Application of CRM Techniques for predicting the consequences of Laborers Sleep Deprivation in Construction Projects

DOI:10.36909/jer.ACMM.16291

Sathvik S, L Krishnaraj*
Department of Civil Engineering, Faculty of Engineering and Technology, SRM Institute of Science and Technology, Kattankulathur – 603203, Tamil Nadu, India.
*Corresponding Author: Dr. L Krishnaraj, Mail Id – krishnal@srmist.edu.in.

ABSTRACT

The purpose of this study is to develop a prediction model using a CRM (Customer Relationship Management) analysis approach that identifies the potential impact of sleep deprivation on construction laborers. Based on the data collected from India's most populous city, Bengaluru Karnataka, employing nearly 800,000 to one million laborers in the construction industry, a dataset was created to establish the relationship of sleep deprivation on laborers. Upon establishing the datasets, CRM methodology using mathematical expressions and designs in the Solutions Box of Microsoft. CRM helped derive significant variables leading to the result, a statistical analysis method to indicate daily sleep cycle disturbances and the working hours are the most influential factors, followed by age, gender, service length, quality of work and nature of work. The results obtained should contribute to creating awareness among construction laborers and contractors about the consequences of sleep deprivation on laborers' health and work productivity. Thus, incorporating safety measures improves the health of the laborers and indirectly contributes to growth of the construction industry and the country's economy.

Keywords*:* Sleep Deprivation, Customer Relationship Management, Workflow, Dashboard, Azure cloud services, Bayesian Network

INTRODUCTION

According to an International Labor Organization (ILO) report, developing countries' construction laborers are more prone to sleep deprivation even with an average sleep cycle of eight hours as opposed to advanced countries (Brick, Seely, and Palermo 2010)(Bogdan and

Reeves 2018). 7% of global employment consists of construction laborers, contributing to the high number of sleep-deprived employees (Huntley et al. 2021)(Guo et al. 2021). In most countries, the construction industry is the major employer, and has a higher number of construction laborers most affected by sleep: Japan, Turkey, South Korea with only 5 hours 59 minutes, India with 6 hours 20 minutes, Great Britain and the Netherlands with 7 hours 24 minutes. Least affected are New Zealand and Australia with 7 hours 30 minutes sleep, shown in figure 1 (Savin et al. 2021)(Goodin, McGuire, and Smith 2010).

Sleep deprivation is caused by inadequate sleep in humans due to different life circumstances and health issues (Chambers, Pichardo, and Rosenbaum 2016)(Meltzer, Shaheed, and Ambler 2016). Not getting enough sleep has become quite common among adults. Many complications, such as sleep apnea, depression, anxiety, insomnia, narcolepsy, cardiac issues, hallucination, mood swings, etc., are caused by sleep disorders (Hawkins et al. 2019)(Raniti et al. 2017). It has been reported that 62% of adults are sleep deprived, i.e., they do not get an average of eight hours of sleep as required. Major sleep deprivation cases have been observed in IT sector employees, such as computer programmers or business supervisors like CEOs, COs & directors or construction industry employees such as laborers, in addition it affects bartenders, stewards, drivers, etc. (Paavonen et al. 2016)(Segrin and Burke 2015). When comparing sleep cycles based on gender, it has been reported that women require 20 more minutes of mood sleep than men because women expend more mental energy (Westerlund et al. 2016)(Powell and Copping 2010), but about 15% of women report having sleep difficulty as opposed to only 8% of men. Adults and students with hectic educational lives face many psychological issues due to sleep deprivation such as impaired memory, inability to concentrate, drowsiness, etc. (Vaux and Kirk 2018)(Guerola-Navarro et al. 2021). Almost all occupations lead to sleep-deprived employees, but the most cases of sleep deprivation have been observed in the construction sector, as it employs more human resources compared to any other industry (Suoniemi et al. 2021). This indicates how sleep affects labor market engagement. Hence, finding a suitable solution to the problem is a pressing issue.

In India, the construction sector is one of the fastest-growing industries, with a Composite Annual Growth Rate (CAGR) of 15.9% due to economic growth from continuous urbanization and upcoming infrastructure projects (Massar et al. 2019). The number of construction laborers in India is estimated at 50% of the total workforce. Women constitute almost 30% of the force,

with over 35 million employees (Ojelabi et al. 2018). Though female laborers are fewer in number, they are more prone to sleep-deprived effects than men. As per the National Commission for Enterprises in the Unorganized Sector (NCEUS), laborers are most affected by hazardous environmental conditions and consequences on their health (Sathvik and Krishnaraj 2020). They are exploited by contractors with no specified time limits, working 10 hours per day. It is absolutely necessary to improve safety awareness by empowering contractors to appropriately inform each employee of the risks faced by sleep deprivation.

