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Before and After Comparison of Traditional Five-Day and Four-Day Workweeks for TxDOT Maintenance Forces.

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Before and After Comparison of Traditional Five-Day and Four-Day Workweeks for TxDOT Maintenance Forces.

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Thesis

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This thesis is dedicated to

Timothy Fournier and Gail Fournier

Before and After Comparison of Traditional Five-Day and Four-Day Workweeks for TxDOT Maintenance Forces.

By

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The University of Texas at Austin, 2012

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The Texas Department of Transportation (TxDOT) has sought to reduce expenditures by better utilizing their maintenance forces through a compressed workweek. The focus of this thesis is a before and after comparison of maintenance crews at TxDOT during a standard 5-day forty hour workweek and a compressed 4-day forty hour workweek. Compressed workweeks are work arrangements in which full-time employees are allowed to work longer days for part of the week or pay period in exchange for shorter days or a day off during the same week or pay period. This type of schedule allows for numerous benefits including increased productivity, additional time to handle personal business, less travel time, less start up and shut down time, improved morale, as well as less stress. Originally three districts were placed upon the compressed workweek but after four months of trial, three additional districts were included. Maintenance activity data from previous years was compared to data collected over the trial period to assess productivity impacts as well as vehicular travel. Surveys of maintenance crews were conducted throughout the study to address personal concerns. The results of the study were that there were no significant impacts to productivity or vehicular usage but a significant improvement in work conditions for the maintenance crews. Further assessment is recommended utilizing additional functional codes for more illustrative results.

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Chapter 1: Introduction

In recent decades, many businesses in both the public and private sector have realized the need to stay proactive in the pursuit of efficiency in the workplace. As the economy continues to become more competitive, especially in the transportation sector, it will become increasingly important to maximize productivity while keeping costs at a minimum. One of the most cost effective and easily implementable strategies is flexible work arrangements (FWAs). At their core, FWAs allow employees to work non-traditional hours or from outside the office. Although they are not plausible for all professions, FWAs have the potential to create more productive employees while decreasing unnecessary overhead expenditures for a significant fraction of the working population.

The three most common FWAs are compressed workweeks, flextime, and telework or telecommuting. HR Magazine, a leading academic journal for human resources professionals, describes these FWAs in the following way:

- Compressed workweeks allow full-time employees to work longer days for part of the week or pay period in exchange for shorter days or a day off during the same week or pay period (1).
- Flextime is an arrangement that allows for arrival and departure times to be different from the standard schedule (2). For example, an employee may choose

to arrive several hours later in the morning and leave appropriately later in the evening. These arrangements are generally restricted by mandatory "core hours," for example 10am to 3pm, in which the employee must be on premises to conduct business.

- Telework or telecommuting allows an employee to work at home, on the road, or in a satellite location for all or part of the regular workweek (3).

For the remainder of this thesis compressed workweeks will be the focal point. There are three generally recognized formats for compressed workweeks. First is a "4/10" schedule in which employees work ten hour days for four days of the week allowing for a day off during the same week. Second is a "9/80" schedule where employees work two-week schedules of eight, nine hour work days consisting of Monday through Thursday and one eight hour Friday to receive every other Friday off. Lastly, is the "3/36" schedule in which employees work three consecutive twelve hour days to receive four days off each week. The most common compressed work week style is the 4/10 (4).

Compressed workweeks were developed in the private sector as a way to satisfy employee demand as well as improve a business' bottom line. Most employees prefer flexibility in their work schedules. Further, happier employees tend to be more productive (5). For example, consider a maintenance crew that works four 10 hour days instead of five 8 hour days; the compressed workweek allows the crew to be on site for

longer periods of time, which helps yield a higher output. There are also a possible fuel and energy savings because the crews are only traveling to the worksite four days a week instead of five. The crew members also have a work day free to conduct business or a three day weekend to enjoy with friends and family. Not only does morale increase among employees, the employers benefit from fewer overhead costs and increased output.

Chapter 2: Literature Review

In order to fully understand the implementation of compressed workweeks as well as identify potential problems, it is necessary to conduct an extensive literature review. This study will identify potential benefits as well as concerns that will have to be addressed in order to better evaluate maintenance crews placed upon a compressed workweek.

2.1 History of Compressed Workweeks

The 4/10 work schedule is the latest in a long line of work week modifications that has been taking place since the late 1700s. Back then it was not uncommon to work 14-16 hour days for 6 days every week (6). This schedule can be thought of as a 6/96 in terms of compressed workweeks. The conditions were seen as unbearable, and left little time for family outside of the workplace setting. General feelings of oppression led to the formation of resistance groups and eventually into labor unions. Unions fought to reduce the work hours per day down to 12 for 6 days a week which remained until the Civil War. Unions eventually got working schedules down to 48 hour weeks by the 1920s (7).

The standard 5/40 or the typical workweek seen within the nation was first established on May 1, 1926. Henry Ford was the first to establish the 5 day 40 hour workweek in history at his Detroit plant. Soon he extended his program to all aspects of his industry

(8). Roughly a decade later, legislation was put into place via the Fair Labor and Standards act of 1938 that would set this workweek style as the norm (9).

In 1967 a German aerospace company noted that its employees' arrival and departure times were being effected due to congested roadways. In order to better facilitate their schedules the company proposed to allow a further reduction in days but not hours for their employees. In this manor they would be able to come to work outside of the typical congestion period but the company would still maintain 40 hours production from each employee. The company found the employees to have reduced tardiness, decreased sick time, and overall improved morale. The concept spread quickly through Europe, to Japan, and the United States (10).

America began experimenting with the 4/40 compressed workweeks in the late 1960's and 1970's. The original purpose was to alternate factory conditions that usually required significant start up and shut down times between shifts (11). Transitioning the concept to government employees proved to be more cumbersome as regulations restricted flexible schedules. In a report to congress by the comptroller general of the United States, revisions were suggested that would allow easier implementation of compressed workweeks. The Walsh-Healy Act along with Labor Union contracts were called out specifically as they required individuals working over 8 hours in a single day to be compensated overtime pay of at least 1-1/2 times base pay (10). Without revising

these restrictions it was mandated that every employee working a 4/10 would receive 2 hours of overtime pay for every day worked.

After the 1970's compressed workweek experimentation leveled off. Hundreds of companies had switched to the new schedule but many claims were outlandish. One tire company claimed 400 percent increased sales due to the 4-day workweek and another said that the new schedule cut absenteeism in half (12). While perceptions were widely different the general consensus was that the 4-day workweek was well received.

After the 1980s there were few reports about the 4-day workweek continuing to spread. One author claimed that out of 162 articles gathered to outline compressed workweeks, the majority of them were generated in the 1970's and early 1980's (13). The four-day workweek does not start appearing in mass reports, especially in government documentations, until Utah mandated a 4/40 schedule for its State Employees in 2008.

2.2 Advantages

Although the causes for compressed workweek implementation vary, they offer numerous potential benefits for the TxDOT maintenance forces. The benefits of a 4/40 schedule over the traditional 5/40 schedule stem from: 1) the lengthened work-day and 2) the day off. Because the work day is extended, jobs that require big start-up and shut-down times can greatly benefit. Consider a highway maintenance crew with traffic controls to set up and machinery that takes an hour to start up and put in place. In an

eight hour work day, about 25 percent of time is spent waiting on the set up and shut down of machines and traffic control. Adding in a one hour lunch break, now only five hours of the day are used for production. TxDOT's Abilene and Odessa districts recognized this inefficiency problem with their maintenance crews who spend a lot of time setting and removing traffic controls at work sites. The switch to 10-hour days substantially increased output by simply increasing the number of productive work hours of each maintenance crew each day (14).

Jobs with compressed workweeks see significant reductions in operating expenses and overhead costs by removing one day from the workweek. Previous studies of compressed workweeks in maintenance departments have shown significant savings in fuel and vehicle repair costs. In the Abilene District of TxDOT, maintenance crews were using significantly less fuel and putting less wear and tear on their vehicle fleet simply because they were traveling to work sites four days a week instead of five (15). In theory, a compressed workweek will reduce the number of vehicle miles traveled (VMT) for a maintenance crew by 20 percent, as a result of having four working days instead of five every week. Decreasing the VMT of maintenance equipment saves on fuel costs as well as extends the life of vehicles, resulting in fewer replacement costs and higher salvage values. TxDOT has a fleet of 15,000 vehicles; increasing the useful life of even a fraction of vehicles could generate significant savings (16). On the other hand, some vehicles may accrue increased mileage as a result of having more productive hours

available each week. While this might seem like a drawback, it is simply the byproduct of a more productive crew. Lastly, a compressed workweek gives time for vehicle preparation and maintenance to be performed. More time is available in the morning and evening for crews to ready their trucks and load materials, while the day off allows additional time for vehicle maintenance to be performed by vehicle service personnel.

