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Doctor of Business Administration Program

DISSERTATION

**The Prevalence of Sleep Wellness Practices in Large US Corporations:  
An Exploratory Study with Managerial Implications**

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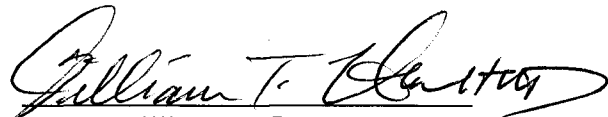


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# THE PREVALENCE OF SLEEP WELLNESS POLICIES

## Abstract

This research synthesizes the most recent findings from sleep medicine that suggest sleep deprivation impairs human functioning, has a negative effect on employee wellness, and reduces workplace productivity. Implications for management practitioners are suggested for mitigating these effects to employees in the workplace. A theoretical model is proposed that accommodates sleep quantity and quality as variables of human health capital. Finally, this dissertation reports on an exploratory study that provides a baseline analysis of the extent to which US firms have incorporated sleep wellness policies into their human resource practices. Compared to eight other corporate wellness initiatives—such as diet, fitness, health screening, and work-life balance—sleep education ranks near the bottom in terms of prevalence. The prevalence of napping and other rest policies are also reported. Further analysis found that managers who believe their firms encourage adequate rest prior to reporting to a work shift are more likely to believe that their firms care about their workers, are enjoyable places to work, and are more productive than their competitors.

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### **Dedication**

To my father, Robert S. Childs, who saw me start my doctoral studies and offered much encouragement. He was a published writer and had offered to help edit this dissertation. Unfortunately, he passed away before my doctoral studies were completed. To him I dedicate this dissertation. Dad, you instilled in me a sense of worth and self-confidence. I know you would have been proud!

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**CHAPTER I—Introduction**

Overview

There is an emerging body of literature in the fields of sleep medicine and somnology<sup>1</sup> that bears consideration by organizational managers and healthcare policy-makers. The Committee on Sleep Medicine and Research claims that 50-70 million Americans are hindered in their daily functioning and work productivity as a result of suffering from sleep loss and sleep deprivation. Colten and Altevogt (2006) summarize decades of evidence by concluding that sleep problems, "...take a toll on nearly every key indicator of public health: mortality, morbidity, performance, accidents and injuries, functioning and quality of life, family well-being, and healthcare utilization" (p. 138). Recently, Roskin (2008) suggested in an editorial published in *Sleep Medicine Reviews*, that the direction of somnology research should include, "...[a] discussion of organizational approaches that can address sleep loss and circadian disruption. These include strategies for improving work/rest scheduling, education and fatigue management" (p. 251). This dissertation contributes to this dialogue by synthesizing recent findings from sleep research with implications for managerial practices. It also provides a baseline exploratory study that provides data on ways in which large organizations in the United States are addressing sleep wellness practices with their employees.

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<sup>1</sup>*Somnology* is the study of the physiological and behavioral dimensions of sleep, and the consequences of sleep loss and sleep disorders on an individual's and the general population's health, performance, safety, and quality of life. *Sleep medicine* is the branch of clinical medicine devoted to the diagnosis and treatment of those suffering from chronic sleep loss or sleep disorders. (Colton & Altevogt, 2006, p. 20)

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## Background

According to the National Sleep Foundation ([NSF], 2008) the typical adult functions best on approximately 8 hours of sleep per 24-hours. Sleep enables restorative processes benefiting the physical body and brain function. The human sleep architecture follows five stages that cycle approximately every 90 minutes through a night's sleep. Light sleep (stages 1 and 2) provides a transition to deeper sleep (stages 3 and 4). During deep sleep, restorative processes occur that increase blood flow and release hormones essential for health. Rapid Eye Movement (REM) sleep follows stage 4 in the sleep cycle. During REM sleep the brain becomes active and dreams occur. It is believed that REM sleep is vital for cognitive functioning. The causes of sleep deprivation are three-fold: (a) lifestyle choice—e.g. individualistic choices to trade-off leisure and or work for sleep, (b) occupational imposed—e.g. scheduling long working hours, shift work, jet lag, and (c) sleep disorders—e.g. insomnia, sleep apnea, and restless leg syndrome. Each of these results in excessive daytime sleepiness, impaired alertness, and declined work performance. For instance, there is evidence indicating that optimum sleep enhances workplace safety, improves employee productivity, and reduces risk-taking behavior (Caruso, Hitchcock, Dick, Russo & Schmit, 2004; Colton & Altevogt, 2006, Calloway, Bharmal, Allen & Gemmen, 2008). Recent advances in sleep medicine also indicate that untreated sleep disorders are highly associated with hypertension, metabolic disorders and other co-morbidities. These conditions increase the rate of healthcare utilization and drive up health insurance premiums (Fletcher, 2000; West, Nicoll & Stradling, 2006; Moreau, Hans, LaBlanc & Morin, 2008).

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To address these concerns, *The 2003 National Sleep Disorders Research Plan* (NSDRP, 2003) called for more corporate, public, and school-based programs to educate the public and healthcare providers on the need to screen for and treat sleep disorders, as well as to influence the attitudes and sleep practices of workers. Echoing the NSDRP (2003) plan, leading sleep-scientist Charles Czeisler, MD suggested in an interview published in the *Harvard Business Review* that companies across all industries need to take seriously the need to adapt their management practices to account for sleep and fatigue. Specifically, he stated, “People in executive positions should set behavioral expectations and develop corporate sleep policies, just as they already have concerning behaviors like smoking or sexual harassment” (Fryer 2006, p. 56). Czeisler calls for mandatory wellness-training to include sleep hygiene and sleep-disorder awareness, plus a cap on working hours, adequate rest time, and other policies to mitigate occupational risks and negative externalities related to sleepiness. For instance, he suggests firms should restrict their employees from driving immediately after a red-eye flight or in other cases when jet-lag is suspected. He also reasons, “A good sleep policy is a smart business strategy” (Fryer, 2006, 58). Czeisler has not been alone in his lamentation about the lack of attention given to sleep wellness in workplace practices. William Dement (2000), considered to be the founder of sleep medicine, suggests that the work ethic and adage to *work hard, play hard* are culpable cultural influences that need to change.

Many firms operate 24/7 by scheduling split-shifts in either three 8-hour or two 12-hour formats. However, these scheduling practices may prove counterproductive to human functioning. Caruso’s (2006) work summarized the broad effects from fatigue related to sleep loss due to extended work hours, including diminishing marginal returns

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in productivity for each work hour beyond 9 in a 12-hour shift. Boivin, Tremblay and James (2007) provide a summary of evidence on the accidents and lost productivity associated with night-shift work. Furthermore, new technologies now allow us to dispense with a set work schedule by enabling us to communicate and work 24/7, often creating an expectation of urgent responses, even if it means interrupting sleep by responding to global operations occurring across hemispheres. Work overload and job stress were found to be positively associated with poor sleep quality among a nationwide random sample of American full-time workers (Knudsen, Ducharme, & Roman, 2007). Dinges, Fomberstein, William, and Banks (2006) analyzed extant cross-sectional data from the 2003 American Time Use Survey (ATUS) to demonstrate that total work-time had a near-linear decline in total sleep time. Corroborating this is the National Sleep Foundation's 2008 Sleep in America Poll (NSF, 2008). This poll revealed that Americans are now spending an average of 4.5 hours each week doing additional work from home in addition to a 9.5-hour average workday. In addition, the poll reported that the average worker receives only 6 hours and 40 minutes of sleep per weekday night—less than the recommended eight hours. Furthermore, 29% reported falling asleep or becoming very sleepy at least once in the last month while at work and 32% disclosed that they were driving drowsy at least one or two times per month. Droblich (2008) concluded of this poll,

Longer workdays and more access to colleagues and the workplace through the Internet and other technology appear to be causing Americans to get less sleep. Reciprocally, the effects of sleep loss on work performance are costing U.S.

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employers tens of billions of dollars a year in lost productivity. It's time for American workers and employers to make sleep a priority (p.1).

Large corporations have emerged as important institutions for reinforcing healthy lifestyles and helping employees to be efficient consumers of healthcare (Oexman, Knotts, & Koch, 2002; Business Roundtable, 2007). This dissertation provides policy makers and practitioners a baseline for assessing the extent to which employers are addressing sleep awareness in their wellness programs.

### Purpose of the Dissertation

Due to the urgency being voiced from the somnology literature to modify work practices and include sleep awareness content as part of comprehensive wellness initiatives, a reasonable starting place is to ask, *to what extent are organizations educating their workforce about healthy sleep habits? And for those that encourage adequate sleep, what are the related outcomes?* These are relevant questions for organizations and policy makers, as a healthy and alert workforce is important in today's competitive global economy. Brown (2004) provided anecdotal evidence of what she calls *humancentric* organizations—firms that integrate policy and sleep-related medical and self-help advice. However, there is no recent research describing the prevalence of sleep policies and sleep awareness programs among US corporations across industries. Hence, this dissertation will accomplish two things. First, it will address the questions of where companies currently stand with regard to sleep education, provisions for napping, and policies to encourage adequate sleep prior to engaging in high stakes tasks. These data will provide a baseline for assessing the prevalence of policies and sleep wellness programs among US companies across industries. Second, the literature review will bring

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together the research of two fields that share an interest in the effects of sleep deprivation and sleep disorders, but don't normally meet or speak to one another—somnology and human productivity at work—in a way that can be used by managers and companies to improve performance. By bridging these two fields, this dissertation will aid managers and healthcare scientists understand one another. The findings will also begin to forge an interdisciplinary approach to understanding and addressing this issue.

### Scope

While it is important to understand the multidimensional influences that contribute to personal lifestyle choices that affect one's quantity and quality of sleep, the scope of this dissertation's focus is on the interaction of sleep and the workplace. The social sciences such as psychology and sociology, as well as occupational specific and other medical disciplines have contributed to our understanding of sleep and human performance (Atlantis, Chow, Kirby & Singh, 2006; Scott, & Judge, 2006). However, the literature review to follow is bounded by evidence from recent sleep research published primarily from within the somnology journals. My reason is not to neglect the contributions from other fields, but to raise awareness of the issues from somnology—a discipline that has heretofore been overlooked by the management field.

Based on the literature review, I suggest best practices and policies that practitioners may find useful to implement. Future research will be needed to validate them. I also propose a model that helps to understand the theoretical relationships between sleep, health, and economic productivity. Finally, this dissertation provides a description of the extent to which large firms have addressed three types of sleep-wellness practices: sleep-awareness education, provisions for napping, and policies

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regarding obtaining adequate rest prior to reporting to a work shift. Future research can build on this survey data to develop and test a more robust construct of how sleep-wellness policies interact with productivity.



**CHAPTER II—Literature Review**

Overview

This literature review accomplishes three purposes. First, it brings together what we know about sleep and how it relates to occupational productivity. Second, it offers a theoretical model from which a study on the linkages between sleep, wellness and economic productivity can be conceptualized. Finally, it provides a rationale for an exploratory study to document the prevalence of sleep-wellness policies and practices at large organizations in the United States.

Relevant Somnology Research

The relationship between sleep and human productivity has been observed for ages. Benjamin Franklin left us a well-remembered proverb, “Early to bed, early to rise, makes a man [sic] healthy, wealthy and wise.” While hundreds of years of human experience bear witness to the relationship between sleep wellness and productivity, it has only been in the last 50 years that empirical studies have begun to convey understanding of the mechanisms of effect and their consequences. Two seminal publications provide a starting point for our understanding of how sleep facilitates wellness and productivity. Colten and Altevogt (2006) served as editors of a 400+ page report funded by the National Academy of Sciences that summarized the research to date regarding sleep loss, sleep disorders and their impact on public welfare. Banks and Dinges (2007) provide a focused summary of the research to date on the psychomotor and cognitive impairments from sleep loss and untreated sleep disorders—important correlates with human performance in the workplace.

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In 2006, the Committee on Sleep Medicine and Research (CSMR) published its findings in a volume entitled, *Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem*. The publication, eventually edited by Colten and Altevogt (2006), was funded by the National Academy of Science and coordinated by the Institute of Medicine (IOM) at the request of the National Center on Sleep Disorders Research (NCSDR) of the National Institutes of Health (NIH), the American Academy of Sleep Medicine, the National Sleep Foundation, and the Sleep Research Society. The goal was to form a committee to review and summarize the relevant research to date from across disciplines including medicine, industrial psychology, public health, and health sciences. The CSMR publication provides a broad review of the literature on the physiological, human function, and economic consequences of sleep loss and sleep disorders. Among conclusions summarized in the volume, chronic sleep loss and untreated sleep disorders increase the risks for common diseases such as hypertension, diabetes, obesity, depression, and heart disease. It also provided ample evidence for the negative consequences of sleep debt on economic performance and workplace productivity. Hence, it is now widely accepted that increasing awareness and treatment for sleep deprivation and sleep disorders will help reduce the health risks for co-morbidities<sup>2</sup> and improved human functioning.

Banks and Dinges (2007) focused their review primarily on the impact of sleep restriction on neurobehavioral and cognitive functioning. This work is of particular interest, as it provides a more discrete understanding the effects of sleep loss could have on particular workplace tasks of knowledge workers. Their general conclusion is that as

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<sup>2</sup>For the purposes of this paper, co-morbidity includes the presence of and the effect of all other diseases an individual patient might have other than a chronic sleep deprivation or presence of a sleep disorder.

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excessive daytime sleepiness increases, alertness and vigilance deteriorate, problem-solving and cognitive throughput slows, flexible thinking is diminished, memory becomes impaired, psychomotor skills decline, and ability to assess opportunity and risk decrease. As way of conclusion, they argued that consensus of the research suggests that 7-8 hours of quality sleep is vital for neurobehavioral and physiological functioning for the average individual. However, they did provide a synthesis of over 20 studies suggesting great variability in the distribution of responses to sleep loss on cognitive and psychomotor functioning (such as decision-making and driving). This suggests trait-like variability. Some people are less tolerant of sleep duration loss, sleep quality, or disruptions to their circadian rhythms. Hans, Van Dongen, Vitellaro, and Dinges, (2005) provided a more exhaustive review of the trait difference research, but came short of offering any causal explanations. Some promising efforts have begun to identify genetic contributors to inter-individual vulnerability to sleep loss. Recently, Vandewalle, et al., (2008) contributed to the cause of trait differences when they discovered through studies using functional Magnetic Resonance Imaging (fMRI) that the ability to recruit higher cognitive prefrontal areas of the brain after extended sleep deprivation is maintained by genetically determined markers. Other work documents individual variances in the *circadian locomotor output cycles kaput* (CLOCK) gene that regulates the circadian rhythm and homeostatic sleep drive (Zeitzer, Friedman, Zhdanova, Lin, Kushida & Yesavage 2008). This promising area of work is shedding light on why some people perform better either in the morning or evening (Dolan, Taylor, Bramoweth & Rosenthal, 2008).

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### *Sleep Deprivation and Sleep Disorders Increases Risks to Individual Health*

While much of the previous research demonstrates an association between sleep and other health conditions, evidence of a singular causal relationship has been elusive (Colten & Altevogt, 2006). The benefits of understanding the causal relationship extend beyond improving individual human health, but also could include interventions resulting in considerable savings on health care costs from other chronic diseases associated with sleep debt. Fortunately, the most recent research now provides strong evidence of the causal direction—that various metabolic conditions such as diabetes and obesity, an impaired immune system, as well as hypertension and heart disease are precipitated in many individuals in part through sleep deprivation and untreated sleep disorders. Hence, the thesis of this dissertation is strengthened by recognizing the following study areas.