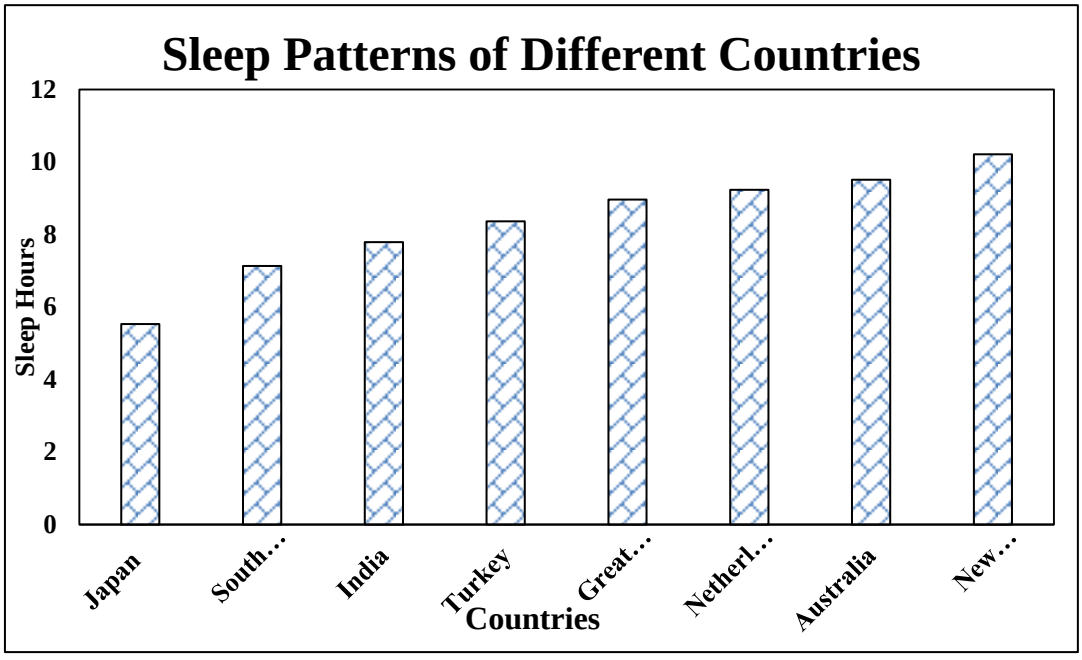

Figure 1 Graph showing sleep cycles of different countries

METHODOLOGY

The study was carried out on construction laborers from the Pramuk Meridian site, Bengaluru, from January 1, 2019, to March 30, 2021. This research was approved by the Ethics Committee of SRM Medical College Hospital and Research Centre (2186/IEC/2020) and was conducted according to principles of the Institutional Ethical Committee. Written informed consent for the study was obtained from all construction laborers. 450 construction laborers installed sleep-cycle measuring applications in their mobile devices to track the sleep cycle, relating to their productivity and health.

DESIGN AND PARTICIPANTS

The study utilized sleep deprivation data from construction laborers collected by researching and enquiring of many laborers working in Bangalore City. Four hundred and fifty laborers were considered for the study, including 230 males & 190 females, and we enquired regarding their sleep cycle and working hours. The collected data were categorized by sex, age, working hours, service length, productivity, fatalities caused, construction type, and employer scale.

CRM TECHNIQUES

Customer Relationship Management (CRM) is comprised of many applications related to IT and procedures that identify clients' preferences and gathers information to improve the relationship between the customer and business. In this study, CRM is used to find the relationship between two factors, i.e., sleep deprivation and labor productivity.

In this research, Microsoft Dynamics 365 CRM, online version, was used to interpret the data and determine the relationship between various factors. The connected business cloud, excellent tools, and powerful features of this software aided in better consolidation of the data. It utilized a single repository, Azure Cloud Services, to organize and manage the relationships and tools to monitor the performance and productivity of laborers. It has an excellent responsive design that runs seamlessly in browsers or phones (Android or iPhone). Using cloud services helps access uploaded datasets from any location, significantly contributing to the extensive research and expanding the research base.

Dashboards are the visual compilation of data. This graphic representation of data from multiple records of entities shows the interaction with each other. It gives an at-a-glance snapshot of performance indicators to be followed, providing information on the functions at a crucial moment. Powerful “drill-down” capabilities are delivered with charts and dashboards. The above tools of CRM aid in creating a graphical representation that leads to analyzed sleep deprivation impacts on labor productivity.