Compressed workweeks also allow for savings in utility costs and overhead expenses. If employees are not in the office on Friday, no air conditioning, lighting, or water is required. After Utah implemented a compressed workweek for all executive branch employees, they saw utility costs drop by about 13 percent from reduced electric and water bills (17).

A compressed workweek typically involves employees coming to work earlier and leaving later. Although a longer workday can be seen as a negative aspect of a compressed workweek, it can actually work in the employee's favor. An early start time and later end time means commuters are most likely going to be traveling outside of the usual rush hour, resulting in less time stuck in traffic. Not only do drivers experience a less stressful commute, they save time and money based on the reduced travel time. Lastly, similar to maintenance crews commuting to a worksite, employees are only driving to work four days a week instead of five, cutting fuel spending and maintenance to personal vehicles.

Companies may also benefit from the attractiveness of a shorter workweek. In a survey performed by the University of Connecticut, employers indicated that they felt an increase in their competitive persuasion to incoming employees (18). The ability to have an extra day to handle personal business, get a second job to produce extra income, or manage work/family life could be a deciding factor when people seek employment.

2.3 Drawbacks

Most complaints with compressed workweeks center around the logistical problems and fatigue associated with a lengthened work day. Not only can a ten-hour work day be physically and mentally exhausting, it leaves less time during the morning and evening for other activities (19). In most cases, employees use their day off to recover from the lengthened work day and to take care of personal issues, such as medical appointments.

A longer day at the office can also mean trouble for parents with school children. An early start time makes it difficult to get children ready for school and staying later means arranging childcare until 6 p.m. or later. About 20 percent of Utah's state employees struggle with their four-days-a-week schedule (17). In an interview with National Public Radio, one state employee articulated a common complaint, "I hate it. It is not working one single bit for me… A 10-hour day… is like an eternity (20)."

Management of staff can become a concern. With a longer work day, supervisors might go an even greater period before receiving face time with their employees. While this

would not be a problem for productive employees, others could see this as an opportunity to become even less productive.

Unfortunately, few remedies exist for these problems, as they stem from the very nature of a compressed workweek. It is possible for managers to use some of the cost savings to provide reduced-cost child care for employees with young children or to offer employees ways to de-stress during the long work days. Another option is to allow some employees to work a four-day workweek of eight hour days (32 hours per week) to accommodate young children (19).

Chapter 3. Case Studies

Case studies will be an important factor in determining the best metrics for assessing TxDOT maintenance crews. In this chapter, several studies will be outlined that cover past practices in compressed workweeks. By this approach "take away" characteristics will be generated that can be utilized in evaluations of the TxDOT experiment that is described later.

3.1 Connecticut Survey Study

Impetus

The University of Connecticut (UConn) was charged with the task of documenting a compressed work week for a small city in the west. The city had seen a significant rise in population since 1990 and was struggling to provide services. In an effort to minimize costs while enhancing services, the city adopted a compressed work week in 2003. This schedule was to run Mondays through Thursdays from 7:30am to 6:00pm. Offices would be closed on Fridays (21).

Implementation

To handle evaluations UConn distributed surveys to the employees of the city as well as the city citizens to gain perspective on the impacts of the compressed workweek. They received replies from 132 full and part time employees as well as 443 citizens (18). As an additional measure, surveys were also distributed to organizations to gain their

perspective on compressed workweeks. These surveys were conducted over the phone primarily to human resource (HR) professionals of cities with populations exceeding 25,000 individuals. Primarily HR directors of 151 cities responded.

Employee Surveys:

Nearly 80 percent of the employees surveyed provided positive feedback about the program. Nearly 47 percent also indicated that they felt more productive during the work day. The majority of employees felt that they were improving citizen access to consumer services. Also, only 2.7 percent of employees found child care more problematic with the compressed workweek as compared to the traditional schedule. Workers mentioned fewer family-work conflicts along with higher job satisfaction. Organizations find the last statement particularly important as research has shown that work/family conflict is related to decreased productivity, increased absenteeism, and increased turnover (22).

Citizen Surveys:

Citizens indicated an almost even split among favored, neutral, and dislike, when asked if they preferred the hours of operation of the compressed workweek. When asked additional questions relating to their preferences about the same percent of respondents indicated they preferred the 4/10 schedule while about 44 percent felt strongly toward traditional workweeks. Roughly 44 percent of citizens also indicated

that they felt offices should be open before and after traditional work hours. When a city responds with mixed expectations, it is difficult to say for certain which schedule is best for providing services (18).

Organization Survey (18):

More than half the cities surveyed offered some type of alternate work schedule. The most common schedule was a compressed workweek with the most common type being the 4/10 schedule. About 34 percent offered flextime, and less than 10 percent offered job sharing or telecommuting. Organizations indicated that alternative work style arrangements were implemented to improve employee morale, and support a balance between work/life. They noticed increased productivity, extended business hours, reduced cost, decreased absenteeism, and an increased ability to attract new employees. Overhead and overtime charges were particularly called out as savings. Organizations also indicated that they felt an increase in service provided to their customers.

Responses from the organizations surveyed were not all favorable. The most frequently reported concern was difficulty in scheduling, particularly between companies with standard work arrangements and those on the compressed schedule. Decreased face-time was also called out as a drawback. Less than 10 percent of the organizations noted

decreased moral, increased absenteeism, customer service complaints, and increased costs.

Best Practices and Take Aways

The survey style of conducting group satisfaction surveys demonstrates an ideal way to measure a maintenance crew's perception of the four-day workweek. Particular attention should be noted for child concerns, productivity, and all around morale. Organization input will be important in addressing corporate concerns as well as addressing implementation issues.

3.2 TxDOT - Abilene District Maintenance Forces

Impetus

In March 2008 the Abilene and Odessa districts within TxDOT implemented a compressed workweek for the Maintenance Operations crews in order to reduce operating expenditures and improve productivity associated with sign replacement, street sweeping, pavement repair, and other maintenance tasks. The program was championed by Abilene District Engineer Russell Lenz. Since the program was conceived of, designed, and launched by TxDOT management, implementation costs for the program were near-zero. The two districts saw significant improvements in efficiency and significant cost savings after a three-month trial period (15).

Implementation

By order of the District Engineers, the Abilene and Odessa districts divided their Maintenance crews into two teams that would enable a staggered four-day weekly schedule. Figure 1 shows that during the first week, employees on the "A schedule" would work Monday through Thursday while employees on the "B schedule" would work Tuesday through Friday. The following week, the schedules were reversed so that "A schedule" worked Tuesday-Friday while "B schedule" worked Monday-Thursday. The alternating schedule created a four-day weekend every other week, so employees could schedule personal businesses on either Mondays or Fridays.

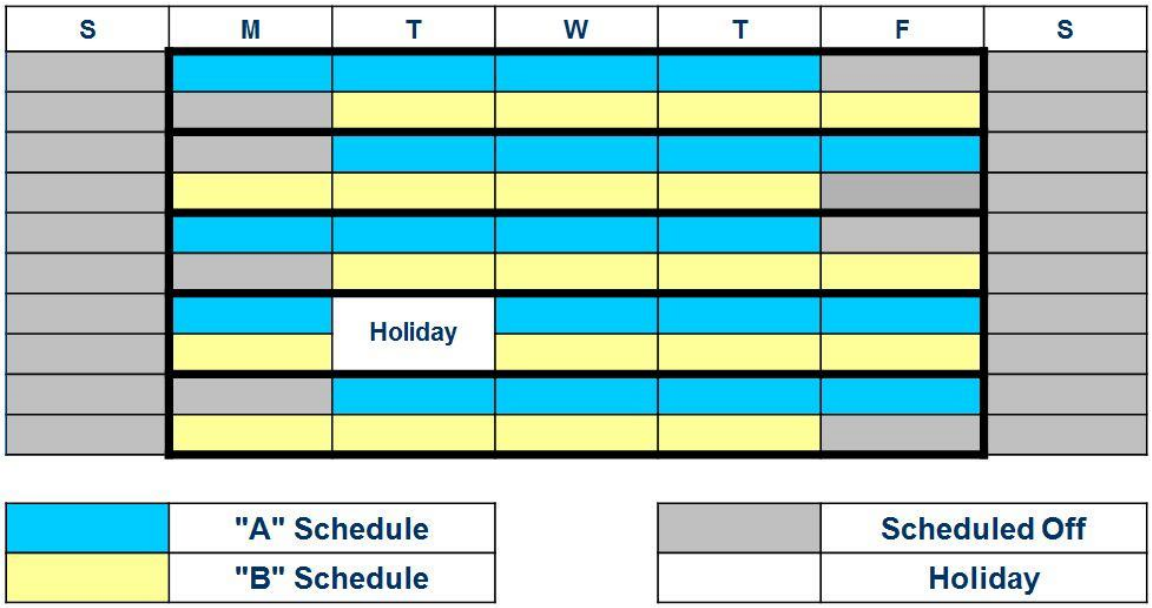


Figure 1. Staggered schedule of Abilene compressed workweek. (23)

The four-day and five-day schedules are compared in Table 1. Notice that the compressed four-day schedule increases the amount of the work day spent on production from 5.5 hours/day (62 percent) to 7.5 hours/day (71 percent) while shortening the number of hours worked per week and reducing the time spent staging, traveling, and setting traffic controls. A compressed work day starts one hour earlier and ends half an hour later, so the compressed workweek uses fewer person hours than the 5-day schedule.

