Nikolin, B., Herrera, J., McCready, T., Grau, D., and Parrish, K. 2015. "A Call for New Research in the Lean Construction Community: Alternative Work Schedules." In: *Proc. 23rd Ann. Conf. of the Int'l. Group for Lean Construction*. Perth, Australia, July 29-31, pp. 435-443, available at www.iglc.net

A CALL FOR NEW RESEARCH IN THE LEAN CONSTRUCTION COMMUNITY: ALTERNATIVE WORK SCHEDULES

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ABSTRACT

While there is considerable research performed in the construction industry on the loss of productivity after a 5 day / 8 hour a day work week there is very little research exploring productivity with fewer work hours. Other industries have shown that they are more productive working shorter weekly schedules. Indeed, if we can produce a quality product with fewer resources, value stream is improved and a leaner process executed. More importantly, if we can be safer and improve quality of life we are achieving the most important tenant of lean, respect for people. To reinforce such notion, data shows that the US is 3% less productive than the other top 10 most productive countries in the world even though the US workforce works 21% more hours. Several countries, such as the Netherlands and Denmark, who work 29 and 33 hours per week, respectively, have a higher quality of life and have similar or higher productivity. This paper presents both a theoretical basis for alternative work schedules in construction as well as the results of a survey administered to trade contractor personnel, illustrating the potential safety benefits of a schedule change.

KEYWORDS

Productivity, quality of life, safety, alternative work schedules (AWS), waste.

INTRODUCTION

Field workers currently work 40 hours each week, spanning 5 days with 8-hour shifts per day. This study aims at challenging this practice and presents alternative work schedules that may improve safety, quality, productivity, and quality of life while reducing the carbon footprint. We borrow ideas from other industries, including healthcare, law enforcement, and others that have shorter workweeks (Geiger-Brown, Trinkoff and Rogers, 2011; Kelly, Moen and Tranby, 2011; Griffin and Moorhead 2012). These industries have shown that they are more productive and that their staffs

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prefer shorter schedules (Tippins and Stroh, 1993; Kim and Wiggins, 2011; Anthony 2012; Morrison and Thurnell, 2012; He, 2013). Moreover, data shows that the US is **not** one of the most productive countries in the world even though the US workforce works 21% more hours (Hall and Jones, 1998). This paper is a call for more research in the area of alternative work schedules in construction, as the authors believe that research in this area may compel owners to accept an alternative work schedule.

ALTERNATIVE WORK SCHEDULES

Combs (2010) implicitly defines alternative work schedules as any work schedule that is **not** 5-day, 9am–5pm (8 hour/day), 40-hour work weeks. Specifically, she defines *flextime,* where employees vary their start and end times while maintaining a required core hours. This schedule allows employees to select their own start and end times, but generally involves a 5-day workweek. A *compressed workweek* allows an employee to work 40 hours but in less than five eight-hour days within a week. Finally, *telecommuting* allows employees to work from home or another alternate location.

Alternative work schedules seem particularly popular in the public sector as well as in the healthcare industries (Tippins and Stroh, 1993; Combs, 2010; Geiger-Brown, Trinkoff and Rogers, 2011; Kelly, Moen and Tranby, 2011; Anthony, 2012; Griffin and Moorhead, 2012; Morrison and Thurnell, 2012; He, 2013). Most of these industries implement compressed workweeks that allow employees to work 40 hours each week in fewer than five days.

In 2002, 100 school districts in 6 states experimented with knocking off Friday. The school days were extended an hour or more to make up for the lost time. Schools found they could save money on transportation, heating and substitute teachers. Advantages were decreased absence by teachers and students, and the 5th day was used for teacher training or personal appointments. There were also reports of improved student morale and behaviour (Donis-Keller and Silvernail, 2009).