STUDY PROCEDURE

Firstly, the mobile application required to collect the data is installed in the laborers’ mobile phones. The study is done on a 10-day analysis; the sleep cycle pattern is recorded in the phone application. After enquiring regarding the laborers, the data from their phones are collected and

uploads it to the analysis tool, Microsoft CRM Dynamics 365. This dataset is automatically saved in the cloud. The data collected are divided based on several factors such as gender, age, working hours, number of days assigned for work, days taken to complete the job, labor productivity, and sleep score. A table is created based on the collected data, as shown in figure 2. The study's CRM workflow is obtained by downloading the required files and packages to Dynamics 365, shown in figure 2. In CRM, workflow is used as a representation tool to analyze and manage the study process and obtain the required result. This result can then be used as predictive analysis for decision-making purposes. In this case, the sleep cycle of the laborer's data will help us predict labor efficiency and diagnose laborers' regarding sleep patterns to improve labor productivity. The workflow diagram below shows the process of acquiring the outcome of this study.

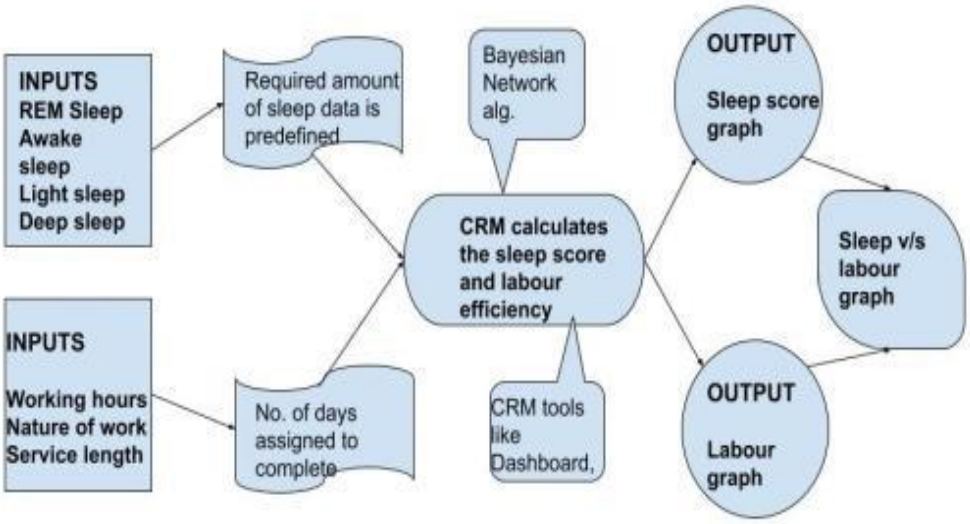

Figure 2 CRM Study Workflow

STATISTICAL ANALYSIS

Statistical analysis used in the study is the algorithm of CRM, the Bayesian Network. This statistical algorithm is one of the data mining techniques that offers clear insight into the relationship between different variables of the domain under the study. Thus, algorithms incorporate prior information to compare and generate a process called parametric algorithms, as the Bayesian network is a directed acyclic graph that has nodes that can automatically determine the link from the given data for tasks of prediction, anomaly detection, diagnostics, reasoning,

and decision making under uncertainty. A Bayesian network with nodes related to labor productivity as an outcome and other factors as nodes.

The probabilistic analytic character of the Bayes Network examines complex inferences. In this study, Bayes Law is used, expressed as follows:

$$P(A/B) = (P(B/A) * P(A))/P(B) \quad \text{(equation 1)}$$

This formula explains the likelihood of an event or factor like work productivity, where P(A/B) is the likelihood of event A if B is present. P(B/A) is the probability of event B under known event A. P(A) and P(B) are likely to be independent of A and B. Here, A could be labor productivity, B could be sleep deprivation or an anomalous sleep pattern. Therefore, this formula (Equation 1) provides a suitable relationship essential for decision making, i.e., the amount of actual sleep required for laborers to work at maximum productivity.

RESULTS

The collected data is uploaded in CRM Dynamics 365 to derive a graphical representation, shown in Dashboard and Workflow in this study. Many factors, like sex, age, sleeping pattern, working hours, service length and labor productivity of construction laborers are used. The nature of work in the construction industry and the quality of work are also considered a perfect representation. To ease the calculation and estimation of results, laborers were grouped into categories of the same age. They followed the same pattern of productivity and working hours as described in Table 2. The productivity of the laborers was calculated as per (equation 2) shown in Table 1.