Table 1. Comparison of TxDOT standard and compressed schedules.

5 Day/Week Standard Schedule	
8-8:30 a.m.	Crew staging at office
8:30-9 a.m.	Travel to job site
9-9:30 a.m.	Set traffic control
9:30-12	**Production**
12-1 p.m.	Hour lunch
1-4 p.m.	**Production**
4-4:30 p.m.	Remove traffic control
4:30-5 p.m.	Return to office
• Provides 5.5 hours production/day (27.5 hours/wk) • 9 work hours per day (45 hours/wk) • 12.5 hours/wk spent staging, traveling, and setting traffic controls	

4 Day/Week Compressed Schedule	
7-7:30 a.m.	Crew staging at office
7:30-8 a.m.	Travel to job site
8-8:30 a.m.	Set traffic control
8:30-12	**Production**
12-12:30 p.m.	Half hour lunch
12:30-4:30 p.m.	**Production**
4:30-5 p.m.	Remove traffic control
5-5:30 p.m.	Return to office
• Provides 7.5 hours production/day (30 hrs/wk) • 10.5 work hours per day (42 hours/wk) • 10 hours/wk spent staging, traveling, and setting traffic controls	

Results

After three months of operation, TxDOT performed an internal evaluation of the compressed workweek. Their investigation concluded that the compressed workweek offered substantial cost savings, increased productivity, and a generally happier workforce. Some key findings include:

- 52,758 equipment miles saved
- $19,232 cost savings from water and fuel reductions (calculated)
- Large efficiency improvements in large and small sign work, street sweeping, and in-place repair of base/subgrade
- Positive employee feedback, some employees preferred the standard 5-day workweek (15).

The compressed workweek proved a solid business decision. At virtually no cost, the Abilene and Odessa TxDOT districts created a program that generated large cost savings and improved productivity. As a human resources decision, the 4-day workweek was a work-in-progress. Due to employee preference for a consistent schedule, the Odessa district currently operates on a consistent 4-day work schedule instead of the alternating schedule shown in Figure 1. Additionally, many employees had to make special child care arrangements to accommodate the extended work day. The Odessa district has not implemented a program to help employees arrange or afford additional

child care, but has worked with those employees individually to meet their childcare needs (15).

Best Practices and Take Aways

The conversion to a four-day workweek for Abilene maintenance crews offers a nearly ideal framework for many of the maintenance offices in the Austin district. The conversion was easily implemented, came at very low cost, was well-documented, and done completely within TxDOT. The Abilene district also provided a methodology to document changes in productivity, money saved, and employee satisfaction.

3.3 Work 4 Utah

Impetus

Utah governor Jon Huntsman made national headlines in June 2008 with an executive order[1] that required 17,000 state employees (about 80 percent of the executive branch workforce) to adopt a four-day workweek (17). The program, called Work 4 Utah and referred to as the 4/10 arrangement, would require most state employees to work ten hours each day from Monday through Thursday and take Fridays off. The program was launched as a one-year pilot program to conserve energy, save money, improve air quality, and enhance customer service within government agencies (24). Observers credit high gas prices, Utahans' preference for earlier and later access to government

[1] The Executive Order #2008-0006 was one of the first issued by Gov. Huntsman after he assumed office.

services, and the desire to cut government spending on energy as key motivators for the switch (25), (26), (27).

Implementation

The Governor's Office began by undertaking several outreach initiatives in the two months before the change to a 4/10 schedule would be made in August 2008. The initiatives were meant to quickly disperse information about the program, establish a baseline from which to evaluate the project, and address agency-side implementation problems before they surfaced. The three most important initiatives included the creation of a hotline, projection of expected cost savings, and the production of a baseline report.

First, a Work 4 Utah hotline was established and a fully staffed call center was set up to answer questions by the public, affected employees, and local government officials. Calls to the hotline greatly declined shortly after the program was in place and the state was able to downsize the hotline staff.

The Governor's Office projected estimates of the project's annual economic impact. The economic impact study made a conservative estimate of projected annual benefits to the state. The estimates suggested that Utah would save $14 million annually from foregone vehicle operation, state savings from utility expenses, and "additional GDP due to reallocated expenditure of savings (28)." The study chose not to project benefits to

the environment, savings on building operational costs, and improved customer service until further study could be done.

A Baseline Report was widely circulated to explain the program's methodology, provide guidance to agency leadership, and address frequently asked questions by the public and affected employees. The focus of the report was on the responses of state agencies to a five-question survey that asked how each agency planned to handle various aspects of a four-day workweek. Answers regarding how the agency would monitor the program's effectiveness, communicate with customers, help employees transition, and maintain productivity were displayed as statistics and a list of innovative answers were given special attention.

Results

One year after the switch, Utah conducted an extensive survey and analysis that compared actual and projected cost savings, put employee opinion in perspective, and assessed the environmental impacts for the first time. Interestingly, the final report does not mention traffic or congestion savings and does not mention a relationship between Work 4 Utah and transportation..”

Table 2 shows the modest, but significant cost-savings from the one-year report. Overall energy savings after one year were about 10.5 percent among all state buildings and about 13 percent among those on a four-day workweek (28). The state could not

achieve 20 percent reductions at 4/10 worksites, since it was not always possible to turn off each building's unique utility system. New control technologies were installed midway through the pilot year in attempts to fix the problem. The largest savings came from reduced overtime pay. According to officials, this unexpected saving was a result of employees' eagerness to leave after the longer workday. A spokeswoman for the Governor simply put it, "they're getting what they need to get done in 10 hours and going home (28)."

Table 2. Work 4 Utah cost savings in FY 2008.

Cost Savings (FY 08 to FY 09)	**Amount**
Operational Costs	$203,000
Custodial Contracts	$203,177
Personal-owned Vehicle Reimbursement Fees	$575,000
Energy (HVAC, Power, Lighting)	$502,000
Fleet-leased Vehicles	$582,137
Non-fleet Vehicles	$289,630
Overtime Pay	$4,100,000
Total	**$6,454,944**

Before the actual cost savings data was published, local leaders thought the switch had saved money. Over 70 percent of local government leaders said that the 4/10 workweek is a "good way" for the state to try and save money. This kind of consensus showed that

Work 4 Utah was unlikely to be cut due to internal pressure that stems from conflicting opinion on the program's usefulness.

The switch to a 4/10 workweek impacted employees negatively in fewer ways than expected. The survey yielded two important findings. First, most employees liked the switch. After one year, 75 percent of employees preferred the 4/10 schedule (up from 56 percent who said they would like it). Only 18 percent reported disliking the new arrangements. Second, the survey found that workers over-estimated the potential negative side-effects of the program. Employees surveyed before the 4/10 workweek was established anticipated more problems with childcare arrangements and public transportation use than actually surfaced. After one year, only 9 percent of respondents indicated a negative impact on childcare (down from 20 percent before) and 8 percent saw a negative impact on public transportation (down from 14 percent before).

From a customer relations standpoint, local governments suffered most. 37 percent of local government leaders had a harder time doing business on Friday due to the closures. Whereas only 22 percent of the public felt the 4/10 schedule was inadequate. Data from the State of Utah showed that significantly more business was done online during the pilot. Business registration renewals, hunting and fishing licenses, criminal background checks, and income tax filings performed online increased substantially during the Work 4 Utah program.

In light of the favorable findings, Work 4 Utah was extended with certain exceptions in December 2009. The extension plan kept the vast majority of state offices on the four-day workweek but let key Utah Tax Commission and Department of Public Safety offices stay open on Fridays.

The Utah legislature passed a bill that stopped the 4-day workweek experiment as of September 2011 and called on state offices to be open five days, but left it up to the executive branch to determine whether to still schedule workers for the four-day weeks. Justification for ending the experiment came from a 2010 legislative audit that showed the expected savings never materialized, in part due to a drop in energy prices.

Best Practices and Take Aways

Work 4 Utah has produced the highest cost savings, highest return on investment, and is arguably the most sustainable alternative work arrangement. All of these positive attributes can be credited to the mandatory nature of the program. Since state agencies were required to close on Friday, the cost savings were much greater than they otherwise would have been under a voluntary or site-by-site implementation plan. Additionally, the fact that all state agencies made the switch provided consistency that helped the public and local governments adapt to the program. Imagine if Work 4 Utah gave agencies a choice regarding which flexible work arrangements to adopt. Different agencies might choose a 4/10 workweek and close on different days, thereby confusing

the citizens and local governments they serve. Others might adopt flextime that would keep the offices open longer each day, potentially increasing overhead costs.

