

Study on Ergonomics in Improving Labour Productivity

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Abstract—One of the uniqueness of human activity is the ability to transform the environment and create new structures. Even though all human activities are agreed not in a construction environment, only a few studies deal about a labor productivity based on an ergonomic approach. Construction project trends carry immense consequences for the economy as a whole. Labour productivity is one of the mainly significant factors affecting the overall performance of any association whether large or small organization. The studies assess the factors that affect labour productivity based on application of ergonomics. The chapter presents a preliminary survey of some principles driven by human ergonomics discipline, analyzing the role they play in the productivity process, in order to define a design methodology supporting the labor to create working and living area actually fitting the needs of inhabitants. The factors that affect the labour productivity are determined from literature study and using these factors conducting the questionnaire survey among the labours in various construction projects. The ranking of the factors will be done by Relative Important Index (RII) using the data's the major factors completing the labour productivity comprise to be recognized from the results suitable suggestion will be given to the companies for improving their ergonomic techniques in worksite.

Key words—Ergonomics, Factors, Labour Productivity, RII

I. INTRODUCTION

Building and construction is one of the oldest activities of mankind. Some of the important improvements in history were the invention of nails and screws, the introduction of ceramic building materials and the invention of pre-stressed concrete. The course focuses on construction and structural principles, safety standards, and the steps involved in the design, procurement and construction of a project. Labour productivity is one of the key components of every company achievement and competitiveness in promote. Productivity in construction is often related to labour only. It is broadly defined as output per labour hour. The primary important step in the field of work group was the introduction of professional tradesmen. Specialization of trades was introduced in the premature middle Ages. In the second half of this century numerous new interests arose, mostly as jobs were split up into some new trades, which often consist of one or a few tasks. In most cases the only change for the construction procedure was the appearance of several tradesmen in a sequential order. Teamwork still exists in road construction and other civil works. As we look at the step of innovation in other undergrowth of industry, the building and construction industry should be described as most traditional.

The concept of labour productivity is importantly linked to the input, output and process. Loss of productivity occurs at the crew level. It is at the crew that physical work is performed. Difficult working conditions, unavailable resources and an unsuitable workforce can each cause slowed pace of work, absenteeism, worker turnover, and an idle time, and fatigue, loss of motivation or poor quality work. Such responses by a crew may be directly observed by the contractor or identified through an appropriate system of measuring and tracking productivity. This action may improve the situation or cause further problems with working conditions, leading to further reduction in the crew's performance. Work is still physically straining, work organization and working methods are

traditional. The study aims to identify and evaluate the main factors affecting the labour productivity and also give possible recommendations to improve ergonomics of construction projects. The level of profit in carrying out construction project improvement activities will also depend heavily on the quality of the management, financial, technical and organizational performance.

The paper is framed as follows: First, a project is based on the labour characteristics to execute their basic needs by apply ergonomics in arrange to raise labour productivity. For this reason, many literatures are reviewed. Subsequently, method used in the study is interpreted, followed by arrangement of the results. The discussion of the result then follows with the conclusion, providing a outline of the issues discussed.

II. ERGONOMICS IN CONSTRUCTION INDUSTRY

A. Ergonomics

Ergonomics are human factors sciences. It plays an important role in the success of a design or task. They can work interdependent to enhance each other, improving safety and productivity and reducing employer costs. Ergonomic disorders are the fastest rising category of work-related illness. It deals with designing and classifies things so that people can use them with no trouble and safely. Adapting the job to fit the personnel can help to reduce ergonomic stress and eliminate many potential ergonomic disorder tunnels.

B. Importance of Ergonomics

Ergonomics is important because when doing a job and body is stressed by a stiff posture, extreme temperature, or repeated movement, musculoskeletal system is affected. The body may begin to have symptoms such as fatigue, discomfort, and pain, which can be the first signs of a musculoskeletal disorder.

In workplaces, various kinds of research and practices are handled ergonomically: optimization of work design, design of protected tools/machines and measures against excessive workloads, design of safe and healthy work environments and workstations, measures against heat, noise, vibration and hazardous substances, appropriate setting of working and resting time and shift work schedule and establishment of organizational culture, safety culture and leadership.

They are five of the proven benefits of a strong workplace ergonomics process are ergonomics reduce costs, ergonomics enhance productivity, ergonomics improves quality, ergonomics improves employee engagement, ergonomics creates a better safety culture.

All ergonomic task force members should take advanced training in job analysis and control measures, problem area identification, and should improve skills in team building and problem solving. In adding together to organization and the work force, contribution should be insured from: safety personnel, health-care providers, human resource personnel, maintenance, and purchasing, ergonomic specialists.

C. Several of Situations Frequently Encountered in the Construction Industry.

Workers come in all different sizes. Ergonomics can help make the work more comfortable for the individual worker.

