

THE MACRIS GROUP

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From Dean's Desk:



Prologue

One of the best parts of my work is meeting interesting people and learning how their work dovetails with mine. It is my pleasure to introduce one of those people here. Andrew Phinney, a principal in Scheduling Group LLC, provides state-of-the-art products and technologies to predict and manage human fatigue and alertness across many industries. When Andrew started telling me about his work, I had just finished a leadership session on Work-Life Balance that included a segment on personal health management. Immediately I saw the connection. Further discussions with Andrew led to a close connection with human performance issues. For example, implementation of Scheduling Group's fatigue management products was part of a fatigue management initiative at Kolomela Mine (Anglo American Kumba Iron Ore) that achieved over 25 million LTI-free man hours between August 2009 and March 2012. This is significant in the areas of human performance and safety considering the numbers of people and hazards of mining. I hope you enjoy the next few articles as we take you through managing circadian cycles for improved human performance.

Fatigue and alertness – an often overlooked human factor

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Introduction

Soon after I started my consultancy, I made contact with the University of Connecticut's human factors doctoral program. The reason being, there was a resource of students who, at that time, had access to research databases not available to me (that's how long ago it was), plus these students enjoyed the opportunity to work in the applied context of human factors, so as interns, it was a good collaboration. The head of the Psychology Department, under which the human factors students worked, was a renowned researcher in circadian rhythms. This was my first exposure to this science. At that time my focus was on nuclear power plants and product liability issues, not necessarily circadian rhythms. Nonetheless, knowing about circadian rhythms expanded my perspectives in the area of human performance.

Over the course of several years, my focus broadened to include safety and human performance, as well as leadership development. When I met Andrew Phinney the initial connection was because of sports cars, but after getting to know him, we shared our professional backgrounds and things started clicking.

In the context of leadership development, balance becomes a major factor in leadership effectiveness. For safety, a balance between safety, productivity and quality is essential. Andrew related how his fatigue management system had such a significant impact on the dangerous mining industry. As a result, we will digress from our more recent focus purely on leadership and shift to the issue of fatigue and human performance. The interesting thing about this topic is that individuals can readily relate to it, based on their own experiences. Please think about it in that context, and also how important this topic is in maintaining a balance for yourself, which impacts your work as well as your family and personal life. Before we get into the details of fatigue and managing it, there is an organizational/leadership issue that must be acknowledged, that of organizational culture.

Cultural shift in organizations

For an organization to have an effective fatigue management program, the corporate culture with regard to fatigue must be examined. The presence of fatigue and its associated risks must be fully acknowledged by all stakeholders. Executives, management, workers, and unions all share in the responsibility of creating an open culture of addressing

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fatigue risks. An effective fatigue management program can only be implemented when everyone is on board.

Fatigue and alertness: An often overlooked human factor

Human fatigue is a fact of life as it affects everyone to some degree on a daily basis. We are all familiar with that feeling during the workday. About an hour or so after eating lunch, it hits us and we could just lay our heads down on the desk and take a nap. This is a familiar example of how some basic daily habits combined with work schedule and physiology can affect our alertness and our ability to perform while at work.

For organizations, efforts to mitigate the effects of fatigue are known as Fatigue Management. The science of Chronobiology (applying natural circadian rhythms and physiology to the daily work schedule) plays a major role in developing an organization's effective fatigue management program.

The science of human fatigue is comprehensive and quite voluminous, so for the purpose of this series of articles we are going to focus on particular definitions of fatigue and alertness:

Alertness is a physical and mental state, achieved by getting a sufficient quality and quantity of sleep, in which one can perform mentally and physically at an optimal level.

Fatigue occurs when this state of alertness ends and the ability to focus, concentrate, and perform is compromised. This transition can occur over a period of as little as a few minutes. (Think of how fast it hits you after lunch!)

Keep in mind that alertness is not only an "on or off" issue. Fatigue can start and end without sleep or start and not end until sleep occurs. It can also vary in degrees of intensity in both situations.

We are culturally trained from an early age that fatigue is a sign of weakness. Adolescents learn early on that becoming tired before the other guy while playing sports indicates a substandard performance. As we move into higher education and our respective professions, it's widely accepted that those who excel are the ones that put in the most hours and burn the candle at both ends. The pressure is on to stay competitive, and one of the first things we do to gain an edge on the competition is to try to perform more tasks in each workday.