Within the construction industry, in Netherlands and Denmark respectively, where standard workweeks are 29 hours and 33 hours, trade contractors work fewer hours and have a higher quality of life and are more productive, according to conversations we held with subject matter experts from those countries. Moreover, Morrison and Thurnell (2012) report that construction companies in New Zealand allow employees to use alternative work schedules to promote retention. While this study provides value, it focused on managers as opposed to field workers, who are the scope of this study.

CURRENT CONDITION IN THE USA: 40-HOUR WORKWEEK

Most industries in the USA work a 40 hour work week combined of (5) 8 hour work days (Combs, 2010). This has roots in the late 18th century, when companies started to focus on maximizing factory output. To do so, many companies sought 24/7 operation. At that time, the notion of increased efficiency was actually to make people work longer. In fact, 10-16 hour days were the norm (Combs, 2010). These incredibly long workdays were not sustainable and soon Robert Owen started a campaign to have people work no more than 8 hours per day. His slogan was **"Eight hours labour, eight hours recreation, eight hours rest"** (Widrich, 2014). Widrich (2014) further reports that Henry Ford was an early adopter of the 8-hour workday because it offered employees leisure time, which contributed to the market for the automobiles his factories were producing.

As in most US industries, construction companies typically employ a 5-day, 40-hour workweek. According to the authors' conversations with owners, they generally feel the 5-day, 40-hour workweek is the fastest and most cost effective way to build. Construction unions have also adopted the 5-day 40-hour workweek to be the standard for regular time wages.

SAFETY IMPACTS

The authors postulate the current workload has safety impacts on construction sites. Based on the 2014 Southern California (USA) safety logs from Turner Construction, the authors tracked the day and time incidents were reported. Fig. 1 illustrates the day of the week and the time of the day associated with incidents. Note that the average and median injury time for everyday of the week occurred between 9:50 am and 12:39 pm. This time corresponds to the timeframes of the morning and lunch breaks (Figure 1). These breaks in work pose the highest risk for safety incidents. By eliminating a day of work and more importantly breaks in work, there is a potential to drastically reduce the number of safety incidents that occur. This further compels the notion of implementing an alternative work schedule.

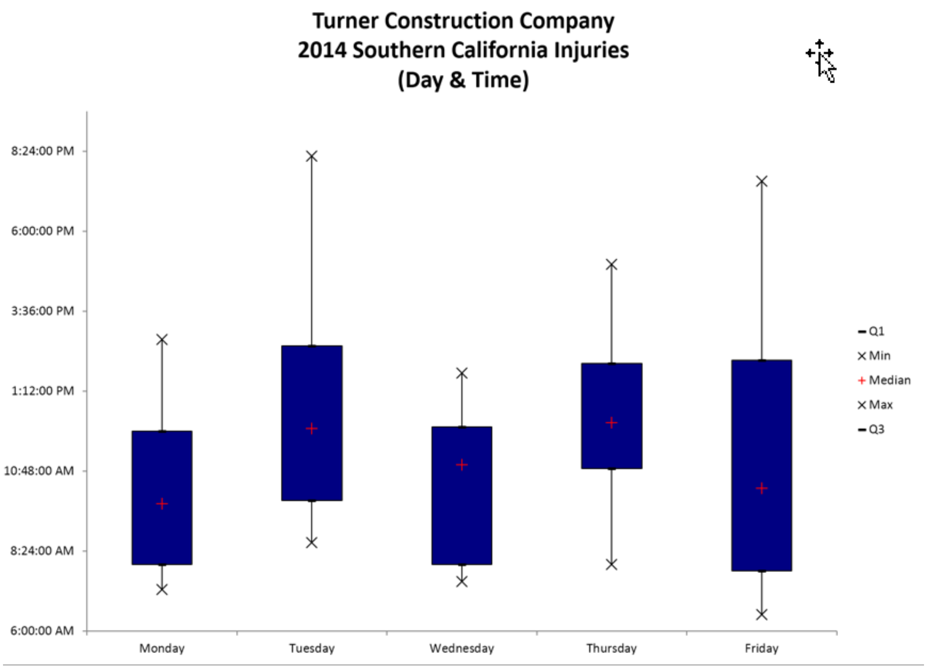


Figure 1: Box Chart of Injuries by Time and Day of Week.