*Metabolic conditions and obesity.* In a controlled experiment of healthy non-obese adult males after seven days of reduced sleep duration (5 < hours), Buxton, Paulova, Reid, Simonson, and Adler (2008), discovered that insulin sensitivity was reduced an average of 11% causing some participants to enter a pre-diabetic state. Another controlled experiment conducted at Johns Hopkins University of healthy adults, Stamatikis and Punjabi (2007) investigated the independent impact of sleep fragmentation on glucose metabolism. Their results were statistically significant ( $p < .001$ ) indicating that after only two nights of fragmented sleep—tested by subjecting test participants to recurrent mechanical and auditory stimulation every two hours to mimic the effects of typical sleep disorders—glucose metabolism was decreased by 20.4% leading to a pre-diabetic risk. Cappuccio, Taggart, Kandala, Currie, Peile, et al, (2008) performed a meta-analysis of short sleep duration and obesity in children and adults. The

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result of cross-sectional studies from around the world showed consistent increased risk odds of obesity amongst short sleepers in children (1.89 times) and adults (1.55 times). Because of the limitations of their research design, evidence was inadequate for assigning a causal relationship. However, other experimental design studies provide evidence for causal effect of sleep loss on obesity, likely through altered regulation of appetite-regulating hormones such as leptin. For instance, sleep deprivation has been demonstrated to decrease the release of leptin, leading to increased food-consumption (Simpson, Banks & Dinges, 2008; Nedeltcheva, Kilkus, Imperial, Kasza, Schoeller & Penev, 2008). Furthermore, Broussard, Van Cauter and Tasali (2008) demonstrated that fatigue related to sleepiness also decreases vigor and physical activity in the sleep deprived subjects but improved with sleep recovery. Coupled with increased appetite and hormonal changes, these findings provide a physiologic model that explains the potential causal mechanism between sleep loss and increased body mass index. While evidence suggests many organizations now offer healthy cafeteria food selections, wellness programs and health club memberships (Collins, 2004; Business Roundtable, 2007; Human Resource Library, 2008) no evidence could be found that included sleep wellness as part of a comprehensive program to reduce employee obesity and diabetes risk.

*Immune system.* Ample evidence suggests that the immune system becomes attenuated after sleep loss. The causal mechanism appears to be triggered by the activation of inflammatory mediators called cytokines (IL-6 and TNF). The normal surveillance protection afforded by the immune system is impaired after even a short period of sleep loss. This was illustrated by a noteworthy study by Spiegel, Sheridan, and Van Cauter (2002) that discovered those vaccinated for influenza following six nights of

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restricted sleep (four hours per night) experienced more than a 50% reduction in the presence of antibodies 10 days post-vaccination. The inference is that sleep deprived workers may be at risk of developing depressed immunity leading to more susceptibility to illness, absenteeism, and loss of productivity.

Tsaoussoglou, et al. (2008) conducted an experimental study simulating a typical week of 5 nights of restricted sleep (< 6 hours of time in bed), followed by a two-day recovery of normal sleep (8 hours). The results indicated that the inflammatory cytokine significantly increased during each of the five days of restricted sleep, but recovered to baseline levels after the two-day recovery. This led to their conclusion that this sleep pattern—typical of a busy 5-day work-week with a sleeping-in on the weekend—leaves a person in a chronic state of low-grade inflammation. In another controlled experiment, Haack, Lee, Chen and Mullington (2008) described an association between regional headaches, back pain and generalized body aches to an increase in Prostaglandin E2 output as detected in the urine of sleep-deprived group (88 hours). After 12 hours of sleep recovery, Prostaglandin E2 levels returned to baseline. The data suggest sleep debt contributes to chronic inflammation and a reduced immune system leaving people vulnerable to illnesses. Thus, it stands to reason that if firms promote improved sleep hygiene, allowances for recovery of sleep, and appropriate consideration of the whole person, they could recover loss productivity through reduced absenteeism and presenteeism.

*Cardiac Function and Hypertension.* The inflammatory marker, C-reactive protein (CRP), is activated during sleep loss. CRP is also a positive predictor for

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cardiovascular disease. Banks and Dinges (2007) speculate this may be the causal link between chronic sleep loss and cardiac health. Hypertension is also associated with sleep deprivation. The National Institutes of Health (2004) has concluded that sleep apnea is an identifiable cause of hypertension. Several other studies have established the causal relationship between various sleep disorders, sleep deprivation and hypertension (Peppard, Young, Palta, & Skatrud, 2000; Nieto et al., 2000; Partinen & Hublin, 2005). The causal link may be associated with the increase in the inflammatory molecule sVCAM-1. In a 7-day controlled, randomized experimental study of healthy adults, Sanchez, Haack, Toth, Serrado and Millington (2008), discovered increases in both systolic pressures (from 112 mmHg to 135 mmHg,  $p < .05$ ) in the sleep-deprived group. In addition, sVCAM-1 levels were significantly high in those who were sleep deprived, but returned to baseline after sleep recovery. Because approximately 50 million people in the United States and 1 billion worldwide are affected by hypertension alone, the identification of sleep debt as an intervening variable is noteworthy. As part of routine health screening and physical examinations required in certain occupations, screening for sleep debt and sleep disorders could provide keys to managing cardiac health and hypertension.

### *Sleep Deprivation and Sleep Disorders Increase Accidents and Occupational Risks*

Sleepiness as an antecedent to motor vehicle and industrial accidents is well established (Colten & Altevogt, 2006). Work by Conner, Norton, Ameratunga, Robinson, Civil, Dunn, & et al. (2002) estimated that 20% of all serious automobile accidents are associated with driver sleepiness, independent of alcohol. Sassani, Findley, Kryger, Goldlust, George and Davidson (2004) determined that patients with untreated sleep

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apnea are twice as likely to be involved in a traffic accident. Shift and night-workers are also at high risk for sleep-related traffic accidents (Caruso, et al., 2004; Drake, Roehrs, Richardson, Walsh & Roth, 2004; Barger, et al., 2005). A cross-industry study in the Netherlands spanning one year found that highly fatigued workers were 70 percent more likely to be involved in an industrial accident than low-fatigue workers (Swaen, Van Amelsvoort, Bultmann & Kant, 2003). In some cases sleep debt has been tied to catastrophic consequences, such as the initial response to the Chernobyl nuclear-reactor malfunction that led to a meltdown, a decision to fly the space shuttle Challenger during adverse weather conditions which led to the O-ring seal failure, and piloting errors which led to the Exxon Valdez oil spill. Much of the costs for these disasters become externalized to the firm (de Souza Porto & de Freitas, 2003). Some industries, such as commercial transportation, defense, first responders, and healthcare have already taken steps to address sleep deprivation among their workers. These steps include policies to address workload, rest-cycles, shift-work scheduling to accommodate circadian rhythms, and workplace napping (A. Pack, Maislin, Staley, F. Pack, Robers, George & Dinges, 2006; Boivin, et al., 2007; Elliot & Kuehl, 2007) but there is limited data available to indicate the extent to which other industries have followed suit.

In perhaps one of the demanding professions in terms of need for top cognitive performance is the medical field. There is a growing body of literature to indicate that the traditional 80-96 hour work-week of medical residents leads to sleep deprivation which contributes to serious errors in diagnosis, medication and procedures. In a seminal study published in the *New England Journal of Medicine* after reducing the workweek from 80 to 63 hours, the rate of serious medical errors by interns working in intensive care fell by



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22% (Landigran, et al., 2004). Nurses who worked 12.5-hour shifts reported 3.3 times more medical errors than those with 8.5-hour shifts (Rogers, et al., 2004). Also, Parthasarathy, Hettiger, Budhiraja and Sullivan, (2007) found that reduced workloads improved employee wellbeing of ICU house staff. In response, the Accreditation Council of Graduate Medical Education (ACGME) mandated work-hour limitation for interns beginning in July 2003. Pre- and post-analyses documented improvement in the residents' quality of life and reduction in medical errors that negatively affected patient outcomes. However, even these efforts may be insufficient. Barger, Ayas, Cade, Cronin, Rosner, Speizer and Czeisler (2007) studied the workload of first-year post-graduate physicians over several months. The study included survey responses from 2,737 physicians who completed over 17,000 confidential month reports to determine the extent to which extended duration shifts had a negative affect on patient safety and physician well-being. Interns who worked 5 or more extended-duration shifts ( $\geq 24$  hours) per month had 7 times greater odds of reporting at least one significant medical error that resulted in an adverse patient event and approximately 300 percent more preventable mistakes resulting in patient death. A June 2007 report prepared for the International Association of Fire Chiefs (Elliot & Kuehl, 2007) implies that the work schedules and associated fragmented sleep patterns of first responders poses not only a health risk to the workers, but also potentially extends negative externalities to the public. These results suggest that extended duration shifts negatively impact patient safety, which becomes a public-policy concern. Consider the number of preventable deaths that could be realized if medical care providers and their employers took heed to these data and changed scheduling and work practices to reduce fatigue-related mistakes. Just as the medical

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profession has begun to study and address the negative impact of work performance and productivity on work schedules and sleep, it is reasonable that management practitioners in other professions would benefit from these insights and future related research.

### *Sleep Deprivation and Sleep Disorders Hinders Knowledge-Based Skills*

Eisenhardt and Zbaracki (1992) concluded that strategic decision makers are boundedly rational—i.e. there are limitations to managers' ability to make economically rational decisions. They called for a research agenda in strategic management to explore the roll of cognition in strategic decision-making. What was unknown at the time of their important study was how excessive sleep debt inhibits cognitive ability. In the last few years a sufficient body of empirical evidence from controlled experiments has emerged to provide insights into the discrete effects sleep loss may have on job tasks requiring peak cognitive abilities. Furthermore, in a competitive service-oriented economy, collaborative interpersonal skills are also needed for an optimized labor force. If mitigating sleep loss is cost effective at improving these skills, then it behooves practitioners and public-policy makers to take note. Recent somnology literature has yielded a body of noteworthy studies. I have summarized them into three groups: cognitive/reasoning/personality, interpersonal/ communication, and decision-making involving risk.

*Intelligence, Reasoning and Personality.* In a laboratory-controlled study of 34 participants, O'Sullivan, Reichardt, Krugler, Killgore and Killgore (2006) demonstrated that intelligence quotient is positively correlated with the quality and quantity of sleep recovery after a period of cognitively demanding work. REM sleep has been associated with memory consolidation. The study reinforced the paradigm that REM sleep is necessary after a period of intellectually demanding work, as it acts to restore intelligence

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as measured on the Full Scale Intelligence Quotient (FSIQ) to baseline. In a more recent laboratory experiment, Reid, Smith, Killgore, Rupp, and Balkin (2008) demonstrated that the higher-intelligence constructs of analogical reasoning, categorical classifying, and sequential reasoning were associated with participants' subjective feeling of being less sleepy during sleep restriction; however, objective performance was worsened with sleepiness. Participants were restricted to only 3 hours of time in bed for 7 days. The results suggest that higher IQ confers protective benefits of subjective sleepiness, but the converse is true for objective measures of performance. Emotional intelligence (EQ) also declines in emotion-based decision-making following sleep deprivation (Killgore, Lipizzi, Killgore, Rupp, Kaminori & Balkin, 2008). In a laboratory-controlled, randomized study after 75 hours of sleep deprivation ( $n = 20$ ), it was determined that caffeine consumption does not preserve emotional intelligence during periods of extended sleep debt, although it may increase the subjective feeling of alertness.

McClure, Drake & Roth (2007) studied insomniacs ( $n = 77$ ) against a controlled group ( $n = 77$ ) from the general adult population. In this self-report study, insomniacs reported reduced concentration, increased forgetfulness, and reduced productivity at work. In a repeated-measures test of sleep deprivation ( $n = 25$ ), Pilcher, Pierce and McCubbin (2007) demonstrated that sleep deprivation negatively affects spatial skills as measured in a standardized test, especially those that require multiple, complex spatial strategies. Furthermore, verbal skills are also negatively affected by sleep debt. Pilcher, Fawver and Bourgeois (2008) conducted a within subjects experiment during 30 hours of acute sleep deprivation ( $n = 25$ ). Sleep deprivation negatively affected both verbal and visual working memory, with verbal having the greatest effect. In addition, Goel,

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Lahtman, Banks and Dinges (2008) conducted a randomized laboratory controlled experiment with test participants (n =155) experiencing 5 sleep- restricted nights. The sleep-restricted group showed significantly reduced cognitive throughput and memory impairment, as well as reduced psychometric vigilance.

McGlinchey, Banks, Minkel & Dinges (2006) examined whether or not personality type was an intervening variable on the effects of sleep loss. Their design was a laboratory controlled repeated measures/within groups over 5 days of sleep deprivation (n =33). Psychomotor vigilance and disturbed mood states increased significantly with sleep deprivation, independent of introvert-extrovert personality type. However, extroverted personalities experienced the greatest change in mood. Recently, Smith, Reid, Killgore, Rupp and Balkin (2008) corroborated these results. In a laboratory experimental design over 7 days of sleep deprivation and 5 days of recover (n =24), neurotic and extraverted personality types were associated with worse psychomotor vigilance and disturbed mood states than other personality types. However, those with a higher neuroticism type score recovered more quickly with sleep recovery than extraverted types.

*Interpersonal/Communication.* Reducing sleep debt and sleep recovery are necessary to successfully accomplish a task when the expression of emotions is required, or when the work environment may be emotionally charged. van der Helm, Gujar and Walker (2008) conducted a laboratory-controlled randomized study in which the effects of sleep deprivation were tested on non-verbal skills. The results suggested that sleep-deprivation significantly disrupts affective processing and the ability to interpret happy and angry emotions, especially in women; however, this disruption does resolve to

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baseline following a single night of recovery. In another laboratory-controlled study on non-verbal performance, Anderson, Webb and Patten (2008) concluded that sleep deprivation increases impulsivity and significantly reduces the ability to detect negative emotions, but not positive emotions. Finally, Minkel, Banks, Htaik, Caruso, Bergamo and Dinges (2008) demonstrated that only one night of sleep deprivation causes reduced positive facial displays after being stimulated by an amusing film clip, but no reduction in negative facial displays after viewing a sad film clip. Sleep recovery restored emotional responses back to baseline.

Sleep recovery is also necessary when tasks require writing, editing, and verbal communication skills. In a controlled experimental design Thacher and Casamento (2008), found that one night of total sleep deprivation ( $n = 14$ ) significantly increases the frequency of syntactical and grammatical errors in essay writings; however, this resolved after sleep recovery. Boyce, MacAuslan, Carr, Picchioni, Braun and Balkin (2008) demonstrated that after 28-hours of continuous sleep deprivation, speech patterns became less articulate and intelligible as detected through an automated procedure. Rupp, Killgore, Balkin, Grugle and Killgore (2007) found that common countermeasures—caffeine and prescription stimulates<sup>3</sup> indicated for increasing alertness—were ineffective and countering the verbal and nonverbal fluency in those who went without sleep for 61 hours ( $n = 54$ ).

*Decision-Making Involving Risk.* Sleep recovery is necessary when rational decision making capacities are required to successfully complete a risky task.

Venkatramam, Chuah, Huettel and Chee (2007) discovered that after only 24 hours of

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<sup>3</sup>The study tested the stimulant-like drug *modafinil*, marketed by Cephalon under the brand name Provigil® and the amphetamine *dextroamphetamine*, marketed under various brand names including Dexedrine®, and Spansule®.