Table 1 Categorization of Laborers

Category*	**Gender**	**Number of Laborers**	**Age**
CM-1	Male	32	24
CM-2	Male	31	21
CM-3	Male	29	33
CM-4	Male	28	36
CM-5	Male	33	29

CM-6	Male	28	38
CM-7	Male	27	41
CM-8	Male	22	19
CF-1	Female	17	22
CF-2	Female	27	34
CF-3	Female	20	26
CF-4	Female	24	29
CF-5	Female	26	37
CF-6	Female	22	43
CF-7	Female	26	39
CF-8	Female	28	25
Total		450	
*The category was used to classify laborers as a basis of calculation			

Labor productivity= (Number of days assigned / Number of days taken to complete) *100 (Equation 2)

The term “labor productivity” reflects the culture and moral development of the workplace and encourages an improved business environment. In most cases, if a company is highly productive, it succeeds. Therefore, incentives will be made to improve the laborer’s productivity to measure the efficiency of labor for input to output work.

BASED ON SEX

Male and female laborers are questioned separately to observe efficiency based on gender. It is reflected in Tables 2 & 3 that male laborers have greater labor efficiency than female laborers because of differences in their physical attributes and sleep patterns. Female laborers generally require more sleep than their male counterparts to match the efficiency of males.

A. Male

Table 2 CRM Model Data Collected from Male Laborers

Category of Labor	Age	Sleep Score	Working Hours	No. of Days Assigned	No. of Days to Complete	Labor Productivity
CM-1	24	72	8	7	10	70
CM-2	21	78	7	6	8	75
CM-3	33	67	8.5	3	4.5	67
CM-4	36	81	8.5	9	10.5	86
CM-5	29	62	8	4	5.5	73
CM-6	38	84	7.5	4.5	5	90
CM-7	41	89	7	6	6	100
CM-8	19	55	8	8	9.5	84

B. Female

Table 3 CRM Model Data Collected from Female Laborers

Category of Labor	Age	Sleep Score	Working Hours	No. of Days Assigned	No. of Days Completed	Labor Productivity
CF-1	22	74	7	6	7.5	80
CF-2	34	76	6.5	8	9	89
CF-3	26	73	6.5	5	7.5	67
CF-4	29	85	7	7	8	87
CF-5	37	64	7.5	4	5	80
CF-6	43	88	7	3	4.5	66
CF-7	39	92	6.5	5	6.5	77
CF-8	25	57	6.5	7	8	89

BASED ON THE QUALITY OF WORK

Laborers' work efficiency and sleeping patterns are directly proportional to the quality of their work. Factors like sex, age, working hours also contribute to the quality of work. It is measured as low, medium, or high. As shown in Table 4, the best sleep score has a higher work rate, and vice versa.

Table 4 CRM Model Data Based on the Quality of Work

Category of Labor	Sex	Age	Sleep Score	Working Hours	No. of Days Assigned	No. of Days Completed	Quality of Work	Labor Productivity
CM-1	Male	24	72	8	4	6	Low	67
CM-2	Male	21	78	7	5	7	High	72
CF-4	Female	29	85	7	3	4	Medium	75
CM-4	Male	36	81	8.5	6	7.5	High	80
CF-7	Female	39	64	7.5	4	5.5	High	73
CF-8	Female	25	57	6.5	7	8.5	Low	83
CM-7	Male	41	89	7	9	9	Medium	100
CM-8	Male	19	75	8	7	9.5	Low	74
CM-3	Male	33	67	8	5	7	High	71
CF-5	Female	22	74	7	5	5	Low	100
CF-1	Female	37	88	7	5	6	Low	83
CM-5	Male	29	84	8.5	8	9.5	High	85
CF-2	Female	34	69	7.5	6	7.5	Medium	80
CM-6	Male	38	61	6.5	8	9.5	High	84
CF-3	Female	26	86	7	9	11.5	High	87
CF-6	Female	43	59	8	8	10.5	Medium	77

After collecting the required data, the researcher uses the tools mentioned above of Microsoft CRM Dynamics 365 and the algorithms in the visual studio. The bar graph shown below in

figure 6 is the result of analysis of the sleep cycle of laborers compared with the required sleep to get the maximum productivity from laborers. The number of days considered to analyze is a week. Each day, the laborers show a decline in their sleep time. Consequently, it is followed by an unproductive day. Thus, the dashboard indicates that the laborers did not get sufficient sleep, i.e., they got less sleep than required to maintain their work productivity.