SUSTAINABILITY IMPACTS

The 5-day, 40-hour workweek requires traveling to and from work 5 days each week, and this travel creates carbon emissions. According to the US Census Bureau, the average travel time to and from work is 50 minutes, totalling 250 minutes of driving per week, which translates to 15,600 minutes a year (McKenzie and Rapino, 2011). The average commute is 30 miles round trip, totalling 150 miles per week and 7,800 miles per year. According to American Forests (2015), each gallon of gas emits 17.68 pounds of CO_2. In 2011, the weighted average fuel economy of cars and light trucks combined was 21.4 miles per gallon (FHWA 2013). Thus, each person emits 6,453 lbs of CO_2 annually driving to and from work.

7,800 miles/year = 365 gal/year
365 gal/year x 17.68 lbs/gal = 6453 lbs/year CO2
21.4 miles/gal

NON-VALUE ADDED WORK IMPACTS

Each day a worker must get to his/her work area and prepare the day's task. This on average can be 20-30 minutes depending on how far and how much prep is required for the task. Additionally, there is a similar timeframe for cleaning up and vacating the work area. Finally, there is a morning and lunch break per day. Similar to the commencement and completion of the work day there is time associated with these breaks where workers must prep/close work area. This can be a combined 20-30 minutes of additional work.

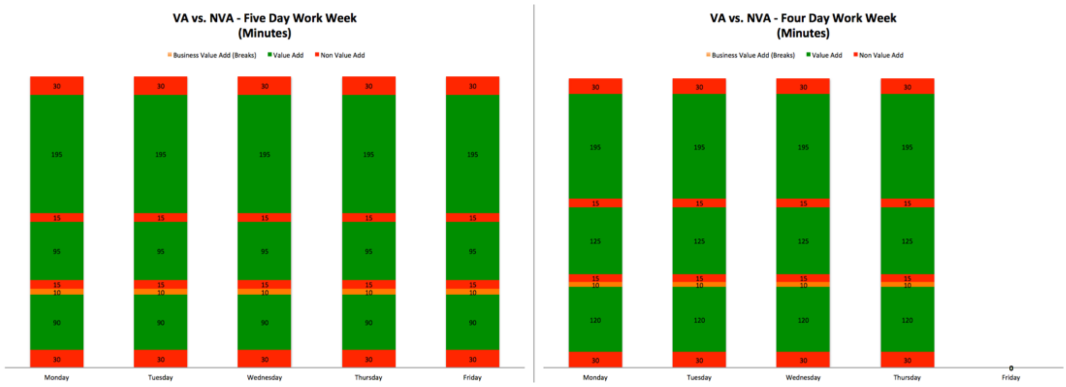
When looking at the effect of a 4 day/9 hour a day work week vs. a standard work week we can quickly quantify the effect. There can possibly be a 100 minute reduction in set-up time (Non-Value Added Work) just by downsizing to a 4 day work week. This means that a craftsmen needs to be about 7% more productive working a 4 day/9 hour a day work week to achieve the current state of productivity. If a plumber is currently installing cast iron pipe at the rate of 20 lf/hr, then in a 4 day/9 hour work week she needs to install 21.4 lf/hr. This is not a considerable change in productivity of the current craftsmen.

FLOW IMPACTS

The industry's ability to plan is often constrained by the on-going activities of the construction project. In a modified work schedule with 4 working days, the management/administrative side can continue to work the 5th day in order to plan work, transmit information (Submittals, RFI's, etc.) and increase flow. This day is an opportunity to plann for the coming work without the constraints and immediate demands of on-going construction activities. "Normally only about 50% of the tasks on weekly work plans are completed by the end of the plan week" (Ballard and Howell, 2003). With this in mind there is a compelling reason to put more emphasis on planning and achieving true flow so that when the craftspeople return to work they can be more productive.