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sleep deprivation, participants demonstrated an elevated emotional expectation of potential gains and attenuated the ability to process regret and disappointment with loss. Their laboratory-controlled experiment involved a behavioral gambling task and objective brain scanning. The results also showed that sleep deprivation modulates activation in the regions of the brain associated with risky decision-making and emotional processing, especially the area important for signaling disappointment. Age is also an intervening variable to risk taking in the sleep deprived. Killgore, Balkin and Wesensten (2005) showed that sleep loss increases vulnerability to accept risk across age groups, but age correlates negatively with the ability to make advantageous decisions. Killgore, Richards, Balkin, Grugle and Killgore (2007) demonstrated that caffeine, modafinil, and dextroamphetamine were ineffective at mitigating risky decision-making in the sleep deprived. Only restorative sleep returned participants to baseline; however, their results suggested that sleep loss does not necessarily trigger blatantly risky behavior. In a related study, errors in judgment that result from sleep deprivation occurred primarily from inattention and reduced vigilance, rather than from increased willingness to engage in novel or highly stimulating behavior (Killgore, Lipizzi, Balkin, Grugle & Killgore, 2007); however, they did conclude that use of the amphetamine dextroamphetamine did increase sensation-seeking over the placebo-controlled group. In an earlier study, Roehrs, Greenwald and Roth (2004) demonstrated that alert, sober subjects had significantly improved choice acuity over sleepy and ethanol-impaired subjects. Use of caffeine only improved results when risk-taking depended upon rapidity of response.

### *Mitigating Sleep Loss and Sleep Disorders*

Use of stimulants, napping and education have been previously used techniques to mitigate the negative effects of sleep loss. Previously mentioned studies evaluated the strategy of recovering functioning through use of caffeine and prescription stimulants. Their effectiveness appears limited to subjective assessment of reduced fatigue and objective improvements in some psychomotor function. Ample evidence suggests strategic napping mitigates excessive daytime sleepiness in operational environments (Bonnet & Ardand, 1995; Dinges & Broughton, 1989; Rosekind, et al., 1995). Driskell and Mullen (2005) summarized the research on napping as a countermeasure to address the adverse effects of fatigue. They concluded strategically spaced and timed naps can improve both the subjective feeling of fatigue and objective performance, although the optimal spacing and duration of napping is idiosyncratic. “Naps are not the solution to the problem of fatigue, yet they do provide an effective fatigue countermeasure that should be incorporated into an integrated fatigue management program” (Driskell & Mullen, 2005, p. 376). More recent research has improved our understanding of the benefits of napping. When compared with modafinil and caffeine, afternoon naps of 10-30 minute duration provided a preferred method to regain productivity improvement in terms of memory, ability to plan, and in emotional quotient. (Dhand & Sohal, 2006; Mednick, et al., 2006; Kahn-Green, et. al., 2006; Murray et. al., 2006). While some may think it counter-intuitive to encourage sleeping on the job, firms including Nike and Deloitte Consulting have already adopted napping policies as a means to boost productivity (Weintraub, 2006).

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Others utilize self-help sleep gurus to coach workers (Maas, 1998, Brown, 2004) or hire corporate sleep consultants to train workers on sleep hygiene or adjust work schedules (Circadian Technologies, 2006). Other than industry-published anecdotal case studies, little literature exists to demonstrate the efficacy of these interventions; however, three recent studies from the Medical College of Wisconsin have demonstrated that curriculum developed for both face-to-face and asynchronous eLearning formats can be equally effective in improving medical student knowledge of sleep medicine (Bandla, et. al., 2006, Franco, et. al., 2006a, Franco, et. al. 2006b).

While interventions focusing on the already sleep-deprived are noteworthy, preventing sleep loss in the first place would be a preferable approach. The National Commission on Sleep Disorder Research estimates up to 70 million Americans have diagnosable and treatable sleep disorders (NCSDR, 2003). It is important to mention these, as Czeisler suggests that corporations reduce external demands that contribute to unhealthy sleep as well as serving as important institution for educating its workforce and providing pre-screening for sleep disorders (Fryer 2006). Below is a list of the estimate prevalence of the most common diseases, followed by a brief description of each and treatment options.

- 30 million have frequent or chronic insomnia
- 18 million have obstructive sleep apnea (OSA)
- 10-15% of the adult population suffers from restless legs syndrome (RLS)

*Insomnia.* Insomnia, a state of hyperarousal, is the most common sleep disorder; however, the precise cause is unknown (American Academy of Sleep Medicine [AASM], 2008a). The condition involves a combination of psychological, social and biological



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variables. Of particular note are internal factors such as anxiety and fear of sleeping as well as external causes such as work stress and shift work (Edinger & Means, 2005). Prescription hypnotics, such as zolpidem, marketed by Sanofi-Aventis under the trademark Ambien®, have proven effective for short-term treatment of insomnia. However, Morin (2005) suggests stimulus control therapy, sleep restriction therapy, relaxation training, cognitive therapy, and sleep hygiene education as appropriate psychological and behavioral treatments for insomnia. Sleep-hygiene education content includes general guidelines about healthy practices such as diet, exercise and reduced alcohol use, as well as the manipulation of external factors such as light, noise, and temperature.

*Obstructive Sleep Apnea.* Obstructive Sleep Apnea (OSA) is a chronic sleep disorder that affects primarily middle-aged and older men, but is present in other populations, including women and children (AASM, 2008b). OSA occurs when the tissues in the upper airway collapse during sleep and close off or severally obstruct the passage of air to and from the lungs. Under normal conditions the upper airway and back of the throat collapse inwardly when a person aspirates. Special muscles work against this to splint the airway open; however, in some people, structural abnormalities, redundant tissue, and/or loss of muscle tone inhibit the splinting effect during sleep. This is especially prominent during deep stages of sleep when the muscles are most relaxed. If the surrounding tissues fully collapse and become blocked, an apnea occurs. When the collapse is partial, breathing becomes shallow and snoring often occurs if the throat also vibrates. This condition is referred to as an obstructive hypopnea. Apneas and hypopneas decrease blood oxygen saturation. The automatic response to an apnea during sleep is for

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the lungs to suck in air, which can create a loud gasping or snorting sound. Often this is accompanied by arousal to a lighter stage of sleep. If the condition occurs more than 15 times per hour, it may inhibit the ability of a person to move from deep stage-four sleep to REM stage. Patients with moderate to severe OSA may experience 30-60 events per hour. The result is a combination of low oxygen saturation, fragmented sleep, which leads to daytime sleepiness and other health consequences.

Successful treatment provides many health benefits, including increased daytime alertness, improved quality of life, reduced co-morbidity for other diseases such as cardiovascular disease and neurocognitive degeneration. Left untreated, OSA also imposes negative externalities on society by increased health care utilization, automobile accidents, and industrial accidents (Caruso, et al, 2004). The mainstay of treatment for OSA includes the use of a positive airway pressure (PAP) system, which includes a pressure generating device connected via hose to either a nasal mask worn over the face or an oral device worn in the mouth. This system essentially pressurizes the airway to keep it unobstructed during sleep. Standard PAP devices provide continuous positive pressure (CPAP). More technologically advanced devices offer preset bi-level pressures to account for differences between inhalation and exhalation (BiPAP), or they may vary the pressure automatically based on measured resistance of the airflow (APAP). APAP devices are becoming more popular, as they have been found to be more comfortable and effective at increasing compliance in some patients (Kakkar & Berry, 2007), but often not reimbursable by Medicare as a first line of treatment. Heated humidification is an added upgrade to the PAP system, as are battery back-ups in case of power outages or camping, both of which provide patient benefits.

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*Restless Leg Syndrome.* Restless Leg Syndrome (RLS) is a neurologically based movement disorder that creates an irresistible urge to move the legs or other limbs (American Academy of Sleep Medicine [AASM], 2008c). During rest or when going to bed the urgency heightens and either delays the onset of sleep or causes fragmentation to a normal sleep cycle. The cause is not fully known, but RLS is associated with iron deficiency, which may impair transmission of dopamine signals. RLS shows up in women 1.5 times more than in men. American and Northern Europeans are more susceptible than Asian populations. Although it can be associated in children with ADHD, it occurs primarily in older adults. Varela, et al. (2007) emphasized the importance of expanding public education and awareness of the disease, as they discovered social stigma and misunderstanding move people away from seeking diagnosis and treatment. Treatment includes reducing caffeine and alcohol consumption near bedtime, as well as regular exercise. Remaining mentally active when sitting down helps as well. Pharmacological treatments include various drugs that address dopamine.

*Circadian rhythm disorders.* The American Academy of Sleep Medicine identifies shift-work disorder (AASM, 2008d), and jet lag (AASM, 2008e) as two conditions that affect the circadian rhythm and are related to lifestyle and work habits. Shift-work disorder affects from 2-5% of the adult American population. The condition disrupts the circadian rhythm when the work schedule takes place during the normal sleep period. This includes early-morning, late evening and overnight scheduling. While society benefits from certain services being offered 24/7, such as medical services, defense, law enforcement, first responders, and other vital services it is important that

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care be taken to minimize their indirect costs. Solutions suggested to organizations managing the human resources of shift workers include (AASM, 2008d):

- Reducing the frequency of workers' shift changes
- Changing shifts clockwise—this means adjusting the next shift change forward in time.
- Facilitating exercise, rest or nap breaks during the shift.
- Avoiding driving after a shift.
- Avoiding exposure to light during the day when trying to sleep.
- Consulting with a physician regarding use of caffeine, prescription medications, use of melatonin, or bright light therapy to readjust the circadian rhythm.

Jet lag is also a circadian rhythm disorder brought on by traveling across two or more time zones. The effects vary according to the direction of travel, number of time zones crossed and age. Eastbound trips tend to be more difficult from which to recover than westbound. Six or more time zones can be very disruptive to human functioning. Older adults have a more difficult time adjusting to jet lag. Mitigating the negative effects of jet lag includes the following (AASM, 2008e):

- Planning ahead and adjusting one's schedule of sleeping and waking to be close to what it will be in their new location.
- Napping, exercise, and the use of light therapy can also reduce the effects of jet lag.
- Avoiding operating motor vehicles until achieving adequate recovery from jet lag.

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### *Summary Implications of the Literature from Somnology*

*Health consequences.* There is a significant and expanding body of evidence to demonstrate that sleep deprivation and untreated sleep disorders contribute to and exacerbate other chronic health conditions. Furthermore, restorative sleep (approximately 8 hours per night) and/or the successful treatment of sleep disorders contribute to overall health and have the ability to reduce chronic inflammation. This leads to the conclusion that education and treatment will improve not only individual quality of life, but reduce healthcare utilization. Thus, it seems prudent that practitioners would welcome insights from somnology on how to shape sleep wellness programs to improve the health and longevity of its workforce, as well as reduce health care benefits costs.

*Human functioning.* Sleep loss contributes to a decline in human cognitive and behavioral functioning. The implication for the workplace is that management practitioners should consider ways to mitigate sleep loss, or at least allow for sleep recovery opportunities especially for those tasks where success is dependent upon critical thinking and communication, or require psychomotor vigilance. Furthermore, it is important to recognize that restorative sleep is necessary prior to engaging in decision-making involving risk and reward. One implication is that firms comprised of a workforce with adequate restorative sleep opportunities may enjoy a competitive advantage over rivals whose workers are chronically sleep deprived. Future research directions could include addressing the question, what kinds of negative affects could fatigue-related decision making by sleep-deprived senior managers have on a broader scope of stakeholder interests?

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*Mitigation and Countermeasures.* While the ideal scenario would be for workers to have sufficient restorative sleep when engage in productive activities, this is not always possible—especially in occupations that require shift-work or sleep interruption (such as first responders who are awakened during a sleep to attend to an emergency). Caffeine and prescription drugs have a limited, but useful benefit. Planning work schedules to accommodate circadian rhythms for shift-work and as prophylactic to jet lag is also recommended. Strategically timed naps provide relief from fatigue and restore human functioning in the short run. Finally, initiatives to increase awareness about the symptoms of sleep disorders, or inclusion in health screening will help to identify individuals who would benefit from treatment.

*Implications for practitioners.* How can findings from these studies be of relevance of to practitioners? The robust data available to date supports the assertion that a comprehensive wellness program that includes sleep and work-life balance could become an important part of a firm's strategy. The benefits include improved decision-making of its knowledge workers and loss minimization from accidents. Moreover, the somnology literature can provide useful insights into workplace practices that provide quality of life benefits to employees, improved productivity and healthcare cost savings to the organization. Derived from the preceding literature review, the following is a useful list to be considered as content for sleep wellness training and human resource practices in the workplace:

- Create a culture of wellness that includes reinforcements and incentives to maintain adequate work-life balance that includes sufficient time to sleep.

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- Provide awareness and pre-screening for sleep disorders in health education initiatives.
- Minimize sleep loss for those performing critical tasks requiring either spatial reasoning or verbal skills.
- Minimize the number of consecutive days of sleep debt and encourage recovery if the task is intellectually demanding and requires attention to detail, concentration and projects requiring risk-benefit analysis.
- Minimizing sleep debt and encouraging longer recovery from sleep debt are particularly important for extraverted personality types, especially if reaction speed is critical for task success and when increased moodiness may negatively affect the outcome.
- Minimize sleep debt when performing critical tasks requiring collaboration or human interaction when interpretation and expression of emotions is required, or when the work environment may be emotionally charged.
- Recognize that emotional intelligence declines with sleep debt and does not recover with caffeine consumption.
- Recognize that higher intelligence may decrease the subjective feeling of fatigue; it also masks the negative perception of decline in objective performance.
- Recognize that caffeine and prescription stimulants have limited impact on improving objective performance.
- Recognize that adequate sleep is more important for older workers, especially when decision-making involves risk/reward trade-offs.

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- Identify the trait differences in individual workers and leverage scheduling and task assignments to maximize performance and minimize risks.
- After extended periods of chronic sleep deprivation, maintain up to five days of restorative sleep to maximize rational decision-making capacities.
- Minimize the impact on circadian rhythm disorders, such as jet lag and shift-work disorder by following the recommendations of the AASM.

### Economic and Human Costs of Sleep Deprivation and Sleep Disorders

There are both economic and human reasons why managers of firms and public-policy makers should consider taking action to change the incentives for individuals to be screened for sleep disorders and improve their sleep habits. A simple cost-benefit analysis provides adequate economic incentives for firms to invest in educating their workforce about healthy sleep habits, adapting policy to accommodate adequate sleep prior to performing certain tasks, and providing information and screening about sleep disorders. Not only will firms enjoy increased efficiencies and increased productivity with their current employees, it may also enable them to attract and retain a more competitive workforce.

Firms with a corporate social responsibility perspective will be oriented to take into account the interests of their employees and society in general. Sleep Medicine pioneer and founder of the Stanford University Sleep Clinic, William Dement (1999) claims that healthy sleep is the single best predictor of longevity. Even after controlling for diet, exercise and heredity, those who average about eight hours of restful sleep per night live longer, have a higher quality of life, and are more alert at work. As socially responsible organizations become more aware of the benefits of incorporating sleep



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education into their wellness programs, the quality of life and human dignity of employees and society at large will also be improved.

