This invention may be employed in a variety of commercial applications covering many occupational areas for purposes of optimizing output (productivity). The invention provides managers with the capability to plan operations and regulate work hours to a standard based on objective cognitive performance predictions. This is in contrast to the frequently used method of regulating work hours by time off-duty (a relatively poor predictor of sleep/wake patterns and consequently a poor predictor of cognitive performance) or by generating alertness/sleepiness predictions (which, as noted above, do not always correspond to cognitive performance). The invention can be "exercised" in hypothetical sleep/wake scenarios to provide an estimate of cognitive performance under such scenarios. To the extent that optimizing cognitive performance is of interest to the general public, there is a possibility for use in a variety of applications.

The method may also be used to gauge and evaluate the cognitive performance effects of any biomedical, psychological, or other (e.g., sleep hygiene, light therapy, etc.) treatments or interventions shown to improve sleep. Examples of these include but are not limited to patients with overt sleep disorders, circadian rhythm disorders, other medical conditions impacting sleep quality and/or duration, poor sleep hygiene, jet lag, or any other sleep/wake problem. Currently, the efficacy of treatments for improving sleep is determined by comparing baseline polysomnographic measures of nighttime sleep and some measure of daytime alertness (e.g., the MSLT, the Maintenance of Wakefulness Test (MWT), the Stanford Sleepiness Scale or the Karolinska Sleepiness Scale) with the same measures obtained after treatment. Both treatment efficacy and the likely impact on performance during waking periods are inferred from the results on the daytime alertness tests. For example, the Federal Aviation Administration currently requires any commercial pilots diagnosed with sleep apnea to undergo treatment. Such treatment is followed by daytime alertness testing on a modified version of the MWT. During the MWT, pilots are put in a comfortable chair in a darkened room and instructed to try to remain awake for extended periods. If the pilots are able to avoid overt sleep under these sleep-conducive conditions then they are deemed fit for duty. The inference is that the minimal ability to maintain wakefulness at a discrete point in time translates into the ability to operate an aircraft safely (i.e., it is inferred that alertness is equivalent to cognitive performance). However, sleep deprivation can affect cognitive performance even when it does not result in oven sleep, particularly during an alertness test when for various reasons the individual may be highly motivated to stay awake.

In contrast, the current method allows cognitive performance to be estimated directly from measured sleep parameters considered in conjunction with the time of day. The advantages of this method over current methods for evaluating treatment efficacy are: (1) the motivations and motivation levels of the patients being tested cannot affect results (cognitive performance determinations); and (2) the method allows numerical specification and prediction of cognitive performance across all projected waking hours rather than indicating alertness at a discrete, specified point in time. Thus, the method provides a continuous scale for gauging cognitive performance across time rather than providing only a minimal "fitness for duty" determination based on the patient's ability to maintain EEG-defined wakefulness at a specific time.

The method may also be used clinically as an adjunct for diagnosing sleep disorders such as narcolepsy and idiopathic CNS hypersomnolence. Equally important, it may also be used to differentiate among sleep disorders. The latter is critical to the course of treatment, and consequent treatment efficacy depends on a valid and reliable diagnosis. For example, sleep apnea and periodic limb movements during sleep are characterized by nighttime sleep disruption (i.e., partial sleep deprivation) accompanied by daytime cognitive performance deficits. In contrast, narcolepsy and idiopathic hypersomnolence tend to be characterized by apparently normal nighttime sleep, but accompanied by daytime cognitive performance deficits. Based on the apparently normal nighttime sleep in the latter two groups, the invention would predict relatively normal cognitive performance. Thus, a discrepancy between predicted cognitive performance (based on the current invention) and observed or measured cognitive performance could be used to distinguish one sleep disorder from another. For example, narcolepsy, idiopathic hypersomnolence, or other CNS-related causes of daytime cognitive performance deficits (where no sleep deficit is apparent) could be distinguished from sleep apnea, periodic limb movements, or other causes of daytime cognitive deficits (where impaired sleep is evident).

Those skilled in the art will appreciate that various adaptations and modifications of the above-described preferred embodiments can be configured without departing from the scope and spirit of the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

What is claimed is:

1. An apparatus for predicting cognitive performance comprising:

an input connection,

a data analyzer connected to said input connection to select a calculation function responsive to the received data,

a calculator connected to said data analyzer to calculate a cognitive performance capacity using the calculation function,

a first memory including modulation data, and

a modulator connected to said first memory and said calculator to modulate the cognitive performance capacity with the modulation data to generate a predicted cognitive performance.

2. The apparatus of claim **1**, further comprising a display connected to said modulator.

3. The apparatus of claim **1**, further comprising a communication port connected to said modulator, said communication port relays the predicted cognitive performance to an external device.

4. The apparatus of claim **1**, further comprising a second memory connected to said calculator and said modulator, said second memory stores the cognitive performance capacity produced by said calculator.

5. The apparatus of claim **4**, wherein said first memory and said second memory are integrally formed as one memory.

6. The apparatus of claim **4**, wherein said second memory is a first-in-first-out memory.

7. The apparatus of claim **1**, wherein the modulation data represents time of day variations over a 24-hour period.

8. The apparatus of claim **1**, wherein said data analyzer includes a sleep scoring system.

9. The apparatus of claim **1**, wherein said input connection is a telemetric receiver.

10. The apparatus of claim **1**, wherein said input connection is a keyboard.