INCREASED PRODUCTIVITY

There is not a wealth of data that shows there is an increase or decrease in productivity by working less than 40 hours a week. There is however, data that shows the decrease in productivity when working more than 40 hours. Figures 3 through 5 show various studies of the decrease in construction productivity when working longer than 40 hours. When looking at these results, however, the analysis is referenced at 40-hour work schedule. One could hypothesize that an increase in productivity could be observed if data was obtained for shorter work schedules, and hence extended to the left of the figures. There is a balance point where the number of work hours optimizes time, productivity and overall output. The question is what such balance point is.



Modified Work Week Example (4 days x 9 hours)												
		7:00 AM		9:30 AM			12:00 AM	12:30 PM			3:30 PM	
Day	Minutes Worked	Set Up	Work	Break	Set Up	Work	Lunch	Set Up	Work	Cleanup	Complete	
Monday	540	30	120	10	15	125		15	195	30	--	540
Tuesday	540	30	120	10	15	125		15	195	30	--	540
Wednesday	540	30	120	10	15	125		15	195	30	--	540
Thursday	540	30	120	10	15	125		15	195	30	--	540
Friday	--	--	--	--	--	--	--	--	--	--	--	0
		120	480	40	60	500	0	60	780	120	0	

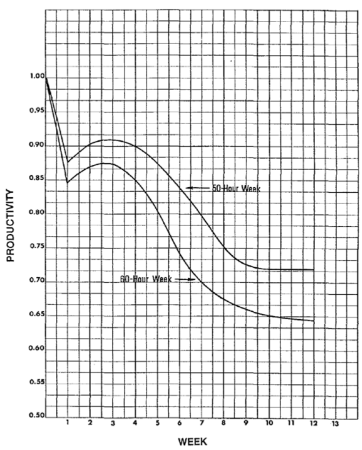
Set-up/Clean-up Time 400
Working Time (WIP) 1760

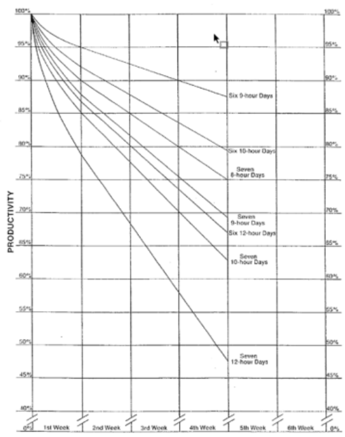
Standard Work Week Example (5 days x 8 hours)												
		7:00 AM		9:30 AM			12:00 AM	12:30 PM			3:30 PM	
Monday	480	30	90	10	15	95		15	195	30	--	480
Tuesday	480	30	90	10	15	95		15	195	30	--	480
Wednesday	480	30	90	10	15	95		15	195	30	--	480
Thursday	480	30	90	10	15	95		15	195	30	--	480
Friday	480	30	90	10	15	95		15	195	30	--	480
		150	450	50	75	475	0	75	975	150	0	

Set-up/Clean-up Time 500
Working Time (WIP) 1900

Ratio of workweeks WIP (4x9)/(5x8) 93%

Figure 2: Non-value Added vs. Value Added Activities of Craftsmen





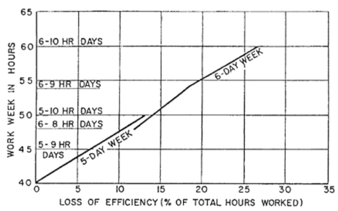


Figure 3: Cumulative Effects of Overtime on Productivity (BRT 1974)

Figure 4: Productivity as a Function of Successive Weeks of Overtime (NECA 1969)

Figure 5: Overtime Inefficiency (O'Connor 1968)

QUALITY OF LIFE

Based on responses to an interview questionnaire, we also postulate that the quality of life for the craftsmen can improved in a smaller workload. Based on 112 craftsmen responses from the sheetmetal, carpentry and electrical fields, the highest ranked modified workweek was the 4x10 (Figure 3). All the workers believed that working 4 days a week would be the most optimal for safety, productivity, and quality of life. One consideration is that the survey did not factor in compensation for the various work weeks presented. We postulate that this may have lead to the craftsmen not to considerate modified workweeks less than 40 hours since they would lead to a reduced compensation.

