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IN THIS ISSUE

MX Fatigue *focus*

Fatigue Training Proven Cost Effective

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A Real World Example

Aircraft damage, maintenance delay, customer returns, worker injuries, and more have an impact on the annual earnings of any large maintenance organization. The costs of such errors should not be considered as "the cost of doing business" rather they are the cost of not doing business optimally. These incidents are indicators of organizational safety and potential predictors of aviation accidents.

In this real world example, a large maintenance organization acknowledged human fatigue as a safety risk in their organization. The company began collecting data on the contribution of fatigue to company incidents and accidents. They used the FAA's objective fatigue questions to identify when fatigue was a possible contributor and instituted scheduling limits in 2009. In 2011, they instituted fatigue countermeasure training, as a safety intervention, for their maintenance technicians and management. The training was implemented from January 2011 to January 2012.

Most readers of this newsletter recognize the training as the Maintenance Fatigue Awareness program. It is comprised of about 90 minutes of interactive training and testing, along with the video entitled "*Grounded*" (available for free at www.mxfatigue.com). The computer based training, for the MRO, was delivered via the FAASafety.gov website. The system delivered the training, administered exams, and issued completion certificates. The software kept a student record of time spent on the CBT as well.

The FAA-delivered training helped the company to achieve

SUMMARY:

A large geographically dispersed aircraft maintenance organization claimed a 300%+ return on investment (ROI) within 12 months after implementing fatigue countermeasure training. They calculated the ROI by reducing aircraft damage and lowering the severity of worker injuries (Johnson & Avers, 2012).

substantial savings by eliminating development and some of the delivery/administration expense. The only significant cost was paying for the student's time to complete the training, which was about $205,000, see CAT article for detailed breakdown.

$ $ $ $ $ $ The Payback $ $ $ $ $ $ $

With all workers and managers sensitized to the hazards associated with fatigue the number of aircraft damages went down by nearly 30% from 2010 to 2011. Only 10% was attributable to the fatigue training. The severity of employee injuries was down by 15%, five percent beyond the 10% goal attributable to fatigue. The company took a conservative approach and did not allow additional payback for likely worker efficiency that went unmeasured.

In summary, the investment was about $200K and the return was over $1M. That means the ROI was over 300%. Not bad for a little fatigue training.

About the ROI Process and Calculations

FAA created the process and software support system for the ROI. It is available, with extensive documentation and training at www.mxfatigue.com.

I Was Just Resting My Eyes

by

Joy Banks and Dr. Katrina Avers

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Have you ever thought about resting your eyes for a few minutes in the afternoon after lunch, only to realize you fell asleep? You wake up startled and look around to see if the boss noticed your snoring. Well, this probably has happened to the best of us at one time.

The problem is most of us don't get enough sleep. Sleeplessness in America is a booming $32.4 billion dollar industry, and medical insurance is paying millions to counter the effects of fatigue, for example Medicare payments for sleep testing rose from $62 million in 2001, to $235 million in 2009, according to the Office of the Inspector General (Mackey, 2012). This is money well spent considering that U.S. employers spend approximately $136 billion per year or more in lost productivity due to things like do-overs and lost time on task due to fatigue (Ricci, 2007). Other costs include increased:

- errors and accidents,
- absenteeism,
- drug use,
- turnover, and
- group insurance premiums

During my military days, it was common to catch a few zzz's in that "secret" spot while working around-the-clock during deployment. During a fatigue countermeasures training session, one AMT said that he quietly steals away during work lulls to take a much-needed nap during the midnight shift, an action he keeps hush-hush since his company has a "no napping" policy. Another AMT shared that he got grief from coworkers when he wanted to use the employee reporting system to report he was too fatigued to work. He was told to "suck-it-up" or look for another job. He decided it was easier to work fatigued or sneak a nap rather than face coworker condemnation.

Currently, FAA rules allow AMTs to work 24 hours in one day (Title 14 CFR §121.377). This gives AMTs the flexibility to work multiple shifts and overtime, and enables employers to offer more overtime, rather than hire more AMTs. From a fatigue risk management perspective, this can be a lose-lose situation. Some suggest a napping rule could mitigate the fatigue risk while maintaining the "status quo." But let's look at the big picture. Impaired mental functioning and its implications are far more threatening than getting caught napping on the job. Managing fatigue risks requires going beyond a napping policy. For one, it requires a shared responsibility between the employer and the employee.