Work 4 Utah shows that a compressed workweek does not necessarily need to be reserved for maintenance forces. The program is an excellent example of how a compressed workweek can benefit in-house employees as well. There is also a greater potential for overhead (operational, custodial, electric, etc.) savings due to employees being in the office only four days a week instead of five.

Although as of September 2011, the Work 4 Utah program was formally ended by Utah Legislature, the bill that stopped the experiment requires state offices to be open five days, but allows the executive branch to determine whether to still schedule workers for four-day weeks.

Chapter 4. Austin Study

As compressed workweeks are relatively new for maintenance crews, it is very important to establish a methodology to evaluate their effectiveness. Metrics must be established to appropriately assess performance, changes in efficiency, and monetary savings as a result of shifting maintenance crews from a standard five-day workweek to a compressed workweek. Performance measures were developed based on information contained in the TxDOT Maintenance Management Information System (MMIS) and the Equipment Operating System (EOS). Previously recorded maintenance activity data was compared to data collected after the compressed workweek was implemented to determine trends, savings, and opportunities to better understand and adjust the program.

4.1 Data Collection: MMIS and EOS

MMIS is the mainframe information system used to track and analyze maintenance work performed on the Texas State maintained transportation network. MMIS provides detailed statistics that can be used to accomplish the following:

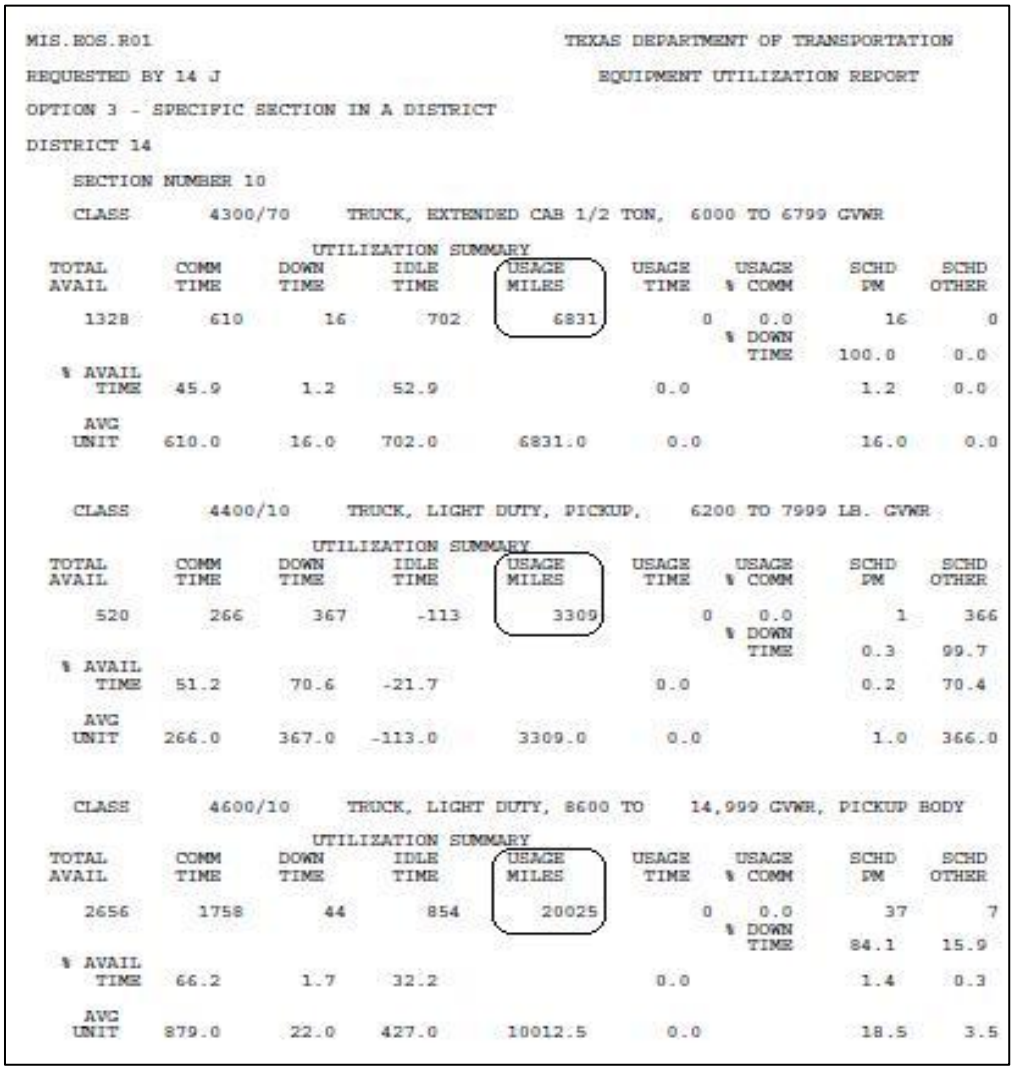
- Provide data on completed work and cost of maintenance activities to support budgeting and planning efforts.
- Provide a tool for analyzing maintenance activities so that production efficiency can be improved.

- Document the work accomplished in order to support the department's budget requests to the legislature.
- Provide data to compare costs of maintenance activities performed under contract with those performed by state forces (29).

MMIS is cataloged by function codes, which designate the various types of maintenance activities completed by the crews. The codes are separated into eight categories; each category is further delineated into specific maintenance activities, where each activity has a unique three digit code. For instance, a crew installing small signs, a “Traffic Service,” will record the number of signs erected, the amount of time spent, and the equipment used under the code “731” in MMIS (30). By categorizing each maintenance activity for individual maintenance sections within the Austin District, TxDOT has created an extremely detailed database. Further, the data has been compiled for previous years which support trend analysis and a “Before-After” study of maintenance crew activity.

Lastly, the Equipment Operations System (EOS), a subsystem of MMIS, was used to determine changes in maintenance vehicle operation. EOS provides specific data on equipment operating and maintenance costs, including mileage logs of maintenance crews (31). EOS reports can also be prepared for individual sections and vehicle classes. Some examples of vehicle classes are: Asphalt Maintenance Unit, Self-Propelled Road Sweeper, 1/2 Ton Extended Cab Truck, and Light Duty Pick-up Truck (32). The most

applicable EOS report, the Equipment Utilization Report, provides class summaries for all vehicles used in a maintenance section. For each class of vehicle, the data is expressed in number of hours used and number of vehicle miles traveled (VMT) (33). Figure 2 shows an Equipment Utilization Report for three classes of vehicles in the Travis East Section with the vehicle usage miles circled.



MIS.EOS.R01 TEXAS DEPARTMENT OF TRANSPORTATION

REQUESTED BY 14 J EQUIPMENT UTILIZATION REPORT

OPTION 3 - SPECIFIC SECTION IN A DISTRICT

DISTRICT 14

SECTION NUMBER 10

CLASS 4300/70 TRUCK, EXTENDED CAB 1/2 TON, 6000 TO 6799 GVWR

UTILIZATION SUMMARY

	TOTAL AVAIL	COMM TIME	DOWN TIME	IDLE TIME	USAGE MILES	USAGE TIME	USAGE % COMM	SCHD PM	SCHD OTHER
	1328	610	16	702	6831	0	0.0	16	0
							% DOWN TIME	100.0	0.0
% AVAIL TIME		45.9	1.2	52.9		0.0		1.2	0.0
AVG UNIT		610.0	16.0	702.0	6831.0	0.0		16.0	0.0

CLASS 4400/10 TRUCK, LIGHT DUTY, PICKUP, 6200 TO 7999 LB. GVWR

UTILIZATION SUMMARY

	TOTAL AVAIL	COMM TIME	DOWN TIME	IDLE TIME	USAGE MILES	USAGE TIME	USAGE % COMM	SCHD PM	SCHD OTHER
	520	266	367	-113	3309	0	0.0	1	366
							% DOWN TIME	0.3	99.7
% AVAIL TIME		51.2	70.6	-21.7		0.0		0.2	70.4
AVG UNIT		266.0	367.0	-113.0	3309.0	0.0		1.0	366.0

CLASS 4600/10 TRUCK, LIGHT DUTY, 8600 TO 14,999 GVWR, PICKUP BODY

UTILIZATION SUMMARY

	TOTAL AVAIL	COMM TIME	DOWN TIME	IDLE TIME	USAGE MILES	USAGE TIME	USAGE % COMM	SCHD PM	SCHD OTHER
	2656	1758	44	854	20025	0	0.0	37	7
							% DOWN TIME	84.1	15.9
% AVAIL TIME		66.2	1.7	32.2		0.0		1.4	0.3
AVG UNIT		879.0	22.0	427.0	10012.5	0.0		18.5	3.5

Figure 2. Equipment Utilization Report.