From a quality of life perspective	Best	Better	Good	Would Not	% of Best votes
Normal Hours 7:00 to 3:30	8	27	53	4	7.48%
Modified Shift 3-12 Hour Shifts	1	3	19	68	0.93%
Modified Shift 4-10 Hour Shifts	85	7	1	0	**79.44%**
Modified Shift 4-9 Hour Shifts	13	41	26	21	12.15%

From a productivity perspective	Best	Better	Good	Would Not	% of Best votes
Normal Hours 7:00 to 3:30	12	24	53	1	11.21%
Modified Shift 3-12 Hour Shifts	0	4	17	67	0.00%
Modified Shift 4-10 Hour Shifts	68	14	8	16	**63.55%**
Modified Shift 4-9 Hour Shifts	10	29	15	8	9.35%

From a safety perspective	Best	Better	Good	Would Not	% of Best votes
Normal Hours 7:00 to 3:30	16	21	50	3	14.95%
Modified Shift 3-12 Hour Shifts	0	0	18	69	0.00%
Modified Shift 4-10 Hour Shifts	66	20	5	0	**61.68%**
Modified Shift 4-9 Hour Shifts	11	52	20	8	10.28%

Figure 6: Survey of Trades on Working Hour Preference

CURRENT CONDITION WORLDWIDE: ALTERNATIVE WORK WEEK

Worldwide, 40-hour workweeks are relatively uncommon. Figure 7 illustrates workweek lengths across the world. Based on anecdotal evidence, these shorter workweeks seem to make workers more productive, as we tend to better utilize their time when they feel constrained in terms of work time availability. Complementary, employees must focus on what is important, and often encourage the attainment of the expected quality of the finished work. The United States ranks forth in terms of hours worked/gross domestic product. However, this statistic is misleading, as the United States hours worked per worker are greater than other top ten countries by more than 20% and the top 20 but more than 10% (OECD, 2015).

Figure 7: Average Workweek Lengths across the World (PGI 2015)

A CALL FOR NEW RESEARCH

Based on the authors' experience to date, owners refuse to adopt or implement an alternative work schedule based on an adverse. However, other industries have successfully adopted alternative workweeks in the United States. Moreover, construction organizations in other countries have also adopted shorter workweeks resulting in the benefits discussed above. We would like to invite the IGLC community to critically assess the productivity, safety, quality of life, and sustainability impacts of alternative workweeks for the labor force. Specifically, the authors make the following suggestions for further research inquiries:

- Conduct simulations to support or refute the notion that alternative workweeks improve productivity, safety, and quality of life while reducing carbon emissions.
- Address the question of productivity comparisons across nations represented at IGLC to understand how and why various workweeks impact productivity and quality of life.
- Conduct a "5 Whys" analysis to understand how and why alternative workweeks were implemented in other industries (e.g., in the healthcare sector) and determine whether or not these same indicators of success exist in the construction industry.

CONCLUSION

Many industries have successfully adopted alternative work schedules to the benefit of their employees and organizations. This study serves as a call to action for future research to analyse the benefits and barriers of adopting alternative work schedules for the construction labor force. The statistical analysis of work field data implies that job incidents are related to work breaks, while most workers prefer a shorter weekly work span with the same amount of work hours (i.e. 10 hours a week, 4 days a week). Based on this data and also on evidence from previous studies, it can be stated that a modified work schedule is likely to result in safer jobsites with more satisfied employees, while securing a reduction in carbon emissions.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the reviewers whose comments made this paper better.

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