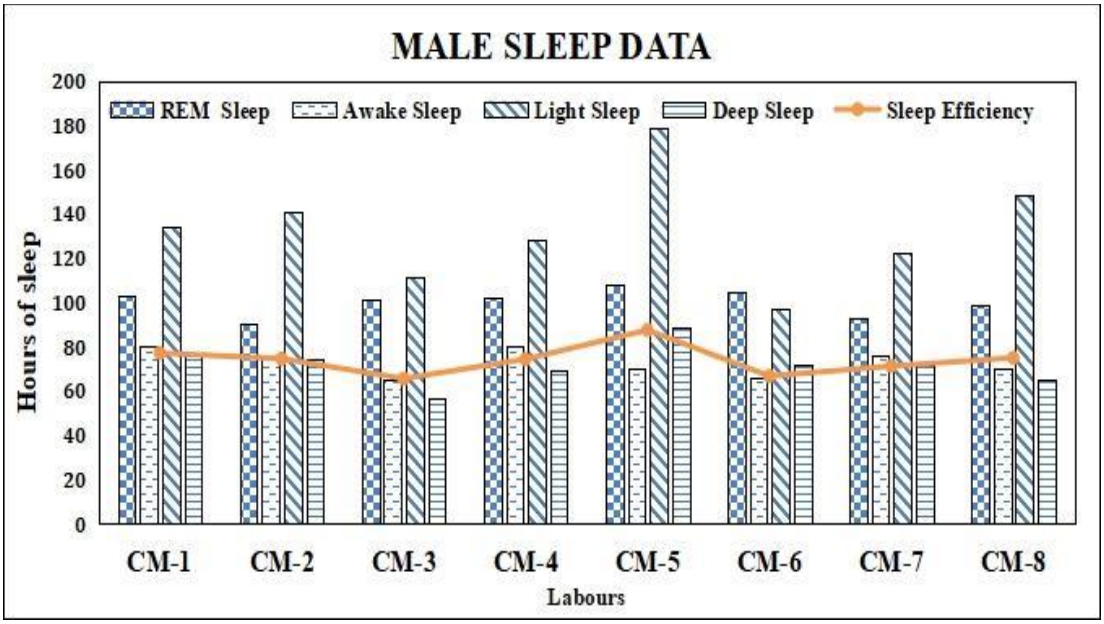

Figure 3 CRM Male Model Sleep Data of Laborers

Figures 3 and 4 show where CM-1 to 8 and CF-1 to 8 represent cumulative labor data of sleep scores. The bar graph shown below in figure 3 shows the labor performance of the work assigned for ten days. It clearly shows that the more sleep-deprived the laborer was, the less their efficiency toward the work. The laborers were given a particular number of days for task completion, but they took a longer time to finish the assigned work than allotted. Thus, the dashboard graph helps us predict efficiency and appropriate measures to be taken for sleep-deprived laborers.

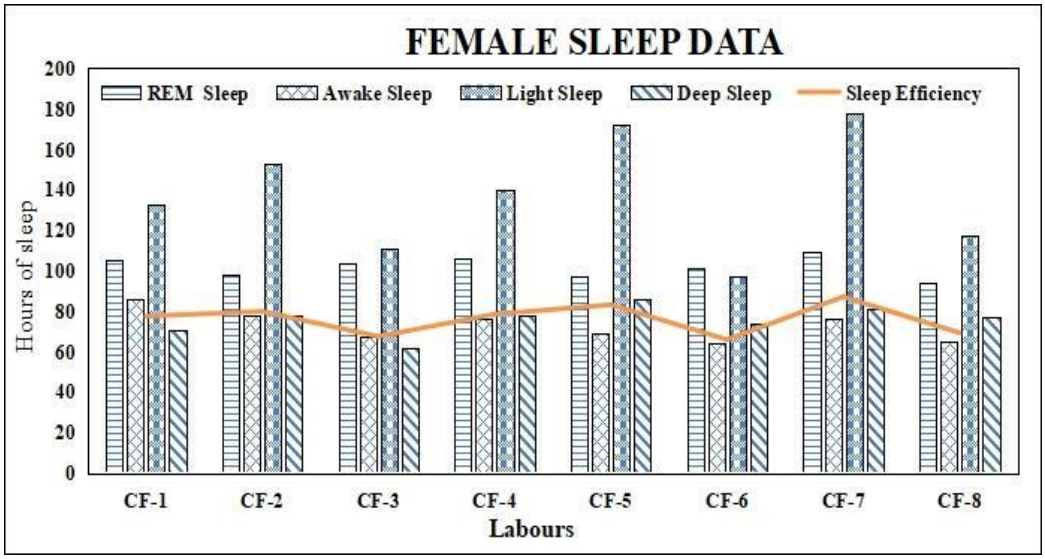

Figure 4 CRM Female Model Sleep Data of Laborers

Laborers were assigned a particular number of days for task completion, but they took longer to finish the assigned work than allotted. Thus, the dashboard graph helps us predict the efficiency and measures to be considered in sleep-deprived laborers.