TABLE I SOME OTHER BEST ERGONOMIC PRACTICE

STRESSED	BETTER
Bent awkward posture	Relaxed posture with less pressure on the back
Bent posture	Extension handle allows for natural posture
Seat is too small and provides minimal support	Higher back seat with lumbar support and more support under legs
Manual screw driver with bent wrist	Powered in-line screw driver allows for straight wrist
Bent posture and extended reach	Tilt table brings work within reach
No neck support or creeper padding under body	Creeper gets worker off floor and provides neck and shoulders support

D. Focus of Ergonomics

The focus of ergonomics is to maximize the productivity and provide comfort place to the workers in worksite. The prevention areas in which the ergonomics are focused are shown in Fig.1.

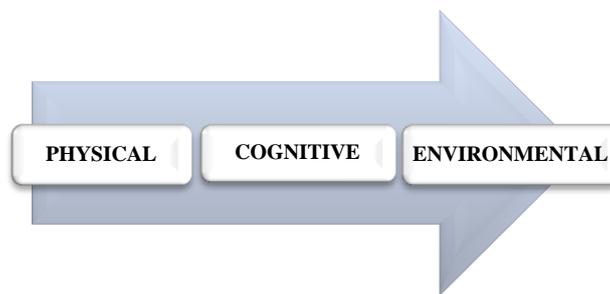


Fig.1. Focus of ergonomics

III. METHODOLOGY TO PROCCEED THE WORK

In construction industry, planning is important to achieve its goal. The plan can be achieved by sequencing the flow of work into a typical methodology. Fig.2. represents the methodology adopted for successful completion of the project.

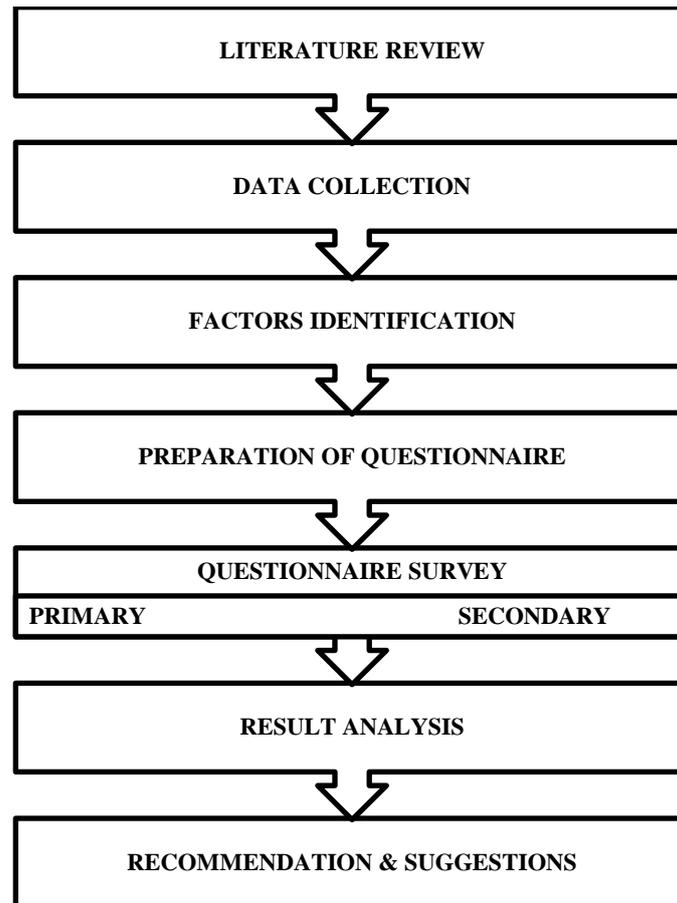


Fig.2. Methodology flow chart

IV. RESULT AND ANALYSIS

This section deals with the collection of data and the tool for analyzing the data.

A. Identification of Factor

The input data's are gathered through literature study. Data collection is a systematic approach for gathering information from a variety of sources to get a complete and clear perspective on the labour productivity.

The goal for data collection is to capture quality evidence that then convert to rich data analysis and allows the building of a compelling and credible answer to questions that have been posed. The factors (Fig.3) can be identified from the data collection. The important factors which affect the labour productivity are determined. Depending upon the factors, the questionnaire will be framed.

This necessitated the use of purposive sampling through which questionnaires were sent to 135 respondents. The respondents were to rate the effect of the variables identified from the literature using the Likert scale of 1 = 1-20 %; 2 = 21-40 %; 3 = 41-60 %; 4 = 61-80 % and 5 =81-100 %. The questions were simplified and written in simple language to easily comprehend and respond to.115 of the responses were received, representing 85 % response rate.

