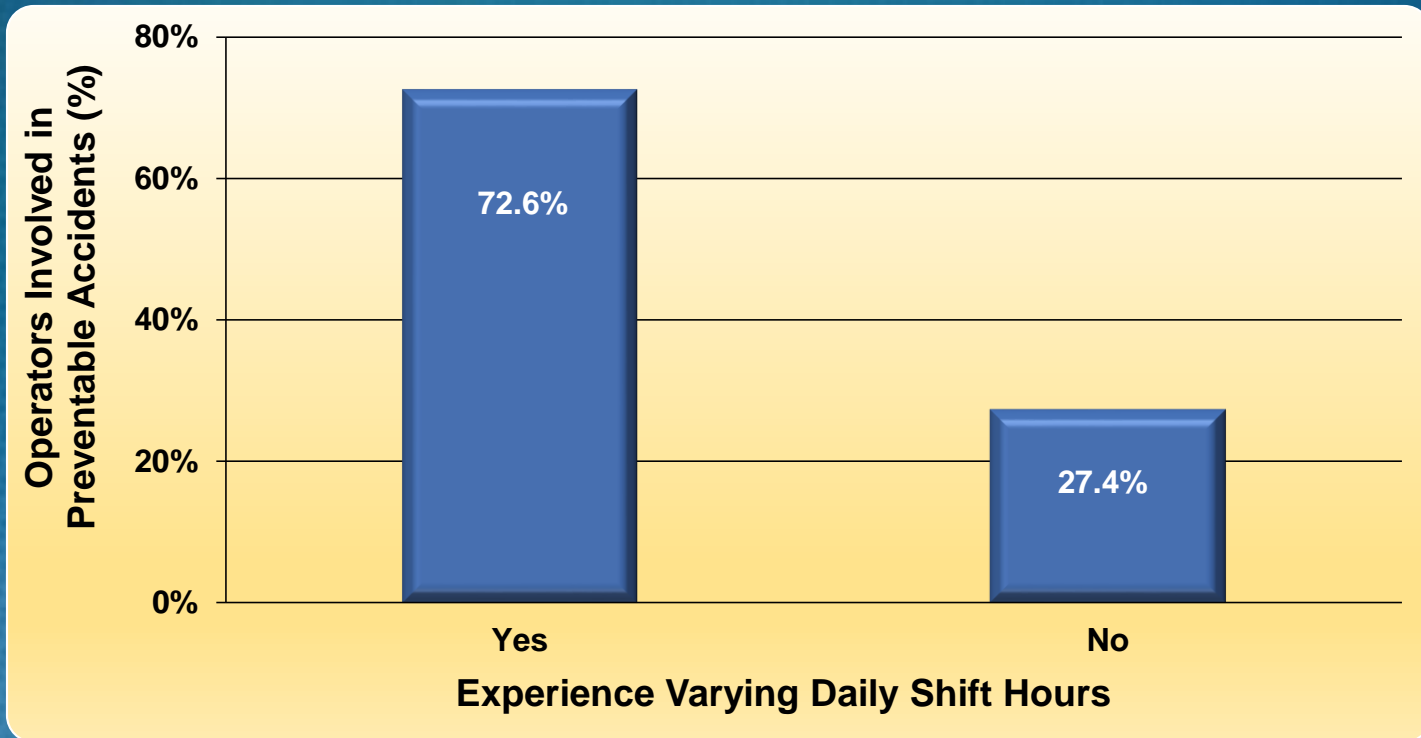
# Schedule data

## Collision Occurrences by Time of Day



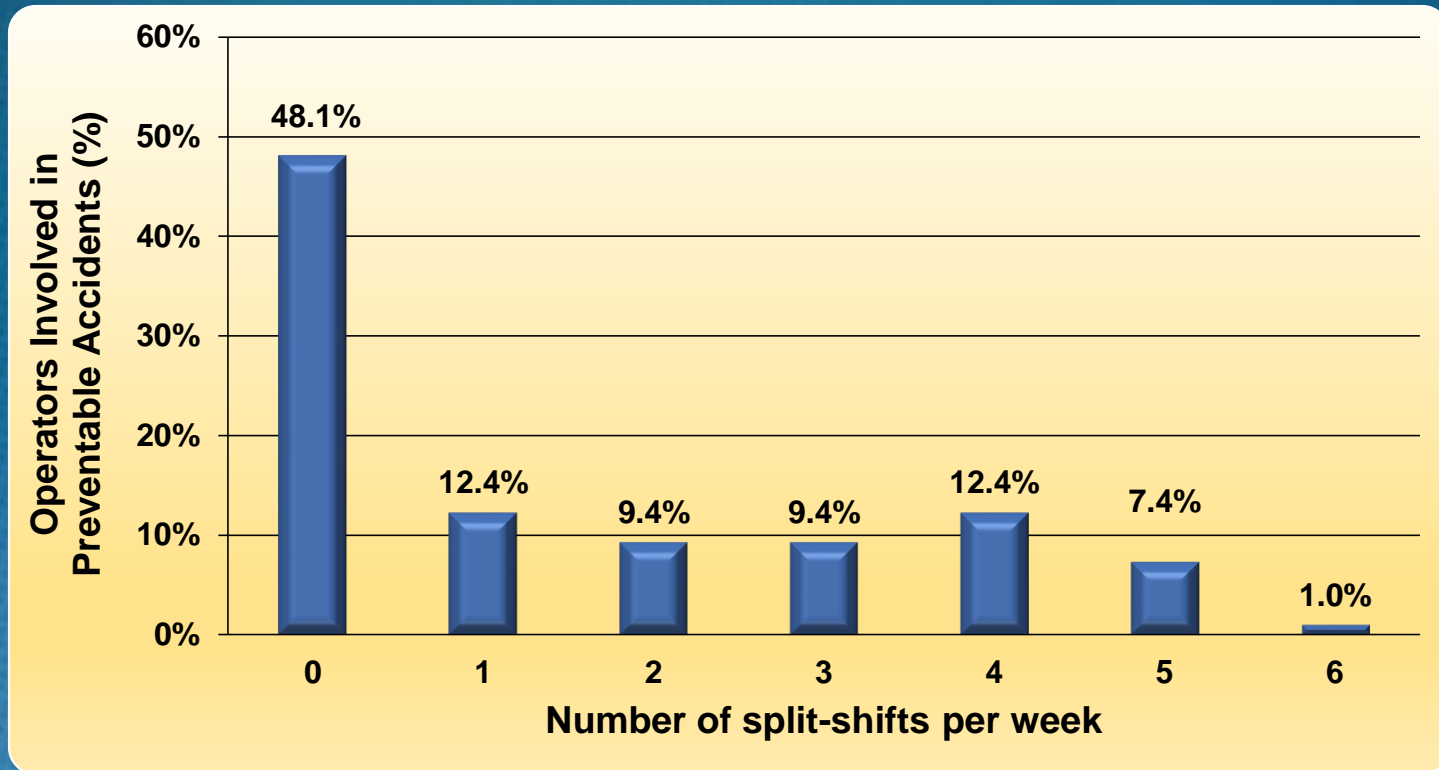
# Schedule data

## Operators with Varying Daily Shift Hours



# Schedule data

Split-shifts during week before accident



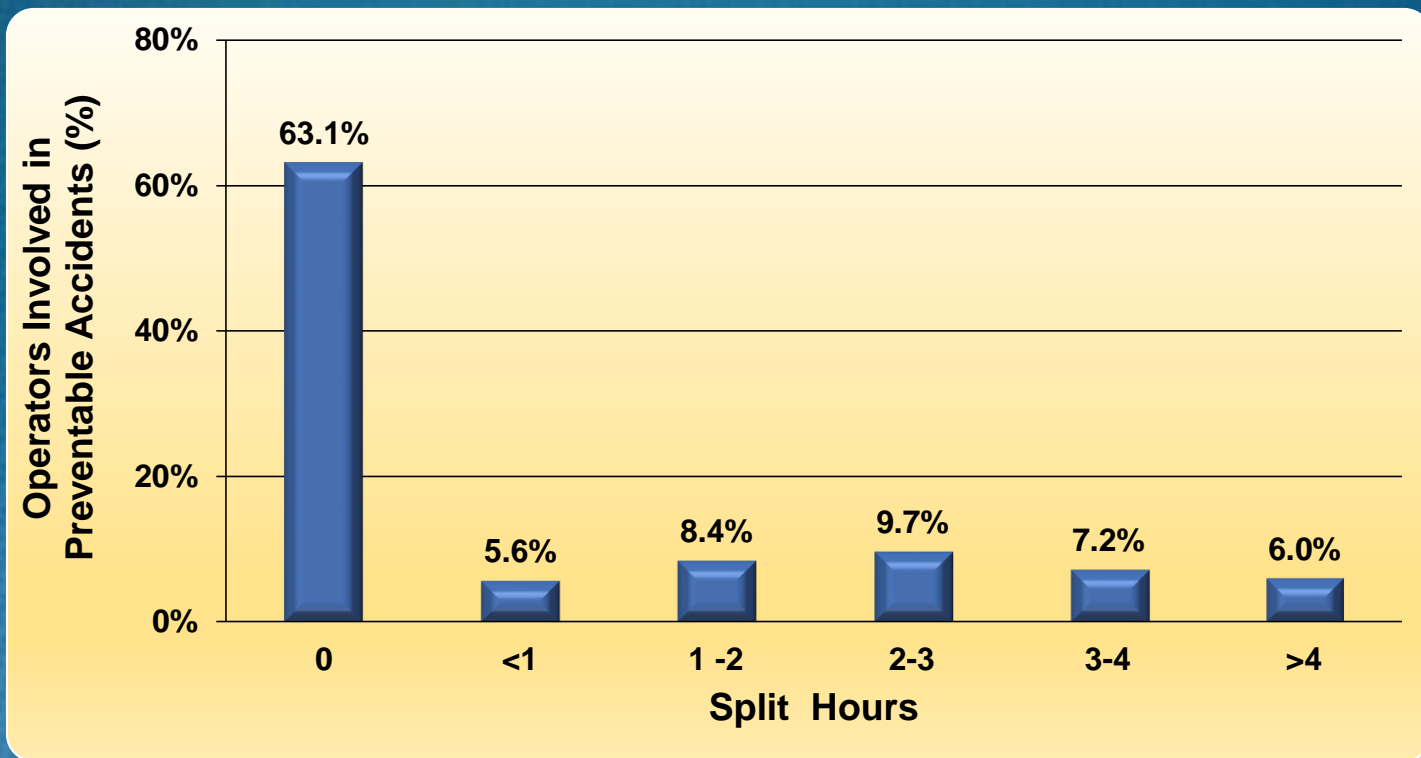
# Schedule data

## Split-time during Day of Accident

| <b>Split time during the Day of Accident</b> |              |              |             |             |             |              |
|--|--------------|--------------|-------------|-------------|-------------|--------------|
| <b>Hours</b>                                 | <b>0</b>     | <b>&lt;1</b> | <b>1 -2</b> | <b>2-3</b>  | <b>3-4</b>  | <b>&gt;4</b> |
| <b>No. Drivers</b>                           | <b>359</b>   | <b>32</b>    | <b>48</b>   | <b>55</b>   | <b>41</b>   | <b>34</b>    |
| <b>% of Total</b>                            | <b>63.1%</b> | <b>5.6%</b>  | <b>8.4%</b> | <b>9.7%</b> | <b>7.2%</b> | <b>6.0%</b>  |