As an employee, consider taking personal responsibility and be aware of the contributing factors that can influence fatigue, including working hours, and the availability of break periods. Alternatively, personal factors can also lead to fatigue, including social and family commitments, commute time, second jobs, and medical conditions that may reduce the quality or quantity of sleep. Your employer has the responsibility to utilize available resources to manage fatigue risk and optimize safety; but ultimately, you are responsible for ensuring that you are rested and "fit for duty" before reporting for work.

Whether you think the aviation maintenance industry needs a napping rule or not, bottom-line, napping is not the only countermeasure in the fatigue countermeasure tool box. If you work while fatigued, you are a safety risk, and you need an arsenal of weapons to fight against it. Try using the fatigue products and tips offered on the MXFatigue.com website the next time you think about resting your eyes for a few minutes on the job.

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Title 14 CFR §121.377. Maintenance and preventive maintenance personnel duty time limitations.

What’s your opinion about NAPPING on the job?

Get the 411…

Benefits of Napping in Shift Work

James Clark & Hans P. A. Van Dongen, Ph.D.

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Shift Work and Sleep Loss

Daytime sleep after night shifts is usually restricted to between 4 and 6 hours per day (Åkerstedt, 1998). In addition, no more than 5 to 6 hours of sleep per day is typically obtained before morning shifts, if the shift starts at 06:00 or earlier (Kecklund et al., 1997). This loss of sleep causes sleepiness and elevated pressure for sleep, which in turn increases the risk of performance impairment and unintentionally falling asleep during the shift (Åkerstedt et al., 2002). Involuntary sleep onset may thus occur at times when it is prohibited or ill-advised (Torsvall and Åkerstedt, 1987), putting workers at increased risk of accidents. One way to decrease this risk is by taking a nap.

Prophylactic Naps

A prophylactic nap is a nap that can be seen as “defensive”. This means it is implemented before one actually feels fatigued, and is thus typically taken proactively before the beginning of a shift. Although prophylactic naps do not maintain performance at fully optimal levels and are no substitute for normal nighttime sleep, they produce longer lasting performance benefits than naps taken when fatigue is already present (Dinges et al., 1988).

Prophylactic naps would often be taken in the afternoon or early evening, when the circadian (i.e., 24-hour) rhythm of alertness is near its peak and it is difficult to stay asleep for long. Still, even a short daytime nap of 30 minutes or less may improve performance for up to 2–3 hours (Gillberg et al., 1996; Brooks and Lack, 2006). In general, though, the longer the prophylactic nap, the more effective it is (Ficca et al., 2010).

Supplementing Reduced Sleep

An issue frequently encountered in shift work is the limited amount of sleep obtainable after a shift. This seems especially true when a (prophylactic) nap was taken before the shift began (Kiesswetter, 1993). However, when comparing individuals who only sleep after their shift to individuals who take a nap prior to their shift and also sleep after it, the total amount of sleep obtained is usually the same (Rosa, 1993) or sometimes even longer in the individuals taking the prior nap (Ishibashi et al., 1982).

Relatively short naps (say, 20–30 minutes) do not seem to affect the amount of sleep obtainable in the daytime after a shift (Sallinen et al., 1998; Purnell et al., 2002). This means that shift workers may be able to take brief naps without significantly disturbing their main sleep period.

Split Sleep Schedules

Split sleep schedules involve obtaining the daily total amount of sleep through a restricted main sleep period, sometimes termed “anchor sleep”, combined with a nap. An example would be a 5-hour nighttime anchor sleep followed by a 3-hour daytime nap. The anchor sleep could also be during the day and the nap during the night. Split sleep does not provide greater performance benefits than unrestricted nighttime sleep, but it is often an effective compromise when normal nighttime sleep is not achievable. In long-haul truck drivers, it effectively mitigates nighttime fatigue and performance impairment (Macchi et al., 2002).