Many other attempts to assess the economic costs for sleep loss/sleep disorders include not only diagnostic and treatment for the primary condition, but also the associated co-morbidities and indirect costs from lost productivity. A 2001 estimate put the total annual costs at \$150 billion to US businesses for sleep-related costs for absenteeism, accidents and productivity losses (Sleep Disorders Create Growing Opportunities for Hospitals, 2001). Other studies provide similar totals. Total direct cost estimates just for insomnia range from \$30 billion (Walsh & Engelhardt, 1999) to over \$100 billion (Stoller, 1994). Moore-Ede (1993) estimated that the indirect annual economic impact of sleep related problems at over \$65 billion. This breaks down as follows:

Lost manufacturing productivity	77% of total indirect costs
Increased industrial accidents/death at work	10% of total indirect costs
Increased motor vehicle accidents	8% of total indirect costs
Other medial and psychiatric illnesses	3% of total indirect costs
Turnover and retraining	2% of total indirect costs

O'Sullivan, Thompson, Treglia, Healey, Harnett, Weinstein, et al. (2007) estimated the 2003 total burden in the US to be \$13.5 billion for lost productivity and treatment costs directly attributable just to insomnia and the associated co-morbidities of depression, alcohol abuse and nicotine dependence. Indirect costs were estimated at 23% of the total through lost productivity from premature death and absenteeism. More recently, Mendelson, Hawkins, Treglia, Healey, Wang, and Harnett (2007) discovered

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that insomnia patients were more likely to be diagnosed with other related conditions that increased healthcare utilization and mortality rates. This retrospective study includes 5,584 insomnia patients in the US paired with a randomized control cohort of 55,580. The nominal economic burden of the insomnia group was \$2,738 per person. Healthcare utilization accounted for 84% of the total and the remaining 16% for absenteeism. In a retrospective study spanning 2001-2006 of almost 300,000 employees in the United States, Brook, Kleinman, Melkonian, Doan and Baran (2007) compared average annual health care costs of insomniacs with a randomized control group. After controlling for age, gender, co-morbid mental and physical disorders, job tenure, salary, and geographic region, there was a significant difference between mean direct and indirect costs in both groups (Table 1).

**Table 1: Direct and Indirect Costs of Annual Healthcare Costs in Insomniacs**

Cost Items	Insomniacs	Control
Direct Medical	\$3,306	\$1,749
Prescription drugs	\$1,220	\$422
Sick leave	\$720	\$325
Short-term disability	\$465	\$229
Long-term disability	\$46	\$10
Worker's Compensation	\$483	\$280
<b>TOTAL</b>	<b>\$6,240</b>	<b>\$3,015</b>

Source: Brook, Kleinman, Melkonian, Doan and Baran (2007)

Hillman, Murphy, Antic, and Pezzull (2006), built a model to calculate the total costs of insomnia, sleep apnea and periodic limb movement in Australia (population 20.1

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million). Their model included both direct and indirect costs to the economy and totaled \$7,494 million (2004 USD), or 0.8% of Australian GDP. Of that total, only \$146 million was accounted for in direct costs for sleep disorders, but \$313 for associated health conditions, \$1,955 for work-related injuries, and \$808 from private automobile accidents. Human capital losses amount to nearly \$4.5 billion (Table 2). When applying this model to the US economy, they estimated the 2004 total burden would have been \$109 billion.

One of the more elusive aspects of calculating the total burden to the economy is an assessment of indirect costs. Previous studies calculate productivity losses from sleep loss primarily through absenteeism. This is the technique used in the Hillman et al, (2006) and Moore-Ede (1993) models. Somnologists suggest that fatigue and excessive daytime sleepiness are associated with neurobehavioral limitations and mood changes that affect human functioning at work and increase the risk for errors and mistakes (Banks & Dinges, 2007).

**Table 2: Human Capital Losses to Productivity from Sleep Disorders in Australia**

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Cost Factor	Total (USD)
Lost productivity from premature exit from the labor force	\$1,114 million
Lost productivity from absenteeism	\$57 million
Foregone taxation revenue, plus administrative burden	\$449 million
Net cost of suffering	\$2,970 million
<b>TOTAL</b>	<b>\$4,590 million</b>

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Source: Hillman, Murphy, Antic, and Pezzulli (2006)

While a sleep-deprived person may choose to show up to work, his/her productivity is impaired through presenteeism. Hemp (2004), Goetzl, Long,

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Ozminkowski, Hawkins, Wang, & Lynch (2004), and Midaugh (2007) argue that presenteeism occurs when employees come to work with a medical or psychological condition that impairs their productivity primarily in the form of reduced output. The preceding review of the somnology literature has established that sleep loss causes impaired cognitive, behavioral, and psychomotor performance in workers, thus it is reasonable to conclude that sleep loss contributes to overall presenteeism. Presenteeism may also increase opportunity costs due to sub-optimal decision-making (such as not being able to successfully negotiate a high-stake decision).

### Theoretical Basis for Analyzing the Impact of Sleep on Human Capital Productivity

The link between health and worker productivity has been established by the recent work from various economists (Grossman, 1972; Strauss & Thomas, 1998; Rivera & Currais 2003; Bloom, et. al., 2004; Cole & Neumayer, 2005; Liu, Dow, Fu, Akin & Lance, 2008). Each has looked at variables of health as having an impact on the production function and/or use the theory of Total Factor Productivity (TFP) as a theoretical basis by which the quality of physical health of labor contributes to productivity.

Total Factor Productivity (TFP), or output per worker ( $Y/L$ ), has been understood as a function of capital,  $K$  and labor,  $L$  where  $Y/L = f(L, K)$ . As a nation's stock of capital and labor increases, so does TFP. Employees who become absent from the workforce because of illness, disability or premature death decrease the quantity of labor, but quantity of available labor alone is insufficient to fully explain TFP. Both quantity and quality of labor matter. Labor quality has been traditionally viewed a function of

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education,  $E$ , and experience,  $X$ , expressed as  $L = f(E, X)$ . However, this model remains insufficient, since the quality of labor is depreciated through presenteeism as noted by Hemp (2004) and Caverley, Cunningham and MacGregor (2007). Hence, our understanding of TFP could improve by including a variable for health. Healthy workers are less likely to be absent or to show up for work at less than full productive capacity. Nobel prize-winning economist Gary Becker argues, “Economists regard expenditures on education, training, medical care...as investments in human capital” (2002).

Grossman (1972) was one of the first to demonstrate this as he adopted the theory of human capital to explain the demand for health and health care. The assumption of the Grossman model is that people are not necessarily consumers of healthcare—rather they seek health and are *producers* of health capital. People invest time and effort to improve their health as well as purchase medical inputs. The model also treats health as a *consumption good*—because it yields personal utility, and as an *investment good*—because it increased the number of days available to earn income. Furthermore, Grossman suggests health is endowed, presumably at birth and then depreciates (as an exogenous variable) over time and often idiosyncratically. Gross investment in health is also mediated by education, which also shifts the demand for health inputs outward because education correlates with health-seeking behavior. Education also improves the efficiency of healthcare consumption.

When applying a similar econometric model of TFP to understand developing nations, Bloom, Canning and Sevilla (2004) explained that differences in economic growth rates can be attributed to health, as measured by proxy in longevity. This was after controlling for education, capital, and experience. Cole and Neumayer (2005)

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performed a study similar to Bloom's but rather than using the single construct of longevity for health, they used three variables: malnutrition, malaria, and water-borne diseases. They demonstrated that poor health had a negative and significant impact on the TFP of developing nations in Africa. Others have explored the relationship between health and productive output. Rivera and Currais (2003) demonstrated that expenditures in health have a net positive effect on GDP. Strauss and Thomas (1998) correlated an optimal body-mass index with productivity in Brazilian and U.S. males. Recently, Liu, Dow, Fu, Akin and Lance (2008) proposed a model for China that treats health as a form of human capital in income production.

Building on Grossman's work, Folland, Goodman, and Stano (2007) developed a useful model to explain how a consumer's quest for healthy days interacts with daily decisions. Their model assumes there is a labor-leisure trade-off, but they segregate leisure into two components—time spent improving health, plus time spent producing home goods (the sum of all other leisure activities). Investment in health ( $I$ ) becomes a function of time spent improving health ( $T_H$ ) and expenditures ( $M$ ) on health inputs (such as medical provider services, drugs and other health-specific goods). Producing home good inputs ( $B$ ) becomes a function of time spent improving home goods, ( $T_B$ ) and expenditures ( $X$ ) on goods and service inputs for the home (such as food, furniture, and related goods and services). Thus, the expenditure trade-off is between health inputs ( $M$ ) and home good inputs ( $B$ ). The trade-off for time is between improving health, ( $T_H$ ) and improving home goods ( $X$ ). The functional notation follows:

$$I = f(M, T_H)$$

$$B = f(X, T_B)$$

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Their framework also provides for equation for understanding the trade-offs of time. The total time, or days in a year, can be allocated to improving health,  $T_H$ , home goods,  $T_B$ , working,  $T_W$ , or losses,  $T_L$ , due to illness. This is expressed as follows:

$$\text{Total available time} = T_H \text{ (improving health)} + T_B \text{ (producing home goods)} + T_W \text{ (working)} + T_L \text{ (lost to illness)}.$$

Folland, Goodman and Stano (2007) visualize their theory in an input-output format, where health inputs build health capital stock over time to create health outputs. They list inputs as follows: healthcare, diet, exercise, environment, income and time. The outputs are conceptualized as “healthy days” and include physical health, mental health, and activity limitations. From this, they develop a production function of health, where inputs create health stock and outputs create healthy days. Provision is also provided for the diminishing marginal returns to inputs.

What is missing from their model is a variable for sleep. Evidence presented previously in the literature review demonstrated the importance of optimal sleep for total health and peak alertness for human functioning. Furthermore, their model lacks a variable to account for vices, such as tobacco use and other substance abuses. The U.S. Department of Health and Human Services and Centers for Disease Control and Prevention have partnered to target educating the public regarding three significant but controllable risk factors related to health: obesity, inactivity, and tobacco use (Steps to a Healthier US, 2006). After controlling for heredity and other environmental factors, these three are commonly regarded as the most preventable health risk factors.

*Macroeconomic model.* I am proposing a modification of the Folland, Goodman and Stano model where time spent on health-seeking behavior ( $T_H$ ) is a function of the

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controllable factors of diet ( $D$ ), exercise ( $E$ ), substance abuse ( $T$ ), sleep quantity ( $S_t$ ), and an exogenous constant ( $\alpha$ ) that mediates for heredity and other uncontrollable environmental factors, such that:

$$T_H = f(D, E, T, S_t, \alpha)$$

Each of these variables can be measured through either subjective or objective means. The literature suggests that there is an optimal quantity of sleep hours in a day. On average this is 7 to 8 hours for healthy adults. However, evidence suggests that too much sleep can be evidence of another underlying health condition (Kripke, Garfinkel, Wingard, Klauber & Marler 2002). As the number of hours sleeping in a 24-hour period increases beyond 8 or 9, the total benefits to human functioning begin to decline and mortality rate increases. One can visualize the marginal return curve for quantity of sleep as being U-shaped. Hence, the  $S$  variable in this expression could include a co-efficient that modulates if total sleep quantity is below or above the mean optimal value.

Sleep quality is also an important variable for an overall model. Sleep quality ( $S_q$ ) declines primarily because of the existence of a sleep disorder. Therefore, health input expenditures for treatment for sleep disorders ( $M_s$ ) can be conceptualized as a proxy for sleep quality. In order to analyze the effects of sleep quality, the variable  $S_q$  as a total percentage of all health expenditures ( $M_t$ ) can be computed and used to build an econometric model for analysis.

$$S_q = M_s / M_t$$

If this conceptualization were robust, the variance of nation's percentage of total spending to treat sleep disorders would correlate with total health capital. Going through the rigor and cost involved in computing its contribution to total GDP output may have



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its limitations; however, this is a similar technique as used by Hillman et al, (2006) and Moore-Ede (1993) in their computations.

At this point, a comprehensive expression can be constructed to explain how sleep interacts with TFP through its effect on human capital (L); whereas, L is a function of available technology capital (K), education (E), experience (X) and health (I), with health being a function expenditures (M) and time spent on health-seeking behaviors ( $T_H$ ). Sleep quantity is captured in health-seeking behavior. Sleep quality ( $S_q$ ) is captured as a component of total health expenditures, such that:

$$T_H = f(D, E, T, S_b, \alpha)$$

$$I = f(M_t, T_H)$$

$$L = f(K, E, X, I)$$

$$Y/L = \text{TFP}$$

The above set of equations is useful for conceptualizing a macroeconomic analysis.

While fully testing this model is beyond the scope of this dissertation, I believe it is useful as a starting point for theory building. It expands on the existing and established work in health economics and now includes a previously unrecognized important variable of sleep. This model can guide future macroeconomic research and policy making.

*Microeconomic analysis.* A suitable approach for a microeconomic or firm-level analysis of the contribution of sleep to firm performance is to simply calculate the cost-benefit and then calculate net present value. This is the approach taken by Sassani, et al, (2004). They estimated that in the year 2000, over 800,000 drivers in the United States were involved in sleep apnea-related motor vehicle accidents resulting in injury, property damage, and loss of life at a cost of nearly \$16 billion. The authors deduced that it would

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cost a little over \$3 billion to provide treatment to all drivers suffering from sleep apnea. Doing so would reduce motor vehicle accidents due to sleepiness and could save 980 lives and over \$11 billion annually. A simple cost-benefit analysis provides a rational conclusion that treatment enhances society's overall utility.

When estimating costs at the firm level, it is important to include both the accounting and economic costs. Below is an expression that accommodates for both the implicit and explicit costs and may prove useful to practitioners,

$$\text{Sleep related costs} = [\text{Lost productivity due to sleep loss (absenteeism} + \text{presenteeism)} + \text{that portion of healthcare insurance premiums associated with co-morbidities caused by sleep loss and sleep disorders} + \text{that portion of liability insurance premiums associated with risk due to errors, omissions, and disasters caused by sleep loss and sleep disorders}]$$

Future empirical research at the firm level will assess the robustness of the above expression. Practitioners may find it a pragmatic starting place to assess the return on investment for sleep wellness initiatives.

### *Summary*

Attempts have been made to calculate the direct and indirect costs slept debt and sleep disorders have on society. While these have provided useful insights and calculations, a comprehensive macroeconomic model that builds on established theories has yet to emerge. I have proposed a macroeconomic model that considers sleep quantity and quality as important mediating variables for overall health. This model is useful because it accommodates for individual choice for time trade-offs. By and large, people make lifestyle choices between work/commute, leisure, and sleep. The literature suggests

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that more and more people have increased their work hours at the expense of sleep, while preserving leisure. The model accommodates for this. The model also accommodates for sub-optimal sleep time, which is known to raise the risk for co-morbidities by decreasing human health capital. Finally, the model accommodates for sleep quality. As expenditures increase for treatment of sleep disorders, we should expect to see a positive correlation with sleep quality, as successful treatment has been shown to reduce excessive daytime sleepiness and fatigue related impairments.

Collectively, sleep debt and sleep disorders reduce human health capital. Furthermore, together they indirectly contribute to loss productivity through presenteeism. It is theorized, then, that optimizing a labor forces' sleep will contribute to total factor productivity. I have also included an expression for estimating the costs at the microeconomic level that includes both direct and opportunity costs. Firms wishing to conduct a cost-benefit analysis prior to implementing sleep awareness or related programs to promote an alert workforce will find this model useful for calculating a return-on-investment.