4.2 Conceptual Framework: TxDOT Implementation Plan

For this evaluation of compressed workweeks, maintenance supervisors agreed to implement a nine-month pilot program in three maintenance sections: Mason (Mason County), Giddings (Lee County), and Travis East (Travis County) which started in November of 2011 and ran to July 2012. A five-month pilot was also introduced in Bastrop (Bastrop County), Lockhart (Caldwell County), and Taylor (Williamson County) which began in March of 2012 and run to July 2012. All sections selected serve "rural" areas due to advisement from the San Antonio District which found this type of compressed workweek to be problematic for crews serving urban areas.

Based on input from maintenance crews in the Abilene District, Austin maintenance supervisors decided to implement a consistent schedule as opposed to a staggered schedule. The consistent schedule, shown in Figure 3, requires 10-hour work days for all maintenance employees with Friday off each week. If a holiday falls on Monday through Thursday, crews will still maintain the four-day work schedule; they will work 10-hour days on the remaining three days of the week, have Friday off, and receive 10 hours of paid holiday. When a holiday falls on a Friday, crews will work four, 10-hour days and receive eight hours of compensatory time for the holiday. Maintenance supervisors have indicated that keeping a consistent four-day work schedule with Friday off every week provides consistency in employee's personal schedules as well as uniformity for county and city offices that contact TxDOT maintenance offices on a regular basis.

Similar to the normal schedule, crews will remain on call for emergency situations that arise on Friday, Saturday, and Sunday. Lastly, crew members were given the option of the start and end time of their workday. Of the thirty-eight employees that participated in a compressed workweek, fifteen elected to work from 7:00 am to 5:30 pm, while twenty-three elected to work from 6:30 am to 5:00 pm.

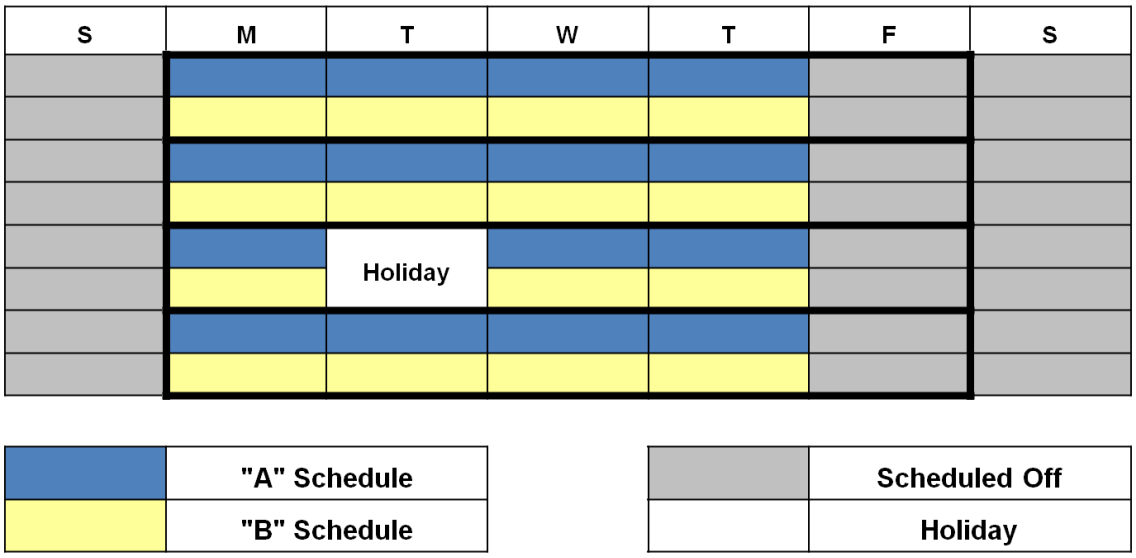


Figure 3. Consistent schedule of Austin compressed workweek.

A specific list of maintenance functions was defined by researchers, maintenance supervisors, and other TxDOT personnel to quantify productivity changes. Table 3 outlines the maintenance function codes, types, and work units analysts used to measure productivity. These functions were chosen because they represent a variety of maintenance categories that are regularly performed. Maintenance functions performed on a regular basis provide a larger and more comparable dataset as opposed

to functions performed irregularly. Similarly, Table 4 shows the vehicle types selected for each maintenance section in order to calculate changes to VMT after the compressed workweek was implemented.

Table 3. Maintenance function codes used for productivity analysis.

Function Code	Function Type	Work Unit
212	Leveling or Overlaying with a Maintainer	SQUARE YARD
241	Potholes, Semi-permanent Repair	EACH
270	Edge Repair	LINEAR FEET
523	Debris	MILES
721	Delineators	EACH
731	Small Signs	EACH
732	Large Signs	SQUARE FEET

Table 4. Vehicle types used for VMT analysis.

Vehicle Type	Giddings	Mason	Travis East	Bastrop	Lockhart	Taylor
Truck, Light Duty, Pickup			✓			
Truck, Light Duty, 8600 TO	✓		✓	✓	✓	✓
Truck, Light Duty, Crew Cab		✓				
Truck, Light/Medium	✓	✓	✓		✓	✓
Truck, Extended Cab ½ Ton	✓	✓	✓	✓	✓	✓
Truck, Extended Cab ¾	✓					
Truck, Platform, Platform Dump, Stake		✓				
Truck, Dump, Single Rear Axle	✓	✓	✓	✓	✓	✓
Truck, Dump, Tandem Real Axle	✓	✓	✓	✓	✓	✓

Along with VMT's and productivity calculations, satisfaction surveys of maintenance crews were also conducted near the beginning and again near the end of the experiment to gauge employee reactions both positive and negative.

Chapter 5. Data Analysis and Results

After the compressed workweek was implemented and data collected, analysts focused on answering three key questions:

5.1 Are crews more productive working under the compressed workweek?

In order to accurately evaluate productivity, analysts measured the amount of work performed by maintenance forces while accounting for the time taken to perform tasks. Each function in the MMIS has a specific work unit. For example, function code 270, edge repair, has a work unit of linear feet. The linear feet of edge repair completed can be normalized by the number of hours dedicated to edge repair for a given month. Therefore, a common unit of comparison can be established: *work units per hour*.

The work units per hour were then used to generate percent changes between past conditions and the study period based upon function code and month of production. For example, if the median (medians used due to significant data variability) of Giddings work units per hour between 2008 and 2011 were 3, and the work units per hour for 2012 were 4 then percent change would be (4-3)/3 or a positive increase of 33 percent.

Unfortunately maintenance crew activities are highly variable in both type of work performed as well as the amount that needs to be performed. While there were 7 specific function codes selected for tracking by TxDOT staff there are over 120 function codes that may be assigned to maintenance crews with only 76 specified as trackable due to unit limitations (34). While all the codes within the function listing are not

applicable for all seasons or locations, many have the potential of requiring crew attention at any given time. This fluctuation of activity resulted in large values on both the positive and negative sides of production. While acknowledging this inherent issue but still gaining meaningful results, emphasis was placed upon the positive/negative aspects of the data rather than the exact number. In this fashion productivity could be compared based upon the number of positive percent changes as they contrast with the number of negative percent changes. If the value of percent change for a function code in a section during a particular month was positive then the result for that value was recorded as a "+1." If the function code value for that particular section's month was negative than the value was recorded as a "-1." Figure 4 shows the summation of productivity results for all the function codes within a section. Figure 5 shows productivity for specific function codes over all sections.

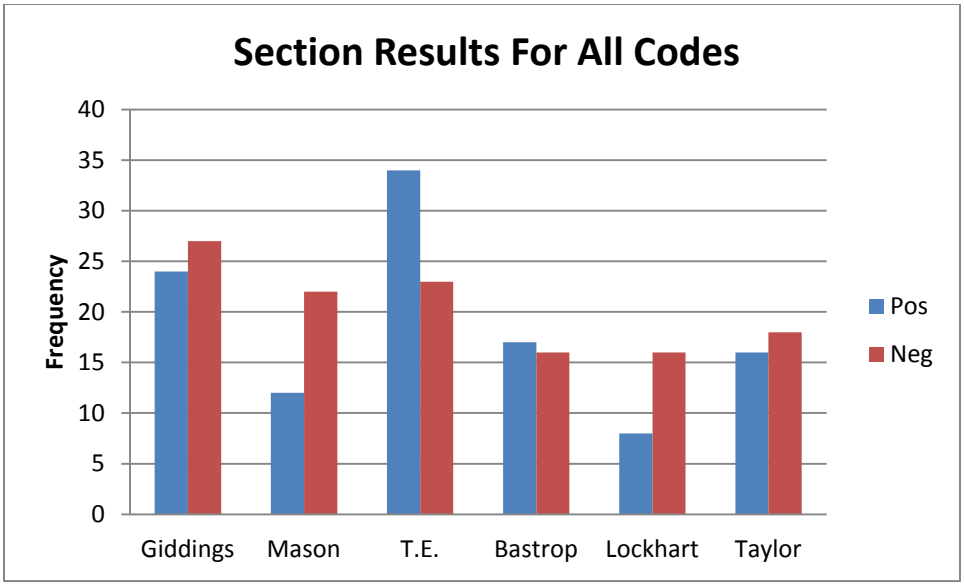


Figure 4. Productivity results based upon all function codes.