As a rule of thumb, the recuperative value of sleep is a function of the total amount of sleep per 24 hours, regardless of whether it is in the form of a single consolidated sleep period or as a split sleep schedule (Mollicone et al., 2008). In other words, every hour of sleep counts regardless of when during the day it is obtained.

On-Shift Napping

On-shift napping has been shown to be beneficial to mitigate fatigue (Purnell et al., 2002). Studies in aviation have demonstrated that a planned 40-minute nap in the cockpit helps to maintain good performance during both day and night flights (Rosekind et al., 1995). In air traffic controllers, even short and poor quality naps during work hours have been shown to mitigate fatigue (Signal et al., 2008).

In ambulance paramedics working 24-hour shifts, a 5.5-hour period during which they did not have to answer emergency calls and could take a nap was found to alleviate subjective fatigue (Takeyama et al., 2009). A 1-year long study of shift workers receiving a 1-hour nap opportunity during their night shifts provided evidence of improved vigilance (Bonnefond et al., 2001). The shift workers in the study reported general satisfaction about quality and easiness of work at night.

Benefits of Napping in Shift Work cont.

Noise and light have been reported as two major reasons for disturbed nap sleep (Koller et al., 1994; Purnell et al., 2002). Access to an isolated sleeping facility promotes the effectiveness of on-shift napping.

Sleep Inertia

There is a potential disadvantage to on-shift napping, namely sleep inertia. This is the feeling of grogginess and the transiently degraded cognitive performance experienced immediately following awakening (Dinges, 1990). It is generally considered to dissipate within about 30 minutes after the end of a daytime nap (Dinges et al., 1981). However, the duration of sleep inertia varies by the length of the nap. For example, a 30–50 minute nap may produce around 10–15 minutes of sleep inertia (Sallinen et al., 1998), whereas the duration of sleep inertia may be extended following longer naps.

The intensity of sleep inertia is greater after naps taken at night than after naps taken during the day (Dinges et al., 1985). Very brief naps of 10 minutes or less are usually not associated with sleep inertia, and may still improve performance for up to approximately 2.5 hours (Brooks and Lack, 2006).

Subjective and objective measures of sleep inertia seem to be disconnected (Achermann et al., 1995), such that performance may be either better or worse than the subjective experience of sleep inertia would suggest. Sleep inertia effects may be counteracted by caffeine (Horne and Reyner, 1996; Van Dongen et al., 2001).

Why Naps Work: Sleep Homeostasis

The effectiveness of napping can be understood on the basis of sleep homeostasis. This is a biological process that builds up a pressure for sleep during wakefulness, and dissipates this pressure during sleep. This occurs in an exponential manner – see Fig. 1. As a consequence, most sleep pressure is dissipated in the beginning of a sleep period, making a brief nap disproportionately effective in reducing sleep pressure over the short term.

Conclusion

Napping helps to maintain alertness and performance during shift work. Long prophylactic naps and short on-shift naps tend to be the most effective napping strategies, although different circumstances may call for different napping approaches. There is no substitute for sleep when it comes to managing fatigue, so when sleep opportunities are restricted due to shift work, napping could be the fatigue countermeasure of choice.

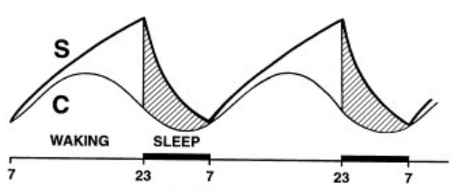

Figure 1: The biology underlying the effectiveness of napping. Sleep homeostasis (displayed as process S) is a biological process involving the build-up of sleep pressure during wakefulness (here 07:00–23:00) and the dissipation of this pressure during sleep (here 23:00–07:00). Sleep homeostasis is an exponential process, such that sleep pressure is dissipated faster in the beginning of a sleep period. For that reason, a short nap is disproportionately effective in reducing sleep pressure over the short term. Also shown is the circadian rhythm (displayed as process C), which provides a waking counter-pressure which is greater during the day than during the night. Spontaneous awakening from sleep occurs if the sleep pressure from process S drops below the wake pressure from process C. Figure taken from Borbély and Achermann (2005) with permission.

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