### Rationale for the Study of Sleep-Wellness Policies and Practices

In recent years increasing attention has been given to study the economic return of corporate wellness programs. The Human Resource Library (HRL, 2008) suggests that wellness programs benefit employers in three ways: 1) to reduce healthcare plan costs; 2) to reduce absenteeism; and, 3) improve employee morale and productivity. Typical wellness programs may include information, education, health assessment and screening, treatment programs and/or employee incentives or subsidies that include access fitness and exercise facilities, weight and diet management, tobacco and substance abuses

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programs, stress and other emotional problems. A Medica (2007) white paper suggests that comprehensive, personalized worksite programs can improve employee health and other measurable business benefits including lower health insurance premiums, improved productivity and reduced absenteeism and presenteeism. Human resource consultants Ingham and Norris (2007) reported that General Motors and Citibank experienced a savings-to-cost ratio of 2.3:1 and 4.56 respectively from their investments in wellness programs.

Furthermore, promoting a culture of wellness and health can be part of a comprehensive corporate social responsibility (CSR) effort. Bhattacharya, Sen, and Korschun (2008) demonstrated that a firm's CSR effort has become an important factor in attracting and retaining productive employees. Of particular interest is their discovery that employees are attracted to firms with initiatives that help to improve work-personal life integration. It may be that firms with comprehensive wellness programs enjoy an advantage because having such programs enables them to recruit and retain more knowledgeable and productive employees.

The Business Roundtable recently sponsored a comprehensive study of a representative sample of its member organizations, which represent approximately 160 U.S. companies with a combined total of \$4.5 trillion in annual revenues and more than 10 employees (Business Roundtable, 2007). Through extensive interviews, they analyzed 73 different wellness initiatives, more than half of which were launched or revamped within the previous five years of the study. The study revealed that wellness is becoming engrained as part of the corporate culture. The report also advocates that corporate

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sponsored wellness programs have become an important institution for fostering greater individual involvement with their health. Consider this conclusion,

Business Roundtable believes that every person has two responsibilities: to make choices that support his or her own health, including participating in wellness, prevention and any necessary chronic care programs, and to have health insurance coverage that, at a minimum, offers catastrophic benefits (Business Roundtable, 2007, p. 5)

Current programs identified included on-site flu shots (97%), health fairs and on-site screening (91%), weight-management programs (85%), nurse/health advice lines (84%), disease management—such as diabetes and heart disease (82%), health risk assessments (80%), tobacco cessation (74%), and on-site workout facilities (73%).

### Empirical Research Questions and Research Design

What is lacking in the literature—and what this dissertation addresses—is an empirical understanding of the prevalence within U.S. corporations and the potential impact of sleep-wellness policies. Thus, the following broad research questions will be addressed:

- 1) To what extent do large American firms have sleep-wellness policies?
- 2) Does encouraging workers to get adequate rest impact the perception employees have of the firm?

I am proposing that *sleep-wellness* practices should include three constructs: 1) incorporation of sleep education and sleep disorder awareness in corporate wellness programs; 2) allowances and provisioning for napping during the work shift; and, 3) policies that encourage or require adequate restorative sleep prior to engaging in high

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stakes or high risk tasks. These will serve as a starting point and a synthesis of what the literature indicates contribute to improving human functioning through adequate sleep. Furthermore, these are three areas of concern argued by sleep scientist Charles Czeisler that should be incorporated into business practices (Fryer, 2006).

To address the first research question a survey was created to document the prevalence of *sleep-wellness* practices among large enterprises in the US. This will accomplish a major goal of this dissertation by providing a snap-shot of what corporate America is doing with respect to helping their employees in gaining awareness of and reinforcing good sleep habits. Given the herald from Czeisler and others on the need to include sleep as a component of corporate wellness programs, it was curious to discover that neither the Business Roundtable (2007) study, nor any other study I could find reported on whether or not sleep education or sleep disorder screening are included as a component of corporate wellness programs. Given that corporations are viewed as important conveyers of health education, it would be important to understand the extent to which sleep education programs may be lacking in comparison with education and services on diet, exercise, and substance abuse—three of the variables in the proposed model of health seeking behavior:  $T_H = f(D, E, T, S, \alpha)$ . I speculate at this point that the prevalence of sleep management awareness education is significantly less than diet and weight management (D), exercises and fitness (E) and substance abuse (T).

The second empirical research question—*Does encouraging workers to get adequate rest impact the perception employees have of the firm?*—is also of exploratory nature, but it is speculated that there will be a positive relationship between encouraging

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adequate sleep with the perception that a firm is more caring of its employees, is a more desirable place to work, and is more productive than its competitors.

### Anticipated Usefulness

The National Institutes of Health has called for increasing awareness and education to mitigate the negative impacts of poor sleep-hygiene and sleep disorders. Particular concerns include the cost to the workplace due to sleepiness and fatigue. This study will contribute to this new, but growing body of literature of the impact sleep deprivation has on workplace productivity. Furthermore, the research may provide useful insights for HR practitioners, consultants, and providers of worker-wellness-productivity consulting services. The findings are also expected to yield additional research questions to better understand how sleep policies and sleep disorder awareness impact productivity.

The medical field also lacks data on the prevalence of policies that exist with a broad cross-section of industries and occupations. Hence, this research will provide health care providers insights into the degree to which sleep disorder patients may find support and screening in the workplace.

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## CHAPTER III—Methodology

### Overview

The objectives of the empirical section of this dissertation are two fold:

1. To discover the extent to which firms have sleep-wellness practices.
2. To discover if managers at firms encourage adequate sleep have more positive perceptions of the firm than those that do not.

To address these objectives, data was collected from a 27-question survey designed to document sleep-wellness practices of a representative sample of large companies in the United States. Descriptive results provide evidence on the extent to which firms, at the time of this study, have sleep-wellness practices. Statistical analysis provides insights into the types of firms that have such practices and policies. Further analysis provides evidence as to whether or not firms that encourage their employees to obtain adequate sleep are perceived to have positive attributes.

### Unit of Analysis

The unit of analysis is U.S. enterprises with annual revenues over \$1 billion. This group was selected because they capture a large percentage of the American workforce. Obtaining such a sample was also convenient. The informants are HR and other managers with functional job rolls that would be knowledgeable of the firm's wellness programs and sleep policies.

### Sample Population

The sample was obtained from a commercially available database offered by TrueSample™, a provider of quality-assured samples. They partner with Zoomerang to



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launch and electronically gather the data. Once the data are gathered they are exported and converted to an SPSS format for analysis. The TrueSample opt-in database is comprised of individuals who agreed to receive and respond to qualified email-based surveys. TrueSample indicated they re-qualify their database quarterly for over 500 attributes. I contracted with them to query a random sample of qualified participants in order to yield an estimated 300 responses. This quantity was selected to yield a sufficient number of participants to provide useful statistical analysis within budgetary constraints. The database query specified the following attributes of each participant: 1) Works at a Fortune 1000 company; 2) firm has >\$1 billion in annual revenue; 3) primary functional work area human resources, legal, or executive management. To verify the quality of the database the following qualifying questions were embedded into the survey:

<u>Qualifying question</u>	<u>Purpose</u>
(#1) Employment status	To verify they are full-time employees
(#2) Functional job area	To qualify their functional occupation
(#26) Zip code	To minimize the likelihood of receiving multiple responses from the same firm. Duplicate zip codes were compared with other categorical data (industry type, revenue, # of employees). A coin flip determined which to retain in the sample set.
(#19) Annual revenue	To qualify that the informant worked at a Fortune 1000 firm (< \$1Billion annual revenue)

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## Survey Instrument

The survey was originally created and then pre-tested on six human resource managers representing firms of various sizes. After they took the first draft of the survey, they were interviewed via phone and email. Feedback was solicited on question wording and content. Including ideas for rewording questions, several suggested adding a “not applicable” or “I don’t know” response to some questions. These suggestions were integrated and a revised survey was then sent back for further feedback. The final version to be used in this study included 27 questions (Appendix A). Due to the scope of this dissertation, only a sub-set of questions from this survey was used and reported in the final analysis.

The survey attempts to capture the extent to which three sleep-wellness practices were present in organizations: 1) sleep awareness education, 2) policies allowing for napping, and 3) policies regarding adequate rest. These were chosen because they recur in the somnology literature as practices recommended for mitigating productivity and human functioning problems related to sleep debt and sleep disorders.

### *Sleep Education*

Sleep education and awareness includes regularly providing information, education, training, or benefits related to healthy sleep habits and sleep disorders. This group of questions is thought to capture a means for empowering workers to make healthy lifestyle choices. The following survey questions were used to develop a sense for the degree to which firms provide information for sleep awareness.

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*#3 Does your firm provide its employees information or education about any of the following? One of the possible selections is Sleep/alertness awareness and management.*

*#15 In the past 12 months, has your firm made available to employees information or training on healthy sleep habits through any of the following ways?*

*#16 In the past 12 months, has your firm made available to employees information or awareness of sleep disorder symptoms through any of the following ways?*

*#17 Does your firm provide screening for any of its employees for sleep disorders?*

### *Naps*

This group of questions is straightforward and seeks to describe whether or not a firm has in place a policy allowing its employees to nap during the work shift. Whether or not a firm provides furnishings to do so would be of interest to furniture vendors and architects. These questions are thought of as a means of providing a counter-measure to fatigue. The following questions were asked:

*#12 Does your firm provide furnishings or a place where any of its employees may take a nap during their work shift?*

*#13 Does your firm allow any of its employees to take nap periods while at work?*

### *Rest Policies*

This group of questions intends to capture whether or not firms require employees to obtain sufficient rest prior to engaging in activities either requiring psychomotor vigilance or negotiating high-stake business decisions. Such policies are thought of as a

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way to minimize accidents and improve decision-making. The following questions were posed:

*#7 Does your firm require employees to have a minimum rest period between work shifts that include operating heavy equipment or machinery?*

*#8 Does your firm require employees to have a minimum rest period between work shifts that include operating a vehicle, aircraft, or vessel?*

*#9 Does your firm require employees to have a minimum rest period between work shifts that include negotiating a significant or risky business engagement?*

*#10 Does your firm require employees to have a minimum rest period between work shifts that include conducting high-risk procedures or potentially dangerous tasks?*

*#11 Does your firm require employees to have a minimum rest period before an employee may operate a vehicle after a transatlantic or red-eye flight where jet lag is a factor?*

### *Variables That May Indicate an Effect*

While it is not the intention of this study to create an experiment or quasi-experiment to test a causal relationship, it is speculated that the presence of sleep-friendly practices will have an association on the perceptions employees have about their firm. To explore this possibility, five other questions using a 1-5 Likert-type responses were included for a correlation analysis.

*#5 My firm encourages employees to get an adequate amount of sleep prior to reporting to a work shift.*

*#6 My firm encourages employees to turn-off all electronic devices during sleep (including cell phones, pagers, BlackBerries, e-mail, etc.)*

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#22 *My firm is one of the best places to work.*

#23 *My firm cares about the well-being of its employees.*

#24 *In general, employees at my firm are more productive than those of our competitors.*

### *Control Variables*

Other categorical questions will be asked that will serve as control variables in the exploratory analysis,

#19 *Total annual revenue*

#20 *Number of employees*

#24 *Listed on Fortune Magazine's list of 100 Best Places to Work?*

#25 *Industry type*

Finally, an open-ended question at the conclusion of the survey invites the respondent to comment further on this survey,

#27 *You may add below any further comments you have regarding this survey.*

### Exploratory Research Questions

One of the goals of this study is to provide empirical evidence to better understand the characteristics of firms that provide sleep awareness education. For certain functional jobs this is especially important, such as commercial transportation operators, medical services personnel and first responders. Therefore, the following exploratory question is asked,

*E<sub>1</sub> What are the characteristics of firms that include sleep awareness in their in their wellness education?*

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Statistical analysis of data collected from the will help to determine if type of industry, number of employees, revenue size and whether or not the firm is listed on the Fortune 100 Best Places to Work helps to predict the presence of sleep awareness education. Logistic regression will be the preferred technique because of its robustness to handle categorical independent variables (Hair, Black, Babin, Anderson, Tatham, 2006; Siegel & Castellan, 1988). An association will be assumed if  $p < .05$ .

### Assumptions Stated as Hypotheses

Empirical research to date into the sleep-wellness practices at organizations is lacking to build a testable theory of cause and effect and productivity. I am not searching for causal variables at this point, although it is hoped that future field research may find this dissertation useful for advancing this understanding. Nevertheless, there is sufficient literature to assume firms that encourage their employees to get adequate rest will have an impact on positive employee perceptions of the firm. Moreover, the model proposed in Chapter 2 assumes that optimal sleep contributes to productivity, as it is a necessary component of health-seeking behavior. Therefore, Chi-Square correlation analysis ( $p < .05$ ) was used to verify the following assumptions, which are stated as hypotheses:

$H_1$  Firms that are perceived as encouraging employees to get adequate rest are positively associated with perceptions that they are caring of their employees.

$H_2$  Firms that are perceived as encouraging employees to get adequate rest are positively associated with the perception that they are a desirable place to work.

$H_3$  Firms that are perceived as encouraging employees to get adequate rest are positively associated with the perception they are more productive than their competitors.

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## Limitations and Delimitations

This empirical study is limited in that it does not fully test the proposed econometric model for analyzing and measuring the economic impact of sleep-wellness policies. To do so would be beyond the available resources constraints for this dissertation; however, the results will reveal whether or not the presence of sleep-wellness practices is associated with positive perceptions of productivity. If this study reveals that there are either no or negative correlations, then the model's robustness would be in doubt. A positive correlation will provide evidence that will warrant further research and model testing.

The descriptive results will have moderate generalizability to large enterprises operating in the United States. Care is being taken to qualify that the data source matches the attributes contracted to be obtained through the vendor and that no more than one participant from the same firm is included in the sample. Because of the opt-in nature of the respondents, it is acknowledged there is selection bias. For instance, selecting a random sample of firms from the actual Fortune 1000 list and then finding an informant at that firm who could produce a policy manual to review would yield more robust data. The self-report nature of the survey also provides limitations on whether or not certain policies are truly in place. For instance, a respondent may not know of or be aware of the existence of a specific policy or practice. For some questions deemed appropriate a response option, "I don't know" may even shed insights. Nevertheless, it is often the subjective understanding of a policy or practice that matters matters when forming an opinion or perception of the firm. Hopefully, future empirical studies can build from the insights gained from the results of this dissertation.

**CHAPTER IV—Research Findings and Results**

Overview

In this chapter the results are presented along with a discussion of their implications. The first section will cover the descriptive statistics. Section two addresses the first exploratory research question: *To what extent do large American firms have sleep-wellness policies?* The third section addresses the second research question: *Does encouraging workers to get adequate rest impact the perception employees have of the firm?*

Descriptive Statistics

*Sample Population Characteristics*

TrueSample indicates an average 16% response rate on typical surveys, so a total of 1970 initial emails with links to the survey were sent to a random sample of participant's with the specified attributes: works in the United States for Fortune 1000 firm; firm has >\$1 billion in annual revenue; functional work area: Human Resources, Legal, Executive Management, and Administering Health and Mental Health Services. The survey exceeded its expected quota and was terminated with 364 responses after five days, yielded a response rate of 18.5%. The survey launched on a Thursday afternoon and closed the following Monday morning in August 2007.

Of the 364 responses, 294 were complete and qualified and used for this study. To be qualified, the respondent must have indicated that the firm had at least \$1 billion in annual revenue. Since the unit of analysis was the firm, care was being taken to minimize the chance of more than one participant from the same organization was included in the



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final sample. Therefore, responses from the same zip code were compared with the following categorical responses: industry type, number of employees, revenue. There were six sets of surveys that fell into this category. A determination was made that these were responses from likely from individuals working at the same firm. A coin flip was used to determine which response to disqualify.