# Schedule data

Split hours during day of accident



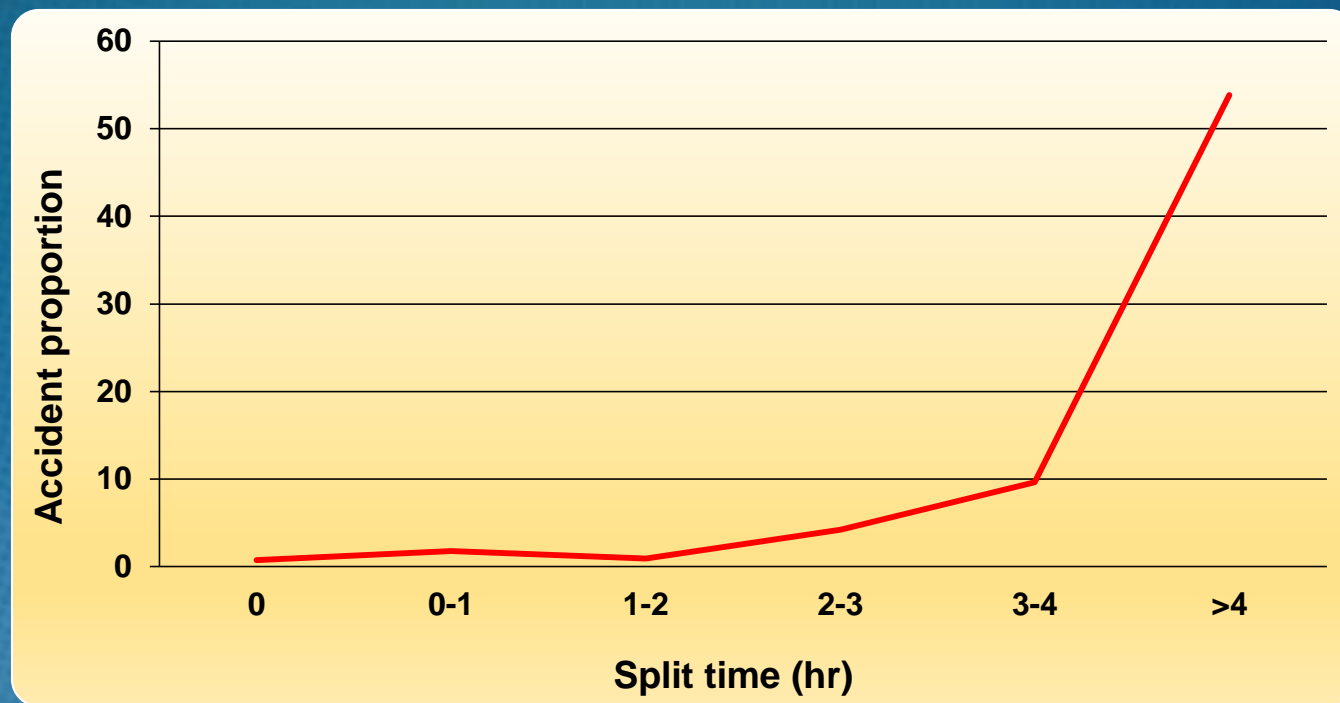
# Schedule data

## 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            |   |

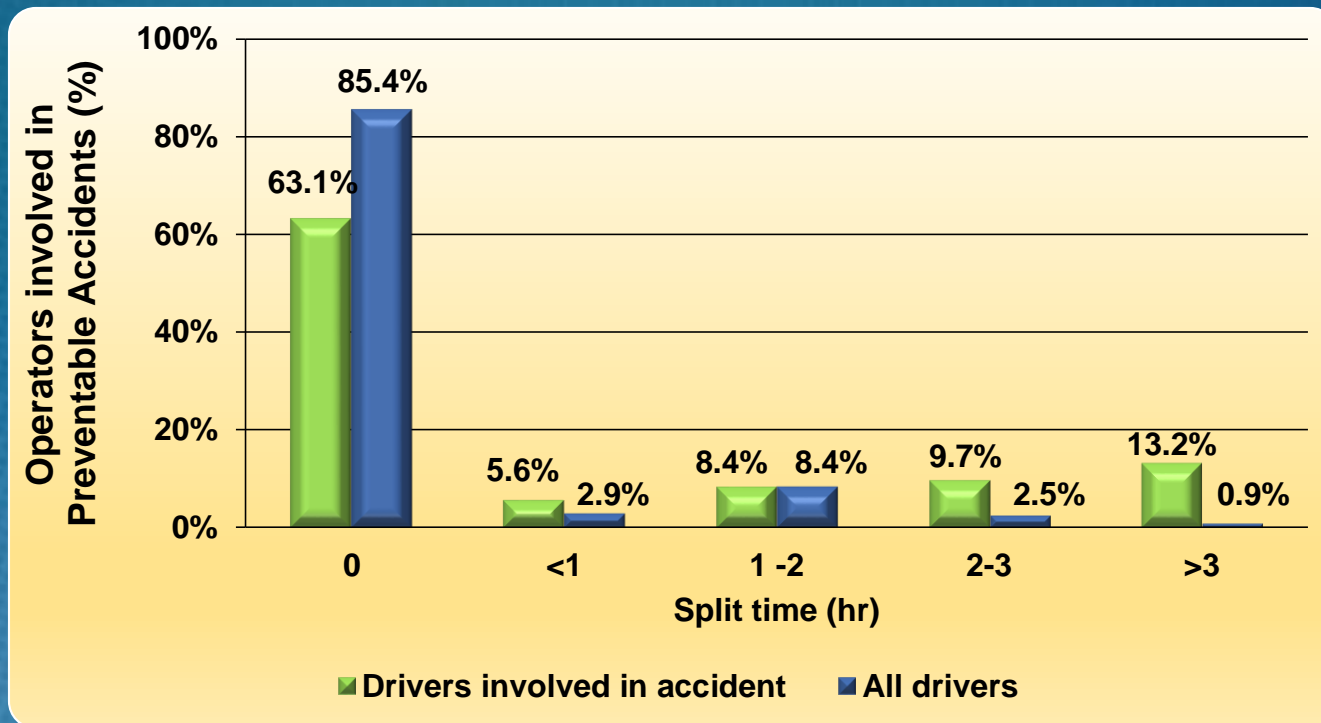
# Schedule data

Accident Proportion Relative to Exposure by Daily Split-time