Most individuals are not even aware that their perfor-

mance is usually compromised in a given window of the workday. The allure and perceived rewards of competitive productivity often overshadow obvious signs of fatigue. Along with our cultural training that fatigue is a weakness, we're also conditioned to employ one or both of these two potentially dangerous responses:

Ignore it: "tough it out," "shake it off," "don't let anyone see," or "power through it." Sound familiar?

Use ineffective countermeasures to fatigue and assume it's "fixed." This usually comes in the form of misusing caffeine to the point where planned sleep is compromised, worsening fatigue the following day.

Fatigue: Just how bad is it?

Fatigue causes the same level of impairment as an elevated blood alcohol level. ⁽¹⁾ Think of fatigued drivers, fatigued workers, and fatigued managers in the same way you would think of them under the influence of alcohol. We do not accept alcohol impairment on the road or at work, but we must also collectively acknowledge the danger that fatigue presents.

No class of worker is immune to the pitfalls of fatigue. From the mail room to the board room everyone experiences reduced performance when alertness is compromised. What does vary by job is the potential for losses. The state of fatigue presents increased probability of incidents as a result of that fatigue. These incidents can be generally categorized as Lost Productivity or Accidents, and each has their own costs associated with them. ⁽²⁾

Lost productivity is usually easy to quantify. If a forklift driver can load 50 pallets per hour onto a truck when alert, and only 40 per hour when fatigued, it is easy to assign a "loss" quantity as a result of the reduced productivity. Accidents present further complications. If the fatigued forklift driver runs into the truck and damages both the truck and the forklift, he not only reduces number of pallets loaded (productivity) but also adds damaged equipment costs, loss of equipment use-time costs, and possibly damaged inventory costs. In the event of an injury or death from the same incident, we can add medical expenses, lost income while infirmed, litigation, increased insurance costs, and possible regulatory fines to the mix. It's not all cold hard dollar losses; reputation damage and, perhaps most importantly, the human tragedies of injuries or death are very difficult, if not impossible, positions to recover from.

Basic physiology of fatigue and alertness

Fatigue science has advanced very rapidly in recent decades. Thirty years ago, a tiny section of the brain known as

the Suprachiasmatic Nucleus (SCN) was identified as the central biological timekeeper of our entire bodies. The SCN is about the size of a grain of rice, and with the input of light through the optic nerve it provides the central control of all circadian rhythms and their associated physical chemistry. ⁽³⁾

Alertness naturally rises and falls throughout the day, and to complicate matters the natural tendency is for the human clock to run on a 25 - hour cycle (not 24). What this means is that left to its own devices (without natural light fluctuations and 24 hour-based schedules), the body wants to push off sleep to an hour later each day. Almost no one does this, as we are constantly constrained and re-adjusted by natural light conditions and a 24-hour clock schedule.

Various chemical and biological rhythms are also closely tied to the alertness cycles.

Body temperature closely tracks alertness; lower temperatures typically accompany lower alertness and are lowest when we sleep. Growth hormones are released at the highest levels during sleep, and cortisol is produced at its highest levels in late sleep and early waking hours.

While these rhythms all run in various cycles, the cycles have unique relationships with one another known as circadian cycle synchronization. Think of each instrument playing in a song: they're all doing their own thing but their relationship to each other is what makes the music. If one player is off time, even though he may be playing the correct notes at the correct speed, we know it doesn't sound right. Improper work and rest schedules can cause "circadian cycle de-synchronization" and cause fatigue. ⁽⁴⁾

Sleep: There's more to it than you think

Most of us are under the impression that sleep wake cycles are like an on/off light switch indicating that we're either asleep, or awake. On the contrary, sleep has various attributes of quality as well as specific duration parameters in order to be effective.

There are four stages of sleep, each characterized by differing brainwave activity, as measured by EEG (electroencephalogram). In a normal night of sleep, the brain cycles through deep sleep and semi-consciousness several times. Each cycle starts at semi-consciousness, goes down through the four stages into deep sleep, then back up through the four stages into semi-consciousness/

Executives, management, workers, and unions all share in the responsibility of creating an open culture of addressing fatigue risks.

dreaming again. Each cycle of sleep takes very close to 90 minutes for most adults. It typically takes five of these 90 minutes cycles (7.5 hours) to be fully rested. The brainwave activity of each stage is indicative of various critical brain chemistry events, such as the release of cortisol and growth hormone, contributing to the quality of the restorative rest.