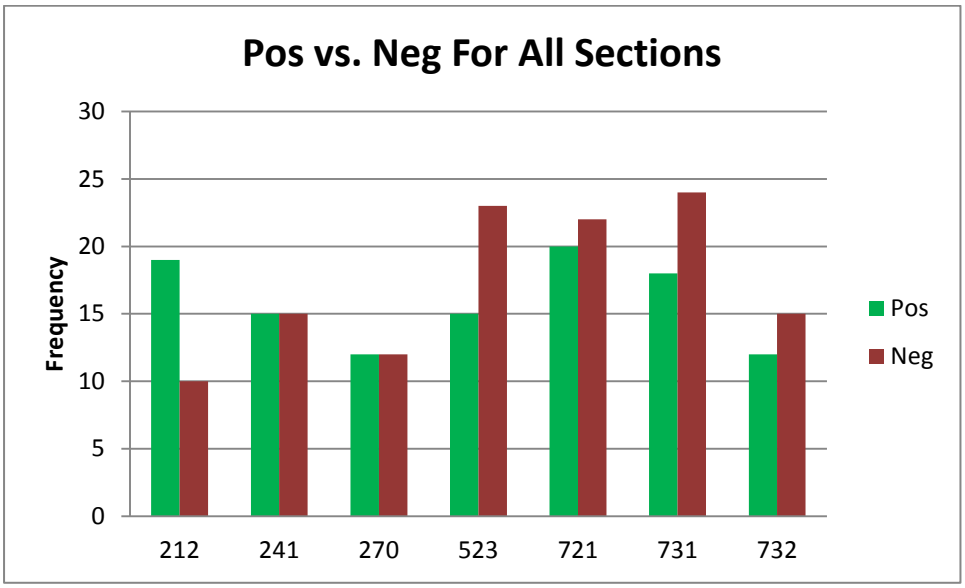


Figure 5. Productivity results by function code for all sections.

As both graphs illustrate there are variations between function codes as well as between sections but without any certain trend. Some sections are slightly positive and some are negative, but this is a general overview of productivity. It is important to note that while certain results may be negative, there could be a rise in productivity in other function codes that were not monitored, indicating again the variation of the crew's schedules. There appears to be no significant difference or trend between past and present conditions.

Statistical testing of the hypothesis that productivity changes were significantly different among the six sections (See Figure 4) indicates that the differences are *not* statistically significant. Using a non-parametric Chi-Square test of the independence of productivity change versus section indicates that the magnitude of observed productivity differences between before and after 4-day work weeks among sections are not significant at a five percent level; in other words they are likely to have occurred due to chance alone. Similarly, testing of the differences in productivity change among the seven function codes were conducted using the same test procedure (See Figure 5). Again, the observed productivity changes across function codes were not statistically significant at a five percent significance level and these would not even be significant even at a 50 percent level. This could be interpreted as saying that the before-after differences across function codes are very likely due to chance; there is no significant relationship between codes and productivity differences.

5.2 How does the compressed workweek affect VMT of maintenance vehicles?

In theory, a compressed workweek will result in reduced fuel spending by about 20 percent simply because crews are travelling to the worksite four days a week instead of five (35). Conversely, maintenance crew vehicle miles traveled (VMT) could increase for some vehicles if production rates increase. Although a VMT increase might seem like a negative side-effect, a higher output could outweigh the additional fuel expenditures.

VMTs were summed by section for all vehicles over the study period and then compared to past VMTs. The results were then averaged between sections depending upon their study period. For instance, all sections starting in November were averaged together. The results are outlined in Figure 6 and Figure 7.

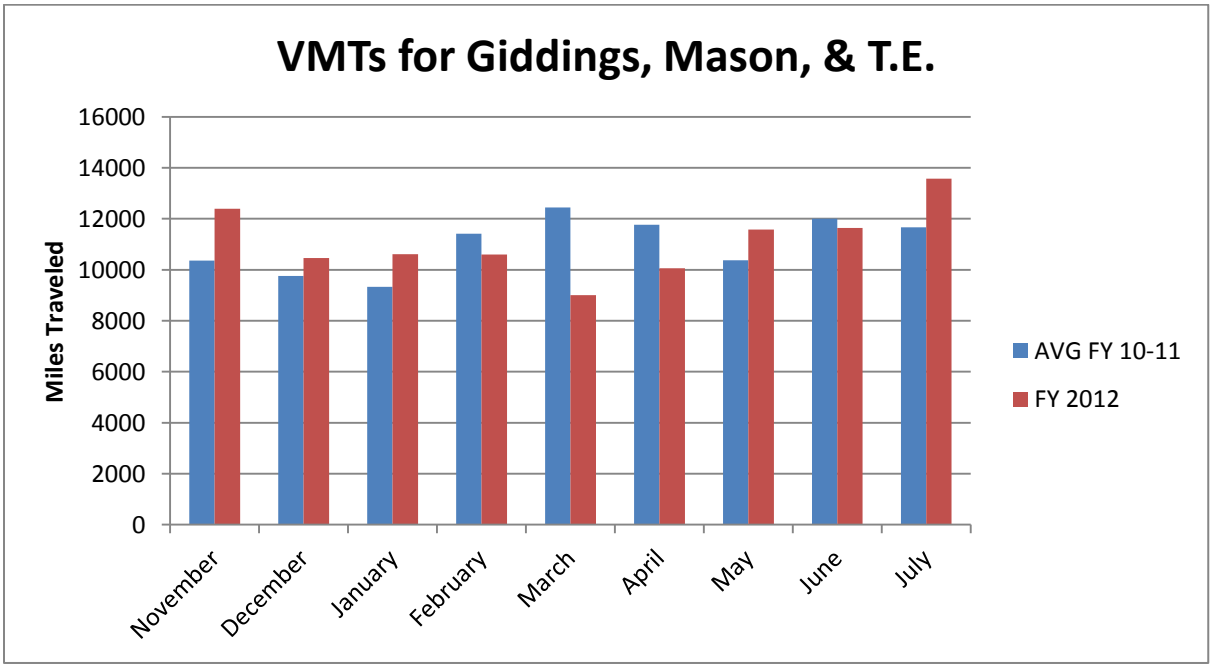


Figure 6. VMTs of all vehicles for Giddings, Mason, and Travis East.

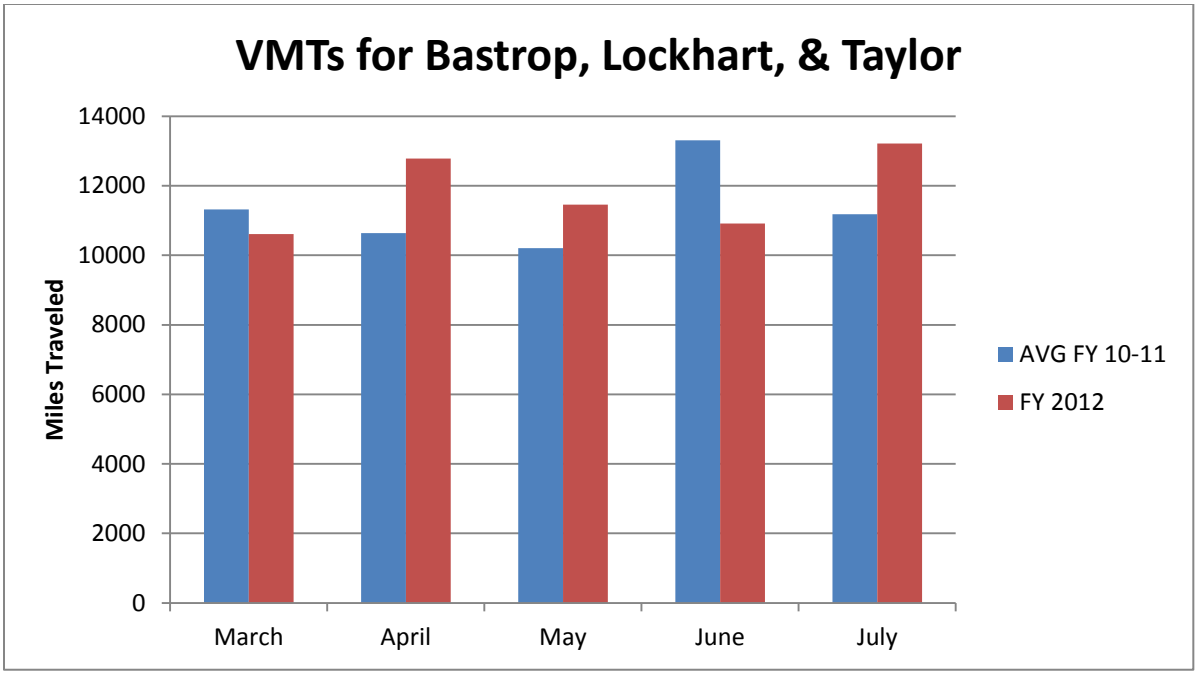


Figure 7. VMTs of all vehicles for Bastrop, Lockhart, and Taylor.