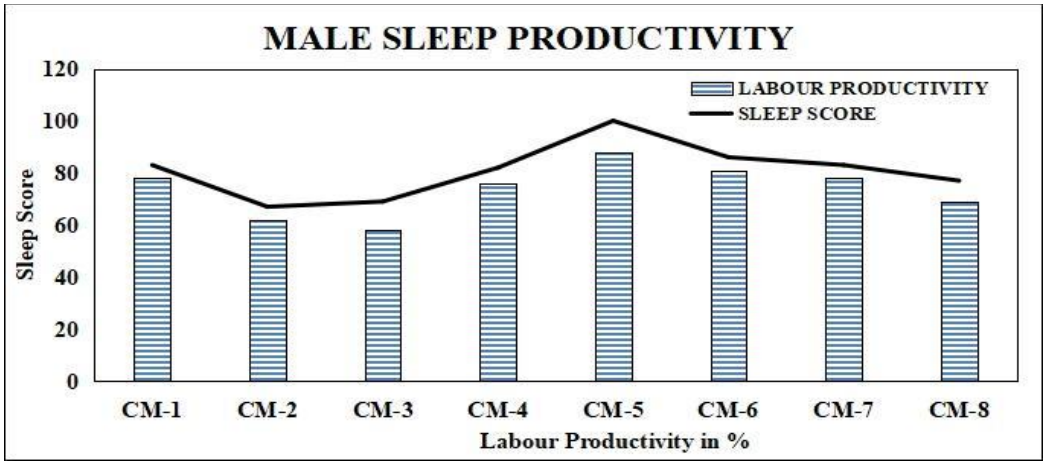

Figure 5 CRM Male Model of Sleep Productivity

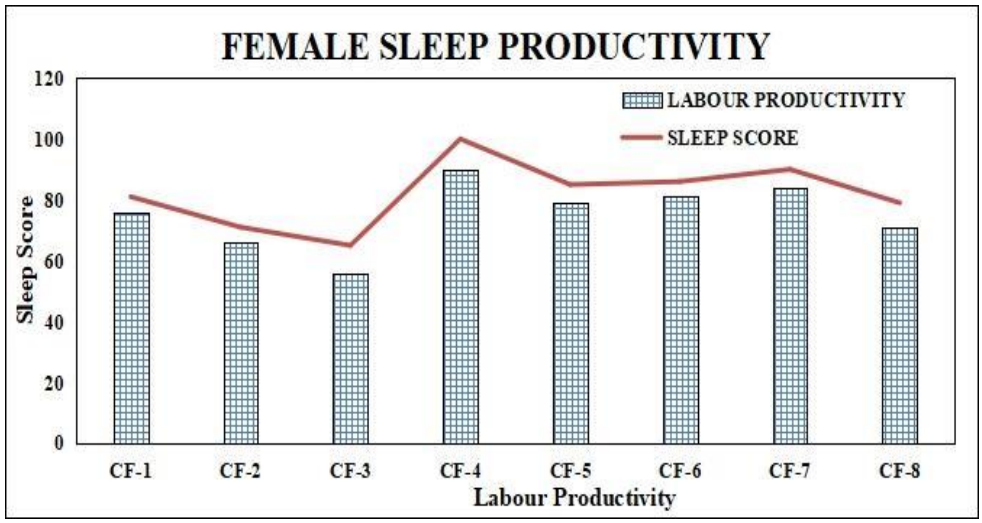

Figure 6 CRM Female Model of Sleep Productivity

Figures 5 and 6 represent the relationship between sleep score and labor productivity of both males and females. It can be inferred that sleep score is related to labor productivity among laborers in the construction industry.

DISCUSSION

There are three management levels in the building industry: top, middle, and lower management levels. The analysis provides an opportunity to determine the lower management level worker's sleep cycle. The study is noteworthy, based on these findings. According to the study, the quantification was recommended because it showed that poor work was the result of poor sleep. The risk of injury for laborers increased to 15% due to insufficient sleep. Higher work risk occurring at all stages, affecting average productivity, is reduced yearly during construction.

The construction sites does a tedious works with long working hours. During the study, eight hours of average sleep per night was 8.5 percent of the workplace, and the guidelines suggested that eight hours of sleep be equally balanced. The work is exhausting, and the reduction in sleep is up to 14%. When you get older and change your sleep pattern, it affects work productivity. Age is the main factor suggested as hormonal content decreases. A sum of sleep scores of different stages of sleep such as light sleep, rem sleep, and deep sleep are the overall sleep scores for a total of up to 100. Many laborers scored from 73 to 84. The scoring of sleep is: excellent: 91-100, good: 81-90, fair: 61-80, and poor: less than 60.