The raw results indicated that there were 135 (45.9%) firms with revenues from \$1-10 billion and 159 (54.1%) with over \$10 billion (Table 3). Three firms indicated they had fewer than 500 employees (.9%) with 22 reporting from 1,000-4,999 (7.5%), 62 from 5,000-10,000 (21.1%), and 207 with over 10,000 employees (70.4%). See Table 4.

During the time of the survey, Fortune 1000 firms had a minimum of \$1.6 billion in annual revenue, with 25% having more than \$10 billion and 75% less than \$10 billion (Aggdate, 2008).

**Table 3: Annual Revenue**

		Frequency	Percent
Valid	\$1-10B	135	45.9
	>\$10B	159	54.1
	Total	294	100.0

N = 294

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**Table 4: Total Employees**

	Frequency	Percent	Cumulative Percent
Valid <50	1	.3	.3
50-99	1	.3	.7
100-499	1	.3	1.0
1,000-4,999	22	7.5	8.5
5,000-10,000	62	21.1	29.6
>10,000	207	70.4	100.0
Total	294	100.0	

N = 294

There were 19 industries reported in the initial data set. Those ranked in the bottom six were reassigned into other groups for a total of 13 industry groupings. This included merging education (n =3), media/printing/publishing (n =1) and government/non-military (n = 3) into the business/professional services group. Food services (n = 3) was merged into entertainment/recreation/leisure. Mining/oil exploration (n = 5) and agriculture/forestry & fishing (n = 1) were merged into manufacturing. The results indicate two-thirds are from six broad industry categories: manufacturing (19.7%), accounting/finance/banking (10.9%), insurance/legal (9.9%), retail/wholesale/trade (9.5%), utilities/ telecommunications, and business/professional services (7.5%). The remaining included computer hardware/software/Internet (6.1%), aerospace/aviation/automotive (5.4%), entertainment/recreation/leisure (5.1%), science/biotech/pharmaceuticals (5.1%), transportation/distribution (4.8%), healthcare/medical (4.1%), and construction/real estate (2.7%). See Table 5.

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**Table 5: Industry Type**

	Frequency	Percent	Cumulative Percent
Valid Manufacturing	58	19.7	19.7
Accounting/Finance/Banking/ Insurance/Legal	32	10.9	30.6
Retail/Wholesale Trade	29	9.9	40.5
Utilities/Telecommunications	28	9.5	50.0
Business/Professional Services	27	9.2	59.2
Computer Hardware/Software/Internet	22	7.5	66.7
Aerospace/Aviation/Automotive	18	6.1	72.8
Entertainment/Recreation/Leisure	16	5.4	78.2
Science/Biotech/Pharmaceuticals	15	5.1	83.3
Transportation/Distribution	15	5.1	88.4
Healthcare/Medical	14	4.8	93.2
Construction/Real Estate	12	4.1	97.3
Total	8	2.7	100.0

N = 294

When asked if their employer had ever been listed on the Fortune 100 Best Places to Work, 49% indicated that they did not know. But 5.8% indicated that they had once and 30.3% more than once (Table 6).

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**Table 6: Fortune Magazine’s List of 100 Best Places to Work**

	Frequency	Percent	Cumulative Percent
Valid Never	44	15.0	15.0
Once	17	5.8	20.7
> 1	89	30.3	51.0
Don't Know	144	49.0	100.0
Total	294	100.0	

N = 294

Extent of Sleep Education and Awareness

Two sets of question were asked regarding the components of a wellness programs. The first relates to sleep education in general. The second relates more specifically to sleep disorder information and screening.

*Set One: Sleep Education in General*

The first question read: *Does your firm regularly provide its employees information or education about any of the following? (Select all that apply)* This question is a useful construct for content of wellness programs. It included eight content areas, plus an open-ended response for *other*. The *other* responses that could not be reclassified into one of the existing eight were left in the *other* category. A content of analysis of the remaining *other* responses (n =4) indicate that each was related to worker safety and injury prevention. Future studies may consider this as a defined category.

The data demonstrate that 12.2% of the firms regularly provide sleep/alertness management information. This compares with 60% that provide work-life balance, 59% health screening, 55% exercise and fitness programs or facilities, 47% diet and weight

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management, 44% emotional well-being, 41% substance abuse and 10% spiritual well being. These data confirm suspicions from Czeisler (Fryer, 2006) and Brown (2004) that sleep awareness education is lacking in corporate wellness programs relative to other content areas. Assuming an expected value of 50% of firms with sleep/alertness information, having only 12.2% is statistically significant less than expected (Wald = 122.5,  $p < .001$ ).

**Table 7: Survey Question #3**

<i>Does your firm regularly provide its employee information or education about any of the following?</i>	n = yes	Percentage of all firms
Health Screening	174	59.2%
Diet and weight management	138	46.9%
Exercise and fitness programs and/or facilities	162	55.1%
<b>Sleep/alertness awareness and management</b>	<b>36</b>	<b>12.2%</b>
Substance abuse	121	41.2%
Work-life balance	177	60.2%
Emotional well-being	128	43.5%
Spiritual well-being	30	10.2%
Other	4	1.4%

N= 274

A second and related question queried respondents to discover the various information channels that have recently been used to communicate information related to healthy sleep habits as follows: *In the past 12 months, has your firm made available to employees information or training on healthy sleep habits through any of the following ways? (Select all that apply)*. Based on pre-testing with HR managers, these five

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information channels were determined to be sufficient to capture the typical channels used by large companies to communicate such information.

The data demonstrate that company newsletters or health insurance provided materials were the most popular channels, 17.3% and 16.3% respectively. These were followed by bulletin board or poster (8.8%), workshop or seminar (6.1%) and employee manual (6.1%). The *other* responses that could not be reclassified into one of the existing eight were left in the *other* category (Table 8). A content of analysis of the remaining *other* responses (n =5) all specified web or Intranet-based channels were used as channels. Future studies may consider specifying the difference between electronic and non-electronic categories.

It is important to note that 68.7% of firms (n = 202) of respondents indicated that their firms *did not* use any channels to inform or educate on healthy sleep habits. Hence, only 31.3% of respondents recalled their firms had dispensed information regarding healthy sleep habits within the last 12 months. Interestingly, this corresponds with the data discussed previously and described in Table 7, where only 12.2% of firms *regularly* provide information or education on sleep/alertness awareness and management.

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**Table 8: Survey Question #15**

<i>In the past 12 months, has your firm made available to employees information or training on healthy sleep habits through any of the following ways?</i>	Yes	Percentage of all firms
Company newsletter	51	17.3%
Health insurance provided materials	48	16.3%
Bulletin board or poster	26	8.8%
Employee manual	14	4.8%
Workshop or seminar	18	6.1%
Other	5	1.7%

N= 274

While beyond the scope of this dissertation, further analysis of the data could be conducted to determine whether the concentration of channels used to communicate sleep information has an effect on whether or not a firm is perceived as encouraging its employees to obtain adequate sleep prior to reporting for a work shift. Marketing theory suggests that as the variety and frequency with which a message is communicated to employees, effectiveness of recall improves (Lowry, J., Borna, S., & Inks, S. 2007). Furthermore, the Business Roundtable Report (2007) indicated that many firms have begun to develop internal marketing plans to brand their corporate wellness programs. This was prompted by results from internal surveys that employees had difficulty recalling the components of corporate wellness programs. The more effective campaigns last upwards of nine months and including multiple promotional and information channels.

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### *Set Two: Sleep Disorder Awareness*

The first of two questions queried respondents to discover the various information channels that have recently been used to communicate information related to sleep disorder symptoms: *In the past 12 months, has your firm made available to employees information or awareness of sleep disorder symptoms through any of the following ways? (Select all that apply).* Based on pre-testing with HR managers, these five information channels were determined to be sufficient to capture the typical channels used by large companies to communicate such information.

The data demonstrate that *health insurance provided materials* (17.3%) was the most used channel. This was followed by company newsletter (8.8%), bulletin board or poster (7.5%), workshop or seminar (4.1%) and employee manual (2.4%). The *other* responses that could not be reclassified into one of the existing eight categories were left in the *other* category (Table 9). Five of the reclassified other responses indicated web-based and electronic channels. Future research should give consideration to the distinctions between electronic, printed and other formats. A content analysis of the remaining *other* response (n = 1) indicated it was conveyed as part of a safety briefing.

It is important to note that 79.3% (n = 233) of respondents indicated that their firms *did not* use any channels to inform or educate on symptoms related to sleep apnea. Hence, only 20.7% of respondents recalled their firms had dispensed information regarding sleep disorders within the last 12 months. Interestingly, this corresponds with the data discussed previously and described in Table 7, where only 12.2% of firms *regularly* provide information or education on sleep/alertness awareness and management. Again, these data confirm the suspicions of sleep scientists and physicians



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that organizations could do more to communicate awareness of the symptoms of and risks associated with sleep disorders. Wellness consultants should take note, as these data provide evidence of potential market opportunities for their services.

**Table 9: Survey Question #16**

<i>In the past 12 months, has your firm made available to employees information or awareness of sleep disorder symptoms through any of the following ways?</i>	Yes	Percentage of all firms
Company newsletter	26	8.8%
Health insurance provided materials	40	13.6%
Bulletin board or poster	22	7.5%
Employee manual	7	2.4%
Workshop or seminar	12	4.1%
Other	1	.3%

N= 274

The last sleep-education related question seeks to discover the percentage of firms that offer *sleep disorder screening* for their employees: *Does your firm provide screening for any of its employees for sleep disorders?* A total of 22 (7.5%) respondents indicated their firms provide screening for sleep disorders; only 5 (1.7%) indicated they screen for sleep disorders as a condition of employment. A total of 51 (17.3%) responded with *Don't know* and 216 (73.5%) indicated that their firm did not provide screening. There was no statistical indication that type of industry was associated with an affirmative response to sleep-disorder screening as a condition of employment, likely because of the sample size. Of the five affirmative responses, the industries represented included *retail/wholesale trade* (n=1), *accounting/finance/banking* (n=1), *manufacturing* (n=1),

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*transportation/ distribution* (n=1), and *business/professional services* (n=1). Commercial transportation industries, including aircraft, shipping, rail, and trucking, require the periodic passing of a physical examination in order for pilots and drivers to be licensed to operate. The presence of untreated sleep disorders could result in the revocation of operating privileges. Firms that are proactive and screen their employees may be able to avert catastrophic accidents. Future studies may also reveal a trend in sleep disorder screening as part of efforts to reduce overall healthcare costs.

**Table 10: Survey Question #17**

<i>Does your firm provide screening for any of its employees for sleep disorders?</i>	Frequency	Percentage of all firms
No	216	73.5%
Yes, as a condition of employment	5	1.7%
Yes, as part of a wellness program	22	7.5%
Don't know	51	17.3%

N= 274

### *Policies Allowing for Napping*

The following questions provide information regarding the extent to which firms allow for napping during their work schedule. These data reveal that 229 (77.9%) of respondents said their firms do not allow employees to nap while at work. A total of 33 (11.2%) indicated that their firms do allow sleeping while 32 (10.9%) said they didn't know. Of these, the distribution is fairly even on the length of time: 12 (4.1%) < 15 minutes; 11 (3.7%) from 15-30 minutes; and 10 (3.4%) > 30 minutes (Table 11). Of those firms that allow napping while at work, 20 (60.6%) provide furnishings or facilities for

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napping on site (Table 12). These findings suggest that policies allowing napping are rather infrequently found among large enterprises.

**Table 11: Survey Question #14**

<i>Does your firm allow any of its employees to take nap periods while at work?</i>	Frequency	Percentage of all firms
No	229	77.9%
Yes, < 15 minutes	12	4.1%
Yes, 15-30 minutes	11	3.7%
Yes, > 30 minutes	10	3.4%
Don't know	32	10.9%

N = 264

**Table 12 Crosstab Results for Firms that Allow Napping**

	Yes	No
Does your firm provide furnishings or a place where any of its employees may take a nap during their work shift?	n = 20 (60.6%)	n = 13 (39.4%)

N = 33

### *Rest Policies*

These questions attempt to capture whether or not firms require employees to obtain sufficient rest prior to engaging in work tasks. The existing literature suggests that long work hours and/or inadequate sleep prior to reporting to work may be hazardous to worker health, result in reduced performance, and increase occupational accident risks. Four questions relate to various tasks more closely associated with psychomotor vigilance. The other relates to a task requiring peak decision-making functioning. Results indicate that less than 20% of firms have any of such policies. Ranked in descending order they are: operating heavy equipment (n=57, 19.4%); conducting high-risk or

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potentially dangerous procedures (n=46, 15.6%), operating a vehicle, aircraft or vessel (n=43, 14.6%); negotiating a significant or risky business engagement (n=33; 11.2%); and, when jet lag is a factor (n=25, 8.5%). See Tables 13-17.

Of interest is the number of times respondents indicated *not applicable*. It is uncertain whether or not the sample of respondents were consistent how they responded to these sets of questions when *not applicable* was an option. For instance, a respondent who worked for a firm that did not have tasks that required the operation of heavy equipment could have selected not applicable, which is what would be expected. However, selecting *no* could also be a plausible response, since no such policy would have been selected. Future research could include qualitative studies to aid in understanding the meaning of *not applicable* responses.

**Table 13: Survey Question #7**

<i>Does your firm require employees to have a minimum rest period between work shifts that include operating heavy equipment or machinery?</i>	Frequency	Percentage of all firms
No	104	35.4%
Yes	57	19.4%
Not applicable	133	45.2%

N=264

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**Table 14: Survey Question #8**

<i>Does your firm require employees to have a minimum rest period between work shifts that include operating a vehicle, aircraft, or vessel?</i>	Frequency	Percentage of all firms
No	90	30.6%
Yes	43	14.6%
Not applicable	161	54.5%

N=264

**Table 15: Survey Question #9**

<i>Does your firm require employees to have a minimum rest period between work shifts that include negotiating a significant or risky business engagement?</i>	Frequency	Percentage of all firms
No	147	50%
Yes	33	11.2%
Not applicable	114	38.8%

N=264

**Table 16: Survey Question #10**

<i>Does your firm require employees to have a minimum rest period between work shifts that include conducting high-risk procedures or potentially dangerous tasks?</i>	Frequency	Percentage of all firms
No	109	37.1%
Yes	46	15.6%
Not applicable	139	47.3%

N=264

**Table 17: Survey Question #11**

<i>Does your firm require employees to have a minimum rest period before an employee may operate a vehicle after a transatlantic or red-eye flight where jet lag is a factor?</i>	Frequency	Percentage of all firms
No	138	46.9%
Yes	25	8.5%
Not applicable	131	44.6%

N=264

*Effect Variables*

The following four questions were designed to capture the perceptions of the individuals responding to the survey on the quality of the work environment. Question #5 dealt with perception of encouraging sleep: *My firm encourages employees to get an adequate amount of sleep prior to reporting to a work shift.* Slightly more respondents disagreed (combining strongly disagree and disagree: n=104, 38.8%) than agreed (combining strongly agree and agree: n=93, 31.6%); see Table 18. Nearly two-thirds of respondents to question 21 believe their firm is a desirable place to work, *My firm is one of the best places to work* (combining strongly agree and agree: n=192, 65.3%); see Table 19. A majority believes their firm cares about their employees: *My firm cares about the well-being of its employees* (combining strongly agree and agree: n=172, 58.5%); see Table 20. A majority also believes their firm is more productive than their competitors: *In general, employees at my firm are more productive than those of our competitors* (combining strongly agree and agree: n=157, 53.4%); see Table 21. Further analysis is presented in the next section.