As the graphs show, the VMTs varied but with no specific pattern.

Tests for statistical significance were used to compare the VMT data for "before" and "after" conditions. The null hypothesis was that there was no difference between the mean of previous VMT's and those during the study period. In order to identify an appropriate significance test, data normality was examined.

Normality was evaluated using the Shapiro-Wilk test. The rationale behind this test is that it was called out by the Journal of Statistical Modeling and Analysis as having the highest power for a given significance (36). Specific calculations were manipulated utilizing XLStat. The findings were that roughly half the data did not follow a normal distribution as shown in Figure 8.

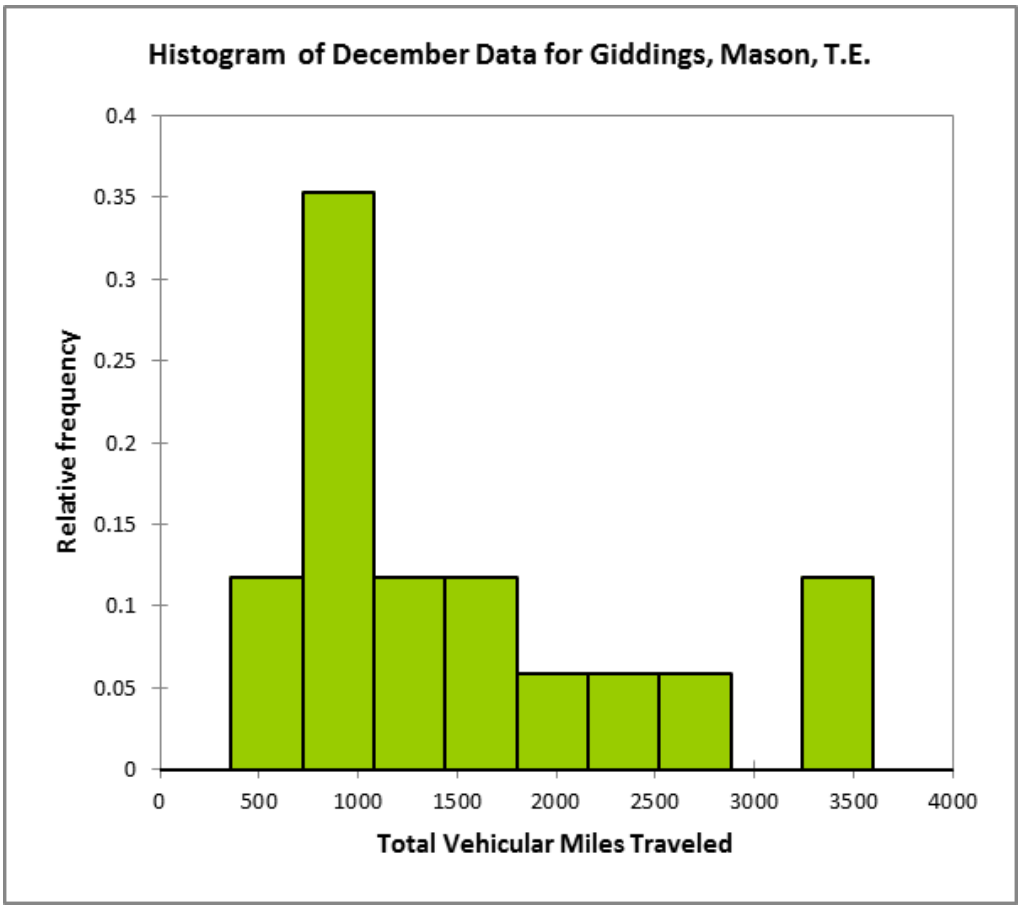


Figure 8. Histogram of VMT's for Giddings, Mason, & T.E.

Traditional parametric methods of significance testing such as the Student's *t*-test are not applicable as they require normally distributed data. Therefore, the non-parametric Kolmogorov-Smirnov (K-S) test was used. The K-S test has several advantages over parametric tests since it does not require assumptions about the distribution of the parent population from which the sample data is drawn. Secondly the K-S test can make comparisons between two different group sets. Lastly this test is capable of determining significance without requiring a large sample size.

Although VMTs were manually compared on a month by month basis, statistical significance testing required a larger sample. To reduce random variability, testing was done over the entire trial period. For instance, all vehicular miles were combined for Giddings, Mason, and Travis East for December. This method increased the sample size and allowed more reliable statistics. Based upon a five percent rejection region (95 percent confidence level) there was no statistically significant difference between VMT's before and after four-day work weeks, that is, differences are likely to have occurred due to chance alone.

As a further point of analysis, VMTs were also compared by vehicle type for all sections who use that type of vehicle. Figure 9 represents these results.

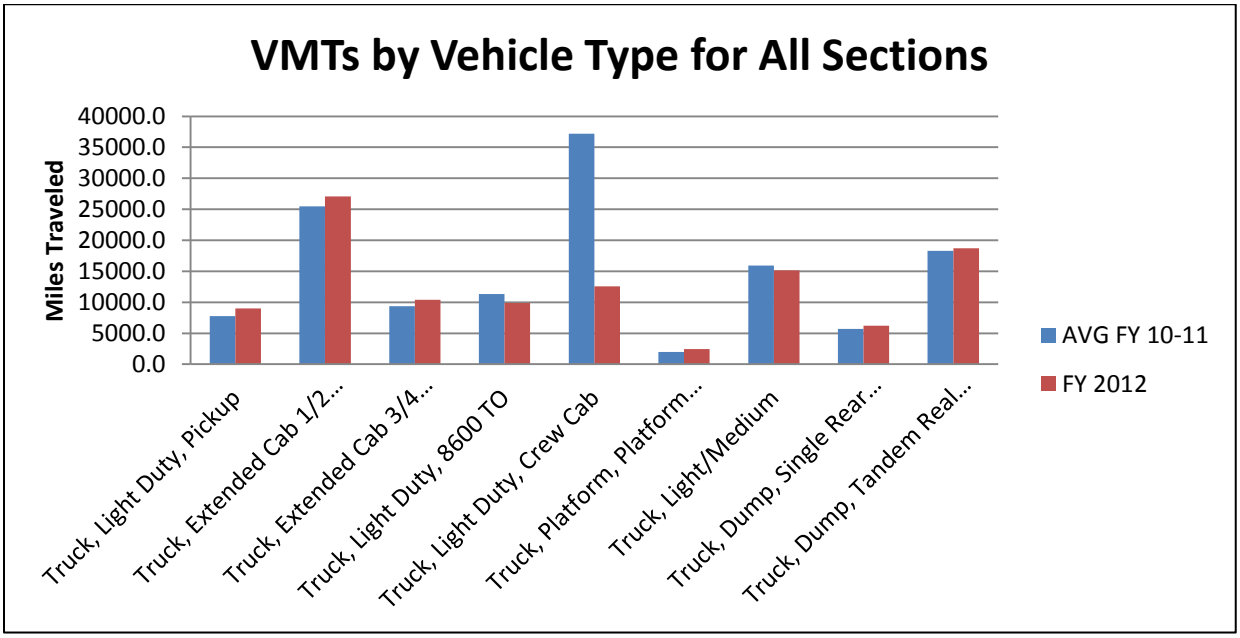


Figure 9. VMTs versus vehicle type.

VMTs show minimal variations between past and present conditions. The only significant change was for the "Light Duty Crew Cab" which is only used by the Mason District. The specific reason for this drop is unknown but is likely due to the utilization of alternative vehicles.

5.3 Do employees prefer a compressed workweek or standard five-day workweek?

Two satisfaction surveys were distributed to the crews, one at the beginning and one at the end of the trial period. Meetings were also held with crew representatives, supervisors, and TxDOT personnel to gather opinions in person several times throughout the study.

Benefits

The 4-day workweek was overwhelmingly approved by the crews as well as their supervisors. The surveys indicated over 97 percent satisfaction, and over 98 percent stating that they had not noticed additional fatigue with the longer work day. Particular benefits that the crews identified included:

- Additional time with family
- Ability to make personal appointments that otherwise required time off
- Less stress and increased efficiency on job sites
- Average travel savings of 31 miles per crew member which saved on fuel expenditures as well as wear and tear to their personal vehicles.

Supervisors made sure to mention that they noticed improved morale among their crews. They also stated that they felt work had improved due the ability to utilize equipment requiring significant start/stop times.

Concerns

Throughout all sections two concerns were noted. The first was difficulty making child arrangements for daycare or school. This concern was presented by roughly 7 percent of the crew members in the beginning survey but dropped to 2 percent by the ending survey. The other popular concern was over the difficulty to input hours into the time recording system designed for a 5-day workweek. This problem has caused confusion over vacation time as well the crew's ability to submit accurate timesheets. Several supervisors mentioned that they were filling out their employee's timesheets by hand to counter this dilemma but were happy to do it as the crew morale had noticeably improved.