This analysis offers the scope for determining the working people's sleep cycle. These sleep vs. productivity results represented in figure 7 indicate that the study is notable. The quantification illustrated those laborers were not getting sleep, which was recommended, hence their work

productivity decreased. The risk to laborers was up to 12% higher due to lack of sleep. In this research, male and female laborers were both considered. The sleep cycle of females is different because they perform multitasking work both at home and construction sites. Female laborer sleep has been affected both during pregnancy and menopause. Female laborers need 20 minutes more rest than male laborers as per expert doctors and researchers' suggestions.

Many organizations have neither impairment policies nor impairment testing, which suggests that much work is needed in this field. It is difficult to believe that organizations allowing laborers to consume alcohol or illicit drugs at work would allow an equally disabled person to continue working because they are sleep-deprived. The same problem is occurring on the road as the same exhausted laborers are driving home. If the estimates of the loss of productivity are not enough to encourage further action, the safety of laborers should be the only one.

CONCLUSION

Although the construction sector is a high-yield industry among various industries, laborers are mainly sleep-deprived, affecting their personal lives, workplace productivity, and relationships, thus increasing stress levels, which will consequently exacerbate their sleep issues. While other studies have provided valuable insights into fatigue and its functioning in many different industries, little has been known about the construction laborer's sleep habits, even though there were ample reasons to be concerned about poor safety records and productivity. The results of this study show an average 9% increase in deep sleep over awake sleep. Field laborers should increase light rest by 10.1% to have a peaceful working environment. In addition to other forms of workplace deficiencies, fatigue is indicated by a significant erosion of personal safety and primary productivity.

This study analyzed and gathered data from nearly 450 construction industry laborers from mid-year 2019 to 2020. Various factors were considered, like age, sex, nature of work, quality of work, service length to reach the purpose of this study, i.e., labor productivity. CRM techniques have been applied to the collected dataset to determine a relationship between sleep deprivation and labor productivity. The Bayesian network used in this study (also called the probabilistic analytical algorithm) provides an excellent foundation to derive labor productivity from the given dataset.

After the analysis of this study, it is clearly understood that adequate sleep is an essential part of life. The first step toward eradicating this issue is to inform the employee about the side

effects of sleep deprivation and diagnose them. This way, most sleep disorders can be corrected at an early stage, improving the overall health of laborers and work productivity. If strict measures are followed, a mutual benefit between laborers and the country's economy will shape the construction industry to another level.

REFERENCES

Bogdan, Alexander R., and Katherine W. Reeves. 2018. "Sleep Duration in Relation to Attention Deficit Hyperactivity Disorder in American Adults." *Behavioral Sleep Medicine* 16 (3): 235–43. https://doi.org/10.1080/15402002.2016.1188391.

Brick, Cameron A., Darbi L. Seely, and Tonya M. Palermo. 2010. "Association between Sleep Hygiene and Sleep Quality in Medical Students." *Behavioral Sleep Medicine* 8 (2): 113–21. https://doi.org/10.1080/15402001003622925.

Chambers, Earle C., Margaret S. Pichardo, and Emily Rosenbaum. 2016. "Sleep and the Housing and Neighborhood Environment of Urban Latino Adults Living in Low-Income Housing: The AHOME Study." *Behavioral Sleep Medicine* 14 (2): 169–84. https://doi.org/10.1080/15402002.2014.974180.

Goodin, Burel R., Lynanne McGuire, and Michael T. Smith. 2010. "Ethnicity Moderates the Influence of Perceived Social Status on Subjective Sleep Quality." *Behavioral Sleep Medicine* 8 (4): 194–206. https://doi.org/10.1080/15402002.2010.509193.

Guerola-Navarro, Vicente, Raul Oltra-Badenes, Hermenegildo Gil-Gomez, and Agustín Iturricha Fernández. 2021. "Customer Relationship Management (CRM) and Innovation: A Qualitative Comparative Analysis (QCA) in the Search for Improvements on the Firm Performance in Winery Sector." *Technological Forecasting and Social Change* 169. https://doi.org/10.1016/j.techfore.2021.120838.

Guo, Lan, Wanxin Wang, Tian Wang, Meijun Zhao, Ruipeng Wu, and Ciyong Lu. 2021. "The Longitudinal Association between Sleep Duration and Suicidal Behavior among Chinese Adolescents: The Role of Nonmedical Use of Prescription Drug." *Behavioral Sleep Medicine* 19 (5): 589–601. https://doi.org/10.1080/15402002.2020.1822361.

Hawkins, Marquis, Bess Marcus, Penelope Pekow, Milagros C. Rosal, Katherine L. Tucker, Rebecca M.C. Spencer, and Lisa Chasan-Taber. 2019. "Physical Activity and Sleep Quality and Duration During Pregnancy Among Hispanic Women: Estudio PARTO." *Behavioral Sleep Medicine* 17 (6): 804–17.

https://doi.org/10.1080/15402002.2018.1518225.