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**Table 18: Survey Question #5**

<i>My firm encourages employees to get an adequate amount of sleep prior to reporting to a work shift.</i>		Frequency	Percent	Cumulative Percent
Valid	Strongly Disagree	45	15.3	15.3
	Disagree	69	23.5	38.8
	Undecided	87	29.6	68.4
	Agree	63	21.4	89.8
	Strongly Agree	30	10.2	100.0

N = 264

**Table 19: Survey Question #21.**

<i>My firm is one of the best places to work.</i>		Frequency	Percent	Cumulative Percent
Valid	Strongly Disagree	14	4.8	4.8
	Disagree	40	13.6	18.4
	Undecided	68	23.1	41.5
	Agree	124	42.2	83.7
	Strongly Agree	48	16.3	100.0

N=264

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**Table 20: Survey Question #22.**

<i>My firm cares about the well-being of its employees.</i>		Frequency	Percent	Cumulative Percent
Valid	Strongly Disagree	20	6.8	6.8
	Disagree	39	13.3	20.2
	Undecided	62	21.1	41.4
	Agree	125	42.5	84.2
	Strongly Agree	46	15.6	100.0

N=264

**Table 21: Survey Question #23**

<i>In general, employees at my firm are more productive than those of our competitors.</i>		Frequency	Percent	Cumulative Percent
Valid	Strongly Disagree	11	3.7	3.7
	Disagree	32	10.9	14.7
	Undecided	93	31.6	46.4
	Agree	123	41.8	88.4
	Strongly Agree	34	11.6	100.0

N=293

### Exploratory Question

An exploratory question was tested to determine if industry type, number of employees or company revenue, or whether or not a firm was listed in on Fortune Magazine's 100 Best Places to work could help to discriminate whether or not a firm included sleep awareness education. Because many of the original industry categories included fewer than 10 firms in each, firms were reclassified into one of six categories.



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This provided larger categories, which facilitated statistical analysis. The goods-producing industry served as the reference category. Furthermore, any positive response to the question about whether or not a firm was listed on the Fortune 100 Best Places to Work were combined into one “yes” category and any “no” or “don’t know” response were combined into one “no” category. Any firm with fewer than 10,000 employees was assigned into one categorical variable (< 10,000 employees). For the statistical analysis, all the independent categorical variables are listed in Table 22.

**Table 22: Categorical Variable Coding**

		Frequency	Percentage
Industry	Goods producing	74	25.2%
	Transportation/communications/ utilities (1)	41	13.9%
	Wholesale/retail trade (2)	28	9.5%
	Technology (3)	33	11.2%
	Finance/insurance/legal (4)	61	20.7%
	Other services (5)	57	19.4%
Fortune Magazine's list of 100 Best Places to Work	No/Don't Know	188	63.9%
Number of employees	Yes	106	36.1%
	10K or less	87	29.6%
Company revenue	>10K	207	70.4%
	\$1B-\$10B	135	45.9%
	>\$10B	159	54.1%

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### Exploratory Question # 1

*What are the characteristics of firms that include sleep awareness in their wellness education?*

To test this question, the dependent variable was derived from responses to question #3: *Does your firm regularly provide its employees information or education about any of the following?* Any responses that selected the item *Sleep alertness awareness and management* were categorized as “yes”; all others were classified as “no.” Table 23 shows that out of the n=294 participants only n=36 (12.2%) work for companies that regularly provide information or education on sleep/alertness awareness and management. The four independent variables are industry type, number of employees, revenue and whether or not the firm was listed on the Fortune 100 Best Places to Work.

**Table 23: Dependent Variable—Sleep Awareness Education**

		Frequency	Percentage
Sleep/alertness awareness and management	No	258	87.8%
	Yes	36	12.2%
Overall Percentage			100%

N = 294.

In the first step of the logistic regression analysis, the model contains none of the predictor variables, only the constant term or intercept (Table 24). All of the predictor variables in the list that were left out of the model are **not** statistically significant. All the p-values are  $>.05$ . This would indicate that none of the predictor variables selected has any ability to discriminate between companies that have sleep/alertness awareness and management and those that don't.

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**Table 24 Logistic Regression Analysis**

			Score	df	Sig.
Step 0	Variables	inds	2.510	5	.775
		inds(1)	.000	1	.992
		inds(2)	.750	1	.387
		inds(3)	.292	1	.589
		inds(4)	.416	1	.519
		inds(5)	.194	1	.659
		rev(1)	.275	1	.600
		mplye(1)	.018	1	.892
		qn24(1)	.143	1	.705
	Overall Statistics		2.845	8	.944

N = 294. Note: Variables include "inds"=industry; "rev"=company revenue; "mplye"=number of employees; "qn24"=Fortune Magazine's list of 100 Best Places to Work.

The next tables (Table 25, 26 and 27) provide data to assess the improvement in model fit with the predictor variables in the model as compared to when they were not included. This is measured by the "-2 Log likelihood" (-2LL) value. In logistic regression analysis, the parameters of the model are estimated using the *maximum-likelihood estimation* (MLE) method. MLE is a technique that selects the parameters that are most likely given the observed data. If the model fits the data perfectly, the likelihood would be 1: the logarithm of 1 is 0 - the -2LL is a convenient way to express these results. Thus, the smaller the value of -2LL, the better the model fit. Since none of the predictors is

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useful, the analysis stops here. All the tables that follow have non-significant values (p>.05).

**Table 25: Exploratory Question # 1—Omnibus Tests of Model Coefficients**

Step 1	Step	Chi-square	df	Sig.
	Step	2.877	8	.942
	Block	2.877	8	.942
	Model	2.877	8	.942

**Table 26 Exploratory Question # 1—Model Summary**

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	215.728(a)	.010	.019

Note: Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

**Table 27: Exploratory Question # 1—Variables in the Equation**

Step	inds	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
								Lower	Upper
1(a)				2.398	5	.792			
	inds(1)	-.346	.575	.362	1	.548	.707	.229	2.185
	inds(2)	-.917	.801	1.310	1	.252	.400	.083	1.922
	inds(3)	-.100	.580	.030	1	.863	.904	.290	2.821
	inds(4)	-.568	.534	1.130	1	.288	.567	.199	1.614
	inds(5)	-.511	.538	.901	1	.343	.600	.209	1.723
	rev(1)	.190	.380	.250	1	.617	1.209	.574	2.544
	mplye(1)	-.001	.414	.000	1	.998	.999	.444	2.249
	qn24(1)	-.083	.373	.049	1	.825	.921	.443	1.914
	Constant	-1.675	.435	14.816	1	.000	.187		

Note: Variable(s) entered on step 1: inds, rev, mplye, qn24.

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Thus, data from this survey do not provide adequate statistically evidence to detect the characteristics of firms with sleep awareness education programs. The explanation could be that sample size is of insufficient design to discriminate any differences. Future research may detect differences with a larger sample size, or, extending the parameters beyond only large firms with revenue over \$1 billion. However, the more likely conclusion is that there is a diminutive presence of sleep awareness as a component of wellness programs *across the entire sample*. This lends evidence to the assumptions of Czeisler, Dement, and other somnologists that all organizations need begin addressing the issue of sleep wellness. It should be noted, however, that certain industries (medical and commercial transportation) do address sleep, rest and workload scheduling, as they are guided by public policy.

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### Hypotheses Testing

The following three assumptions were tested as hypotheses. The hypotheses were accepted if the p value of the Chi Square correlation was  $< .05$ . It is understood that correlation does not indicate causation, but merely an association of the variables. However, a negative association, or failure to find a positive association of significance, will cast doubts on the robustness of the proposed model from Chapter 2 that includes optimal sleep as a variable of human productivity. A positive correlation will provide useful evidence for further theory building.

#### *Hypothesis one*

*H<sub>1</sub>: Firms that are perceived as encouraging employees to get adequate rest are positively associated with perceptions that they are caring of their employees.*

To test this assumption a cross-tab analysis was conducted between questions #5 and #11. Results indicate a strong and positive relationship in the Chi-Square Pearson correlation test,  $\chi^2(16, N = 292) = 157.9, p < .001$ . Somers' d was used to evaluate the directional strength between the variables. The closer the value is to 1, the stronger the correlation between the variables. The results demonstrate a clear and significant positive association (Somers' d = .409) between *encourages adequate sleep* (independent variable) and a respondent's perception that the company cares for its employees (dependent variable). In other words, respondents that report working in companies that encourage adequate rest tend to believe that the company is caring of its employees. Thus, this hypothesis is affirmed.

*Hypothesis two*

*H<sub>2</sub>: Firms that are perceived as encouraging employees to get adequate rest are positively associated with the perception that they are a desirable place to work.*

To test this assumption a cross-tab analysis was conducted between questions #5 and #21. Results indicate a strong and positive relationship in the Chi-Square Pearson correlation test,  $\chi^2(16, N = 292) = 109.4, p < .001$ . Results show a clear and significant positive association (Somers' d = .351) between *encourages adequate sleep* (independent variable) a respondent's perception that the company is one of the best places to work (dependent variable). Thus, the hypothesis is affirmed.

*Hypothesis three*

*H<sub>3</sub>: Firms that are perceived as encouraging employees to get adequate rest are positively associated with the perception that they are more productive than their competitors.*

To test this assumption a cross-tab analysis was conducted using questions #5 and #23. Results indicate a strong and positive relationship in the Chi-Square Pearson correlation test,  $\chi^2(16, N = 293) = 77.5, p < .001$ . Results show a clear and significant positive association (Somers' d = .273) between *encourages adequate sleep* (independent variable) and a respondent's perception that the company is more productive than its competitors (dependent variable). Thus, the hypothesis is affirmed, although the association measure (d = .273) is not as strong as the results for the two previous hypotheses.

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### Summary Results

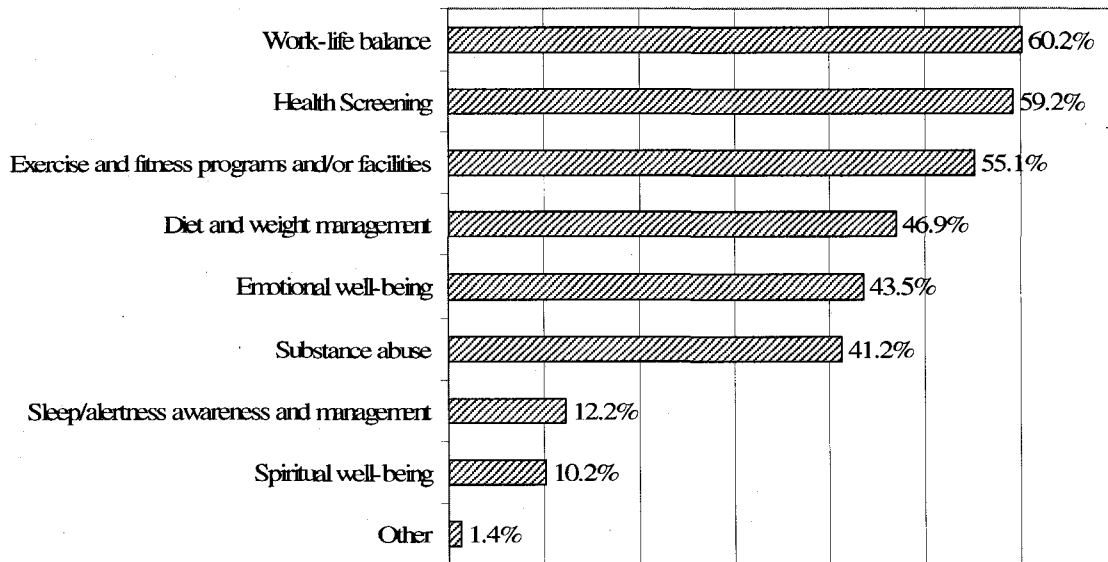
The results of this study into the extent to which firms provide sleep awareness programs yields new and useful insights. These data can be summarized into three categories: descriptive results; firm characteristics; and impact of perceptions.

There are three sub-categories of the descriptive results. The first is the extent to which firms provide information and awareness about healthy sleep habits and sleep disorders as a component of wellness programs. Only 12.2% of respondents report that their firm regularly provides sleep awareness and alertness management education. Of the nine possible selections (including *other*) this ranked 7<sup>th</sup>, following work-life balance (60.2%), health screening (59.2%), exercise/fitness (55.2%), diet and weight management (46.9%), emotional well-being (43.5%), and substance abuse (41.2%). Only spiritual well-being (10.2%) and other (1.4%) were less (Figure 1). When sleep wellness information is communicated, the three most common channels are *health insurance provide materials*, followed by *company newsletters* and *bulletin boards or posters*. These three channels were also cited as the most frequently used channels for communicating to employees regarding sleep disorder symptoms. These data confirm the claims by sleep scientists (Fryer, 2006) and the national *The 2003 National Sleep Disorders Research Plan* (NSDRP, 2003) that more work needs to be done to increase awareness of healthy sleep habits and sleep disorders.



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**Figure 1: Distribution of Wellness Programs (Firms Reporting they have)**



N = 294.

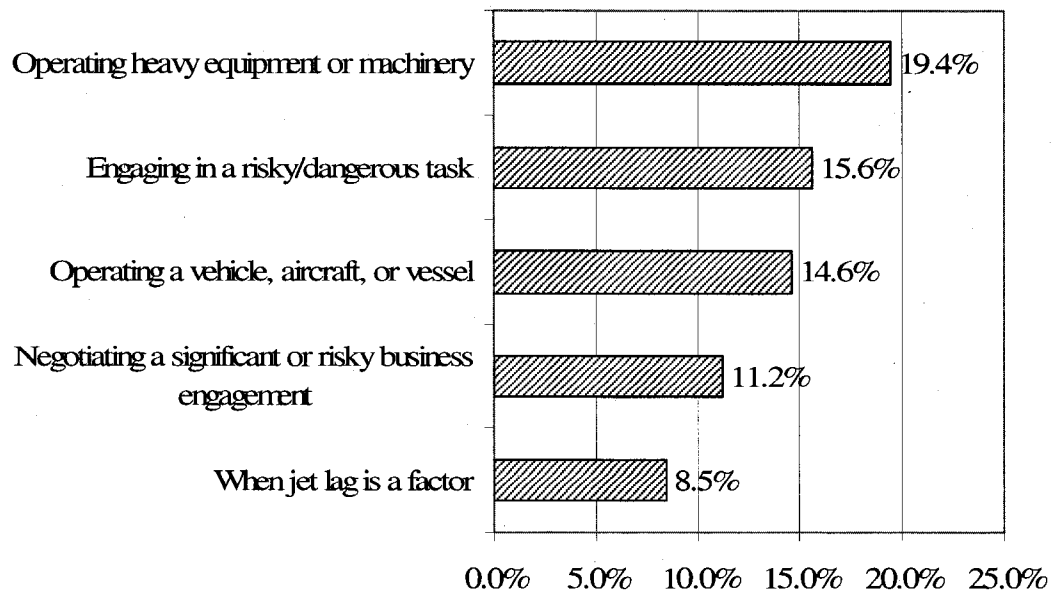
The second sub-category was to discover the extent to which firms had policies allowing employees to nap during their shifts. Only 11.2% of those responded indicated their firms allow napping of any length and a total of 10.9% provide facilities or equipment for napping. These data affirm the claims by sleep scientists (Fryer, 2006) and the national *The 2003 National Sleep Disorders Research Plan* (NSDRP, 2003) that more firms should consider incorporating napping policies as a means to help mitigate the negative effects of sleep debt.