Vacation and Sick Leave

Monthly employee vacation and sick leave times were compiled between 2008 and 2011. These results were averaged and compared to times used for 2012 to create percent changes and significance testing was handled in the same fashion outlined above for VMTs For Giddings, Mason, and Travis East, only the month of November showed a statistically significant change between before and after four-day work weeks.

November showed a decrease in vacation time. For Bastrop, Lockhart, and Taylor the month of March showed significantly decreased vacation time and April showed significantly decreased sick leave. All other months had no significant changes in activity.

Chapter 6. Recommendations and Conclusions

The 4-day workweek was an initiative that was thought of and generated in-house at near-zero cost. This program has not significantly changed productivity or wear and tear to the maintenance fleet but has improved employee perception of the working conditions. Crew members as well as their supervisors have noticed increased morale and reduced stress. Additionally workers have mentioned increases in family time as well as the ability to create personal appointments without having to take time off. Negative impacts have been minor with only 2 percent of the work force mentioning side effects typically associated with compressed workweeks. An improved timesheet system would solve many of the staff's issues.

For the reasons outlined above, it was recommended that the compressed 4-day workweek be continued and possibly extended to additional sections at TxDOT. Further study would be necessary to determine if the program could be executed, in some form, for workers in urban areas. The consistent scheduling was an improvement over the staggered schedule seen in Odessa as crew members were able to clearly follow the consistent schedule without confusion. Unfortunately, utility information was not available for savings calculations, but it is reasonable to assume that with additional analysis TxDOT will see reduced expenditures.

Recommended improvements identified through the surveys and personnel meetings included changing the system in which timesheets are recorded. An arrangement that

could accommodate the 4-day workweek would take pressure off supervisors who have been manually inputting hours as well as reduce employee concerns over potential lost vacation/sick time.

Improvements to the analysis would be to fully analyze all function codes used by the maintenance crews. The variability in the work demanded of the crews cannot be fully illustrated from the observations based upon only selected function codes. TxDOT should continue to document changes in productivity to better visualize the impacts of the 4-day workweek.

References

1. Flexible Schedules: Compressed Workweek Policy Procedure #1. *Society for Human Resource Management.* [Online] January 2011. [Cited: March 23, 2011.] http://www.shrm.org/TemplatesTools/Samples/Policies/Pages/CMS_005020.aspx.

2. **SHRM.** Flexible Schedules: Flextime Policy. *Society for Human Resource Management.* [Online] January 2011. [Cited: March 23, 2011.] http://www.shrm.org/TemplatesTools/Samples/Policies/Pages/CMS_007473.aspx.

3. Telecommuting: Telecommuting Policy and Procedure #1. *Society for Human Resource Management.* [Online] January 2011. [Cited: March 23, 2011.] http://www.shrm.org/TemplatesTools/Samples/Policies/Pages/CMS_000573.aspx.

4. **Rex L. Facer II, Chyleen A. Arbon & Lori L. Wadsworth.** Cities Leading the Way: The Use of Alternative Work Schedules. *ICMA.* [Online] 2009. [Cited: September 22, 2012.] http://bookstore.icma.org/Cities_Leading_the_Way_The_Us_P1970C19.cfm.

5. **Lister, Kate and Harnish, Tom.** *Undress for Success: The Naked Truth About Making Money at Home.* Hoboken, New Jersey : John Wiley and Sons, Inc, 2009.

6. **Viau, J. M.** *Hours and Wages in American Organized Labor.* St. Louis : Putnam and Sons, 1939.

7. **Bird, Robert C.** The Four-Day Work Week: Old Lessons, New Questions. [Online] May 2010. [Cited: September 22, 2012.] http://uconn.lawreviewnetwork.com/files/documents/RobertC.Bird.pdf.

8. This Day in History: Ford factory workers get 40 hour week. *History Channel.* [Online] [Cited: September 22, 2012.] http://www.history.com/this-day-in-history/ford-factory-workers-get-40-hour-week.

9. Fair Labor and Standards Act. *Wikipedia.* [Online] [Cited: September 22, 2012.] http://en.wikipedia.org/wiki/Fair_Labor_Standards_Act.

10. **Staats, Elmer B.** *Contractors' Use Of Altered Work Schedules For Their Employees--- How Is It Working?* s.l. : Department of Labor, 1976.

11. **Zabel, Christine Avery & Diane.** The Flexible Workplace: A Sourcebook of Information and Research. Westport, CT : Quorum Books, 2001.

12. **Bird, Robert C.** The Four-Day Work Week: Old Lessons, New Questions. [Online] May 2010. [Cited: September 22, 2012.] http://uconn.lawreviewnetwork.com/files/documents/RobertC.Bird.pdf.

13. **Hung, Rudy.** *An annotated bibliography of compressed work weeks .* s.l. : MCB UP Ltd, 1996.

14. **Lenz, Russel.** *Maintenance Operations Update: Work Week Revision to Enhance Efficiency and Reduce Operating Expenditures .* Texas Department of Transportation. Abilene : s.n., 2008. Presentation.

15. **Lenz, R.** Work Week Revision to Enhance Efficiency and Reduce Operation Expenditures. Albiene : Texas Department of Transportation, 2008.

16. **K. Dennis, and J. Muller.** *TxDOT Equipement Replacement Model-TERM.* s.l. : Texas Department of Transportation, 2011.

17. **Hansen, M.** *Working 4 Utah.* [Online] February 2009. [Cited: March 30, 2011.] http://www.uth.gov/govemor/docs/Working4UtahInterimReport.pdf.

18. **Wadsworth, Rex L. Facer II & Lori L.** Four-Day Work Weeks: Current Research and Practice. [Online] May 2010. [Cited: September 22, 2012.] http://archive.connecticutlawreview.org/documents/Volume42Issue4.pdf.

19. Work Options. *Compressed Worweek: Pros & Consas a Flexible Work Arrangement.* [Online] January 2011. [Cited: July 1, 2011.] http://www.workoptions.com/compros.htm.

20. **Brundin, J.** Utah Finds Surprising Benefits In 4-Day Workweek. *NPR.* [Online] April 2009. [Cited: September 22, 2012.] http://www.npr.org/templates/story/story.php?storyId=102938615.

21. **L. Rex, & Lori Wadsworth.** Alterntive Work Schedules and Work-Family Balance. [Online] May 2008. [Cited: September 22, 2012.] http://rop.sagepub.com/content/28/2/166.abstract.

22. **Estes, Jennifer L. Glass & Sarah Beth.** The Family Responsive Workplace. [Online] August 1997. [Cited: September 22, 2012.] http://www.annualreviews.org/doi/abs/10.1146/annurev.soc.23.1.289?journalCode=soc.

23. **Loskorn, Jeffrey.** *Framework for Compressed Workweek Implementation for TxDOT Maintenance Forces and Flexible Work Arrangements for Employees.* Austin : University of Texas, 2011.

24. **Hubert, Gary.** State of Utah. *Utah.gov.* [Online] June 26, 2008. [Cited: March 30, 2011.] http://www.utah.gov/governor/news_media/article.html?article=1724.

25. **Walsh, B.** TIME Magazine. *The Four-Day Workweek Is Winning Fans.* [Online] September 7, 2009. [Cited: March 30, 2011.] http://www.time.com/time/magazine/article/0,9171,1919162,00.html.

26. **Copeland, L.** Most state workers in Utah shiftin to 4-day week. *USA Today.* [Online] July 1, 2008. [Cited: March 30, 2011.] http://www.usatoday.com/news/nation/2008-06-30-four-day_N.htm.

27. **Cavuto, N.** Utah's 4-Day Work Week Due to Gas Prices. *FOX News.* [Online] July 3, 2008. [Cited: March 30, 2011.] http://www.foxnews.com/story/0,2933,375881,00.html.

28. **Hansen, M.** Initiative Performance Report. [Online] August 2008. [Cited: March 30, 2011.] http://www.utah.gov/governor/docs/Working4UtahReport.pdf.

29. Maintenance Management Info. System (MMIS) Users Manual Ch. 1 . s.l. : Texas Department of Transportation, 2002.

30. MAintenance MAnagement Info. System (MMIS) User Manual Ch. 2. s.l. : Texas Department of Transportation, 2002.

31. Equipment Operations System (EOS) User's Manual Ch. 1. s.l. : Texas Department of Transportation, 2011.

32. Equipement Utilization Report (R01). Austin : Texas Department of Transportation, 2011.

33. Equipment Operating System Manual Ch. 12. Austin : Texas Department of Transportation, 2011.

34. Maintenance Function Codes Code Chart 12. s.l. : Texas Department of Transportation, July 2009.

35. **Lenz, R.** July 2011.

36. **Razali, Nornadiah and Wah, Yap Bee**. Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics 21-33.* 2011.