# Schedule data

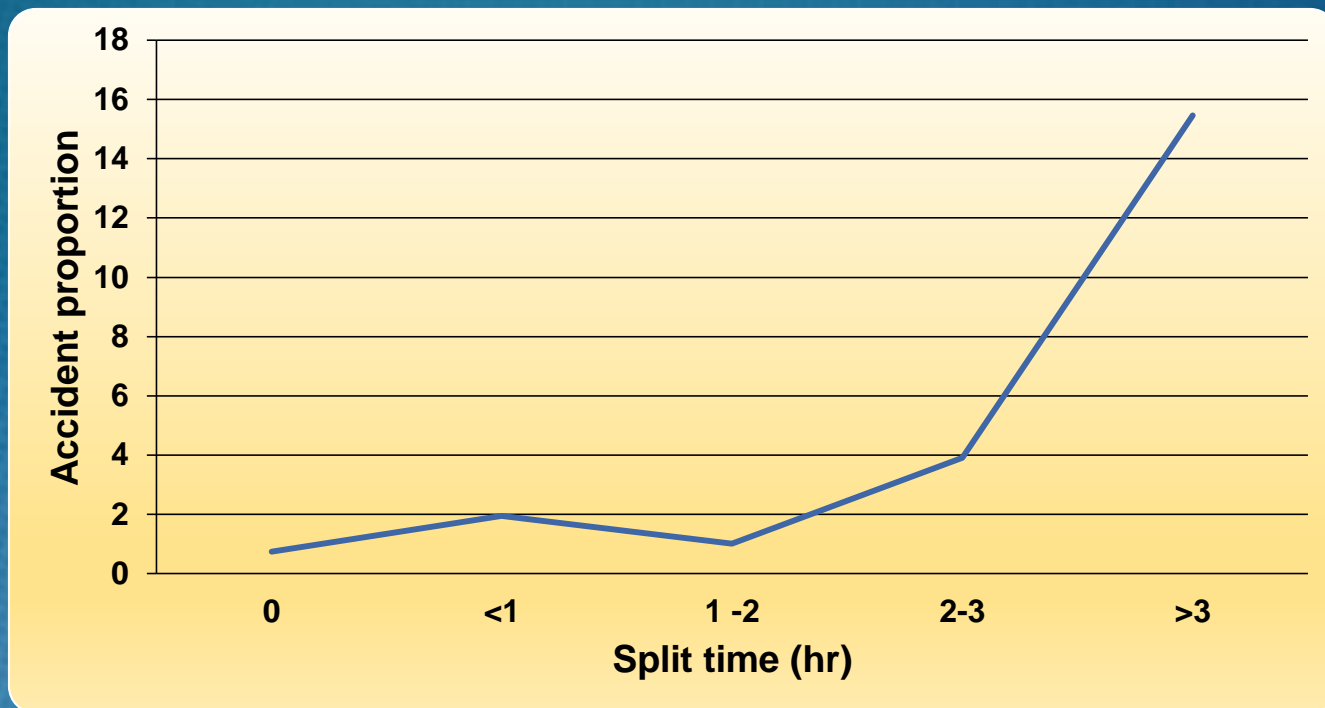
## Operators involved in Accidents Relative to Split-time





# Schedule data

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



# Schedule data - Results

- 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

# 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