The third sub-category was to discover the extent to which firms had policies requiring employees to obtain adequate sleep prior to engaging in certain tasks. Five tasks were included in this survey. The top three in rank are operational tasks requiring peak psychomotor vigilance and include: operating heavy equipment or machinery (19.4%), engaging in risky/dangerous tasks (15.6%), and operating vehicles, aircraft, or vessels (14.6%). The last two are tasks more typically associate with white-collar workers and or

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when which peak cognitive performance is required: negotiating a significant or risky business engagement (11.2%) and when jet-lag is a factor (8.5%). See Figure 2. While the first three are often tasks subject to regulatory policies (such as rest prior to operating in commercial transportation), the bottom two ranked tasks have only recently received attention in the literature as factors to be considered for sleep policies.

**Figure 2: Distribution of Rest Policies Prior to Engaging a Certain Tasks**



N = 294.

Logistic regression analysis of the data suggests there is little or no evidence that the size of the firm, industry type, number of employees, or whether or not the firm was listed on Fortune's list of best companies to work for are associated with whether or not a firm provides sleep awareness as part of its employee wellness programs. Because only 12.2% (n = 36) of all respondents indicated that their firms provided such programs, the low number may make it more difficult to yield a statistically significant result.

Oversampling firms that provide sleep awareness may prove useful at distinguishing the characteristics of such firms. In any case, such distinction may provide only limited

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theoretical value, but may be important for sleep wellness consultants and practitioners who care about targeting market opportunities. The more likely explanation is that the lack of sleep-awareness as a component of corporate wellness programs among large firms is widespread and crosses all industries.

Correlation analysis confirms that there is a positive relationship between whether or not a firm encourages its employees to get sufficient rest prior to reporting to work and perceptions that they are caring of their employees, ( $d = .409$ ), that they are a desirable place to work ( $d = .351$ ), and that they are more productive than their competitors ( $d = .273$ ). It should be noted that these results are based on correlations of single questions from within the survey. Future research could provide more robust and sophisticated constructs of the variables being tested. Nevertheless, practitioners should take note that the positive correlation suggests human resource practices that include addressing sleep wellness may be an important source of competitive advantage in recruiting and retaining a productive workforces.

**CHAPTER V—Conclusion**

Evidence from the Literature

The review of somnology literature has established that the relationship between the quantity and quality of sleep, as well as the presence and treatment of sleep disorders, have an effect on health, occupational risk and productivity, and human functioning. Sleep deprivation and untreated sleep disorders are also associated with metabolic diseases such as hypertension, obesity, and diabetes, as well as cardiac diseases. Fortunately, sleep deprivation and sleep disorders are treatable. Sleep-wellness programs and awareness education, as well as health screening empower workers to improve their sleep habits. By allowing employees to nap and implementing work policies and scheduling that encourage adequate rest, firms can mitigate some of the risks of occupational accidents and catastrophes. Furthermore, the literature demonstrates that healthcare utilization is reduced with successful treatment of sleep disorders, which indicates that firms can reduce their healthcare benefits costs through including sleep awareness in their employee wellness programs.

The literature also provides evidence that specific occupational skills are hampered when employees show up to work sleep-deprived. These include knowledge-based skills that require cognitive speed, concentration, numeracy, learning, memory, and risk-taking assessment. Interpersonal and communication skills are impaired as are psychomotor speed and vigilance. Macroeconomic studies suggest that untreated sleep disorders contribute to a measurable loss of a nation's aggregate output. Taken together, these results strongly indicate that productivity improvements can be realized by ensuring that a workforce obtains adequate sleep. A complete list of suggestions for creating a

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culture of sleep wellness is included in chapter 2 and includes: scheduling and rest or nap periods that allowing for sleep recovery prior to engaging in critical tasks, especially those requiring emotional stability and cognitive alertness; creating incentives and policies to minimize sleep debt; recognizing that caffeine and other prescription stimulates may only mask the effects of sleep deprivation; implementing on-going education and screening for sleep disorders.

### Evidence from the Exploratory Study

Calls from sleep scientists and the Committee on Sleep Medicine and Research suggest organizations should do more to encourage their workers to get adequate sleep and increase awareness of sleep. One of the purposes of this study is to provide a baseline documentation of what large enterprises in the United States are doing to encourage healthy sleep among their workforce. The findings indicate that only 12% of managers of large enterprises surveyed indicate their firms include sleep awareness and alertness management as part of their wellness programs. Further analysis did not indicate that the categorical variables of company size, number of employees, industry type, or whether or not a firm is on the list of Fortune 100 best places to work predicted these results. Hence, it is likely that the sleep-wellness programs are lacking across firms in all industries.

Approximately 20% provided some kind of information on sleep disorders and 11.2% have policies allowing employees time to nap during their work shift. The study also described the extent to which firms requires employees to have adequate rest prior to certain tasks. In descending order they are: operating heavy equipment (19%); conducting high-risk or potentially dangerous procedures (16%), operating a vehicle, aircraft or

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vessel (15%); negotiating a significant or risky business engagement (11%); and, when jet lag is a factor (9%).

Finally, the study indicates that when firms are perceived as encouraging their employees to get adequate rest prior to reporting to work, their employees are significantly more likely to believe: *that their firms are caring of their employees, that their firms are a desirable place to work, and that their firms are more productive than their competitors.* The results of these exploratory results recommend that the theoretical model proposed in chapter two is worth testing further—that sleep as a component of health-seeking behavior is a contributor to productivity.

### Future Research Opportunities

Many of the limitations of this exploratory study have been previously acknowledged. Future research can improve our understanding of the relationship between sleep, sleep awareness, and alertness management with productivity in the workplace. While the focus of this exploratory study was large enterprises located within the United States, sleep deprivation and sleep disorders are apparent world-wide. Hence, future research should explore the practices of sleep awareness in firms in other countries as well as firms of various sizes.

More analysis and examination of the data from this study could be conducted to gain further insights. For instance, an analysis of the types and number of channels used to communicate sleep information may have an effect on whether or not a firm is perceived as encouraging its employees to obtain adequate sleep prior to reporting for a work shift. Marketing theory suggests that to effectively communicate a message to employees as the variety of methods employed increases, effectiveness improves (Lowry,

J., Borna, S., & Inks, S. 2007). Other possibilities include the testing of associations between the other components of wellness programs affect the employee perceptions of whether or not a firm is desirable place to work and perceived as more productive than its competitors. Finally, a series of case studies targeting firms that are actively promoting sleep awareness and sleep wellness programs would be helpful at deepening our understanding of their effects. Interviews with employees and managers in such firms would help to corroborate the relationship between such programs and how they are linked to a perception that they are an attractive place to work. This will also help to distinguish between confounding variables.

While there is extensive laboratory-based research on the effects of sleep debt and human functioning, there is scant literature where field-based methodologies have been used. Theoretical models could be developed from lab-based data and then tested within a competitive context that requires business strategy decision-making. For instance, if it is hypothesized that sleep loss negatively affects outcomes in situations where strategic decision-making occurs, a study could be conducted that manipulates sleep debt as a variable. This could be accomplished through measuring the results of individuals in a business-strategy game simulation. Participants would be randomly selected from a homogeneous group of individual strategic decision-makers. A baseline of variables, such as experience, training, cognitive intelligence, emotional intelligence would be controlled for. Subjects then would be randomly assigned to two groups and then a baseline of normal sleep cycles would be established over an appropriate period of time. The experimental group would be restricted from sleep. The number of days and length of time would be based on previously established norms and specific research questions.

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The control group would continue to experience normal sleep. Then, members of both groups would engage in the game against the entire study, which could span a length of time determined to be appropriate for the answers sought. The findings of such a study could be useful at quantifying the effects of sleep loss on strategic managerial decision-making.

Another direction would be to integrate the contribution from the noteworthy studies in behavioral economics and consumer behavior (Tversky and Kahneman, 1973; Kahneman, 2003; Ariely 2008). Behavioral economics combines insights from cognitive psychology to better understand economic decision-making. Ariely's (2008) work, *Predictably Irrational*, has made accessible to the practitioner insights from this field: (a) that people make decisions and assess risks based on approximations, or rules of thumb (*heuristics* and *Prospect Theory*); (b) that the way a problem or opportunity is presented will affect a decision (*framing*); and, (c) that people often make irrational decisions because of biases (*endowment effect, inequity aversion, and heard instinct*). More specifically, work done by (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Vohs, Baumeister & Ciarocco, 2005; Vohs, K., & Faber, R. 2007) in depletion looks at the situationally determinants of self-regulation in decision-making. Self-regulation involves a stock of internal resources that when depleted, reduces self-control (Muraven and Baumeister, 2000). For instance, Baumeister, et al (1998) demonstrated that increased temptation is an antecedent to depletion. Since the somnology literature indicates there are limitations in neurobehavioral and interpersonal/mood capacities in those who are sleep deprived, future research may contribute to an understanding of the extent to which sleep deprivation contributes to depletion.



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# THE PREVALENCE OF SLEEP WELLNESS POLICIES

## Appendix: Survey Questionnaire

### Greeting and instructions:

Thank you for participating in this 5-7 minute survey which is part of an academic research project designed to better understand the benefits companies provide to their employees. We are specifically interested in wellness, sleep/rest/nap policies and programs that may be offered at the firm where you work.

We believe you are qualified to participate in this survey. When answering the questions, please think of the policies and practices of either your firm, or the business unit/division where you work. Your response will be anonymous and no personal information that can identify you will be asked or stored.

At the end of the survey you will be provided information on how to obtain the results of this survey and add additional comments.

Thank-you, BU/GGU DBA Research Team

#1. Which of the following best describes your current employment status?

- Employed full-time
- Employed part-time
- Self-employed
- Retired
- Not currently employed

#2 Which of the following most accurately describes your primary functional work area at your current employer?

- Human Resources
- Other, please specify

#3 Does your firm regularly provide its employees information or education about any of the following? (Select all that apply) [NOTE: The first 8 answers are randomized]

- Diet and weight management
- Substance abuse
- Emotional well-being
- Spiritual well-being
- Health screening
- Work-life balance
- Exercise and fitness programs and/or facilities
- Sleep alertness awareness and management
- Other, please specify

## THE PREVALENCE OF SLEEP WELLNESS POLICIES

# 4 Does your firm currently have a policy or benefit that will pay for some or all of the costs for qualified employees to access services that address any of the following? (Select all that apply) [NOTE: The first 8 answers are randomized]

- Diet and weight management
- Substance abuse
- Emotional well-being
- Spiritual well-being
- Health screening
- Work-life balance
- Exercise and fitness programs and/or facilities
- Sleep alertness awareness and management
- Other, please specify

#5 My firm encourages employees to get an adequate amount of sleep prior to reporting to a work shift.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

#6 My firm encourages employees to turn-off all electronic devices during sleep (including cell phones, pagers, BlackBerries, e-mail, etc.)

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

#7 Does your firm require employees to have a minimum rest period between work shifts that include operating heavy equipment or machinery?

- Yes
- No
- Not applicable

#8 Does your firm require employees to have a minimum rest period between work shifts that include operating a vehicle, aircraft, or vessel?

- Yes
- No
- Not applicable

#9 Does your firm require employees to have a minimum rest period between work shifts that include negotiating a significant or risky business engagement?

## THE PREVALENCE OF SLEEP WELLNESS POLICIES

- Yes
- No
- Not applicable

#10 Does your firm require employees to have a minimum rest period between work shifts that include conducting high-risk procedures or potentially dangerous tasks?

- Yes
- No
- Not applicable

#11 Does your firm require employees to have a minimum rest period before an employee may operate a vehicle after a transatlantic or *red-eye* flight where jet lag is a factor?

- Yes
- No
- Not applicable

#12 Does your firm allow any of its employees to take nap periods while at work?

- Yes, but less than 15 minutes per shift
- Yes, from 15 to 30 minutes per shift
- Yes, for more than 30 minutes per shift
- No
- I don't know

#13 Does your firm provide furnishings or a place where any of its employees may take a nap during their work shift?

- Yes, for more than 30 minutes per shift
- No
- I don't know

#14 Does your firm allow any of its employees to take nap periods while at work?

- Yes, but less than 15 minutes per shift
- Yes, from 15 to 30 minutes per shift
- Yes, for more than 30 minutes per shift
- No
- I don't know

#15 In the past 12 months, has your firm made available to employees information or training on healthy sleep habits through any of the following ways? (Select all that apply)  
[NOTE: The first 5 answers are randomized]

- Company newsletter
- Health insurance provided material

## THE PREVALENCE OF SLEEP WELLNESS POLICIES

- Bulletin board or poster
- Employee manual
- Workshop or seminar
- None
- Other, please specify

#16 In the past 12 months, has your firm made available to employees information or awareness of sleep disorder symptoms through any of the following ways? (Select all that apply) [*NOTE: The first 5 answers are randomized*]

- Company newsletter
- Health insurance provided material
- Bulletin board or poster
- Employee manual
- Workshop or seminar
- None
- Other, please specify

#17 Does your firm provide screenings for any of its employees for sleep disorders?

- Yes, as a condition of employment
- Yes, as part of an employee wellness program
- No
- I don't know

#18, Briefly explain the type of accommodations your firm provided. Please do not identify the employee(s). [*NOTE: This question is contingent upon an affirmative response to question #17*]

#19 What is the total annual revenue or spending budget of your firm (which ever is higher).

- Under \$1 million
- \$1-50 million
- \$50-100 million
- \$100-500 million
- \$500 million to \$1 billion
- \$1 billion to \$10 billion
- Over \$10 billion

#20 How many people does your firm employ?

- Under 50
- 50-99
- 100-499
- 500-999

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- 1,000-4,999
- 5,000 – 10,000
- Over 10,000

#21 My firm is one of the best places to work.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

#22 My firm cares about the well-being of its employees.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

#23 In general, employees at my firm are more productive than those of our competitors.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

#24 Has your firm ever been recognized on Fortune Magazine's list of 100 Best Places to Work?

- Don't know
- Never
- Once
- More than once

#25 In which industry/field below best fits your firm? (Select one) *[NOTE: The following was list is a modification derived from the attributes provided by the sample vendor, TrueSample]*

- Accounting/Finance/Banking/
- Advertising/Marketing/PR/Creative
- Aerospace/Aviation/Automotive
- Agriculture, Forestry & Fishing
- Business/Professional Services
- Computer Hardware/Software/Internet
- Construction
- Education
- Entertainment/Recreation/Leisure
- Food service
- Government (not military)
- Healthcare/Medical

## THE PREVALENCE OF SLEEP WELLNESS POLICIES

- Insurance/Legal
- Law Enforcement/Security Services/First Responder
- Manufacturing
- Media/Printing/Publishing
- Military
- Mining
- Non-Profit
- Retail/Wholesale Trade
- Science/Biotech/Pharmaceuticals
- Transportation/Distribution
- Utilities/Telecommunications
- Other, please specify

#26, What is the zipcode of the headquarters of your firm

#27 You may add below any further comments you have regarding this survey.

Salutation:

Thank-you for your participation. If you would like a copy of the survey results, please send a request in mail to:

Professor Joe Childs  
Wellness Survey Results  
Bethany University  
800 Bethany Dr.  
Scotts Valley, CA 95066