⁽⁵⁾ We've all experienced poor quality sleep where we've "slept" all night but really did not get rested. This is often a result of not getting into the deep levels of sleep that should occur in each sleep cycle. Any of a variety of sleep disorders can complicate matters and should be addressed with professional help, ⁽⁶⁾ but our focus is on sleep schedule control and lifestyle choices that affect sleep quality. Getting the right quantity and quality of sleep regularly is a skill that can be developed. Unfortunately, many of our daily habits, such as diet, general health, personal stress management and work schedules, often work against the natural sleep cycle.

Work Schedules: A major contributor to fatigue

Armed with our knowledge of circadian rhythm physiology and the accompanying effects of sleep quality and quantity, it becomes clear how certain work schedules can have adverse effects on daily alertness. We refer to the quality of a work schedule's potential to fit with our physiology as Biocompatibility. An ideally biocompatible work schedule might look something like this:

- Awaken naturally, without alarm clock, after 7am.
- Allow for 30 minutes to fully "wake up"
- Allow for enough time for morning routine and travel
- Begin work
- Plan for lunch around 12 or 1
- Break from work for 45 minutes around 2pm (the post-lunch alertness dip)
- Return to work after the post lunch dip
- Work until near darkness.
- Have evening meal, relax, and get to sleep by 10:30pm
- Work this schedule for 3 or 4 days in a row then take a break for 2 days.

While this naturally occurring physical schedule would be very friendly to our health and alertness, we all know it often does not fit in with our current culture of work and productivity goals. It is from a biocompatible baseline schedule such as the example above that we measure the fatigue risk of all other work schedules. As work hours increase or deviate from natural circadian tendencies, the risk of fatigue rises. It is important to understand that all work schedules present some risk of fatigue during work hours, but we can

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now scientifically assign risk levels to entire schedules and to individual days and times within each schedule. ⁽⁷⁾

Some of the more challenging schedules with regard to fatigue are rotating shift work schedules. Those who work days, then nights, then back to days are nearly in constant circadian rhythm de-synchronization and as such experience very high fatigue risks. Highly motivated managers and executives are at risk as well. While they may have some freedom in their work hours, they often push themselves far beyond a biocompatible schedule, often times in a random and unpredictable fashion.

If you are beginning to think that the work schedules imposed upon us, either by industry or ourselves, combined with the limits of human circadian rhythms and physiology, mean that we have to learn to live with fatigue and all of its risks then think again.

Closing

As we indicated in the opening, this is a departure from the usual focus of our Update articles. It is common to consider circadian rhythms we think of shift workers' schedules, but it is equally important for those in leadership positions to consider effects of fatigue. For leaders who have organizations that use shift work, have long unpredictable hours, or spend a lot of time flying to different time zones, this information is another important tool for you to know and understand. We subject our organizations and ourselves to demands and stresses that not everyone can easily handle. Some can appear to thrive in such situations (but do they?) while others appear to be sluggish after a change from the "normal" work day. Fatigue impacts everyone whether it is readily apparent or not.

There are factors in everyone's life that can add to the impact on circadian rhythms – marital issues, child care or child health issues, elder care issues, debt, addictions, etc. We cannot control those issues and may not even know they exist, but they may show up in performance, exacerbated by shift work, long unpredictable hours or heavy travel.

As we have said in prior articles there is no silver bullet solution to most of the problems a leader will face. You must arm yourself with knowledge and then try to apply the appropriate solutions to the demands of the workplace. The information in this article may help you and it may help your employees.

In the next issue we will discuss Biorotors, the shift work schedules designed with the best possible biocompatibility

to run 24-7 operations. We'll also cover some ways to manage the shift work Lifestyle to minimize fatigue in the workplace.

As always we welcome your feedback and comments.

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Andrew L. Phinney has over 25 years of consulting, teaching, and management experience over a cross section of industries including engineering, information technology, and service.

He has developed unique fatigue management solutions for multi crew shift work operations, and is currently developing alertness schedule and lifestyle applications for various mobile platforms.

Andrew holds a Master of Science in Management Information Systems, and is a principal of The Scheduling Group, LLC.

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