Huntley, Edward D., Leslie M. Swanson, Giselle E. Kolenic, Holli Bertram, Ann Mooney, Richard Dopp, and J. Todd Arnedt. 2021. "Associations between Self-Reported Daily Affect Ratings and Sleep Duration during the First Two Weeks of Antidepressant Therapy." *Behavioral Sleep Medicine* 19 (1): 1–11. https://doi.org/10.1080/15402002.2019.1695617.

Massar, Stijn A.A., Julian Lim, Karen Sasmita, and Michael W.L. Chee. 2019. "Sleep Deprivation Increases the Costs of Attentional Effort: Performance, Preference and Pupil Size."*Neuropsychologia* 123 (September2017): 169–77. https://doi.org/10.1016/j.neuropsychologia.2018.03.032.

Meltzer, Lisa J., Keisha Shaheed, and Devon Ambler. 2016. "Start Later, Sleep Later: School Start Times and Adolescent Sleep in Homeschool Versus Public/Private School Students." *Behavioral Sleep Medicine* 14 (2): 140–54. https://doi.org/10.1080/15402002.2014.963584.

Ojelabi, Rapheal A., Adedeji O. Afolabi, Opeyemi O. Oyeyipo, Patience F. Tunji-Olayeni, and Bukola A. Adewale. 2018. "Data Exploration of Social Client Relationship Management (CRM 2.0) Adoption in the Nigerian Construction Business." *Data in Brief* 18: 1471–76. https://doi.org/10.1016/j.dib.2018.04.037.

Paavonen, E. Juulia, Taina Huurre, Maija Tilli, Olli Kiviruusu, and Timo Partonen. 2016. "Brief Behavioral Sleep Intervention for Adolescents: An Effectiveness Study." *Behavioral Sleep Medicine* 14 (4): 351–66. https://doi.org/10.1080/15402002.2015.1007993.

Powell, Ronald, and Alex Copping. 2010. "Sleep Deprivation and Its Consequences in Construction Workers." *Journal of Construction Engineering and Management* 136 (10): 1086–92. https://doi.org/10.1061/(asce)co.1943-7862.0000211.

Raniti, Monika B., Nicholas B. Allen, Orli Schwartz, Joanna M. Waloszek, Michelle L. Byrne, Michael J. Woods, Bei Bei, Christian L. Nicholas, and John Trinder. 2017. "Sleep Duration and Sleep Quality: Associations With Depressive Symptoms Across Adolescence." *Behavioral Sleep Medicine* 15 (3): 198–215. https://doi.org/10.1080/15402002.2015.1120198.

Sathvik S., and L. Krishnaraj. 2020. "A Case Study on Impact of Labours Sleep Deprivation in Construction Project Using Application Method." *IOP Conference Series: Materials Science and Engineering* 912 (6). https://doi.org/10.1088/1757-899X/912/6/062055.

Savin, Kimberly L., Sanjay R. Patel, Taylor L. Clark, Julia I. Bravin, Scott C. Roesch,

Daniela Sotres-Alvarez and Yasmin Mossavar-Rahmani. 2021. "Relationships of Sleep Duration, Midpoint, and Variability with Physical Activity in the HCHS/SOL Sueño Ancillary Study." *Behavioral Sleep Medicine* 19 (5): 577–88. https://doi.org/10.1080/15402002.2020.1820335.

Segrin, Chris, and Tricia J. Burke. 2015. "Loneliness and Sleep Quality: Dyadic Effects and Stress Effects." *Behavioral Sleep Medicine* 13 (3): 241–54. https://doi.org/10.1080/15402002.2013.860897.

Suoniemi, Samppa, Harri Terho, Alex Zablah, Rami Olkkonen, and Detmar W. Straub. 2021. "The Impact of Firm-Level and Project-Level It Capabilities on CRM System Quality and Organizational Productivity." *Journal of Business Research* 127 (January): 108–22. https://doi.org/10.1016/j.jbusres.2021.01.007.

Vaux, James S., and W. Max Kirk. 2018. "Relationship Conflict in Construction Management: Performance and Productivity Problem." *Journal of Construction Engineering and Management* 144 (6): 04018032. https://doi.org/10.1061/(asce)co.1943-7862.0001478.

Westerlund, Anna, Ylva Trolle Lagerros, Göran Kecklund, John Axelsson, and Torbjörn Åkerstedt. 2016. "Relationships Between Questionnaire Ratings of Sleep Quality and Polysomnography in Healthy Adults." *Behavioral Sleep Medicine* 14 (2): 185–99. https://doi.org/10.1080/15402002.2014.974181.