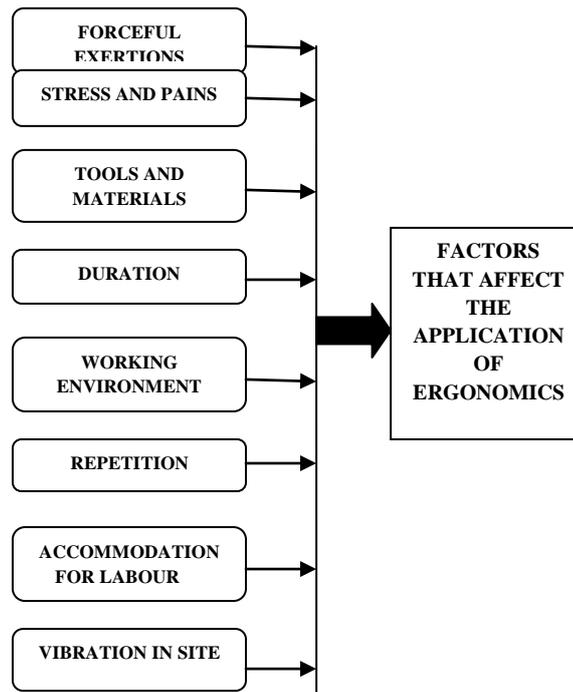


Fig.3. Factors that affect application of ergonomics

B. Factor Analysis

Factor analysis was used to establish the underlying interrelations existing among the many factors identified above. This makes it possible to reduce the factors to a more meaningful framework to increase the labour productivity in construction project. Based on the literatures there are 8 key factors consider for the questionnaire design. Each of these consists of several sub factors.

The relative importance index method (RII) is manual calculation method used to determine the significant factors affecting the application of ergonomics in improving construction labor productivity of the project. Based on the obtained mean value the factors are represented by charts. RII value manual analysis of 5 Likert scale is,

$$RII = \frac{1N1 + 2N2 + 3N3 + 4N4 + 5N5}{5(N1 + N2 + N3 + N4 + N5)}$$

TABLE II VALUE MANUAL ANALYSES FOR FACTORS AFFECT THE APPLICATION OF ERGONOMICS

S.NO	FACTORS	RII MEAN
Forceful exertions		
1	Increase weight of load handled or lifted.	0.4867
2	The speed of movement.	0.5667
3	Used of muscular forces.	0.5600
4	Handling more loads for long distances.	0.7533
5	Increased slipperiness of the objects handled (requiring increased grip force).	0.4800
Repetition		
6	Repetitive movements.	0.4821
7	Working in same position for long time.	0.6315
Duration		
8	Changes in scheduling during execution.	0.4875
9	Working more than 8 hours.	0.6482
10	Working at holidays.	0.5467
Vibration in site		
11	Using Vibrating tools.	0.4733

12	Vibrations due to movement of equipment.	0.5333
Working environment		
13	Working in cold conditions.	0.5666
14	New environment causes the labours to work less.	0.6667
15	Climatic conditions affect the labour performance.	0.5533
16	Working in humid conditions.	0.5600
17	Congested work area.	0.5867
18	Exposure to noise.	0.600
19	Working in hot conditions.	0.6999
Tools and materials		
20	Using of advanced equipment in site.	0.4800
21	Handling heavy equipment.	0.5767
22	Working with use of body force.	0.6267
23	Climbing and descending.	0.5267
24	Handling heavy materials.	0.7133
Stress and pains		
25	Stress due to heavy work.	0.5200
26	Injury while working with machines.	0.5467
27	Bending or twisting the back.	0.5733
28	Reaching overhead.	0.6400
29	Reaching away from the body.	0.526
30	Working while hurt or injured.	0.5600
31	Labour injuries on site.	0.6800
32	Temporary installation of electrical wire causes stroke.	0.600
Accommodation for labors		
33	Tin shed and Plastic sheet shed.	0.4775
34	Self-constructed temporary sheds.	0.4467
35	Sanitation and hygiene of the construction site.	0.4467
36	Drinking water facility.	0.6800

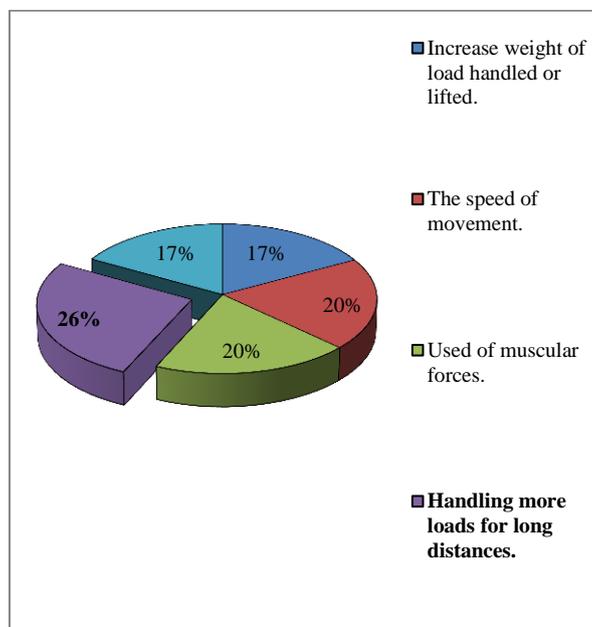


Fig.4. Forceful exertions

It shows that most of the respondent views handling more loads for long distance.

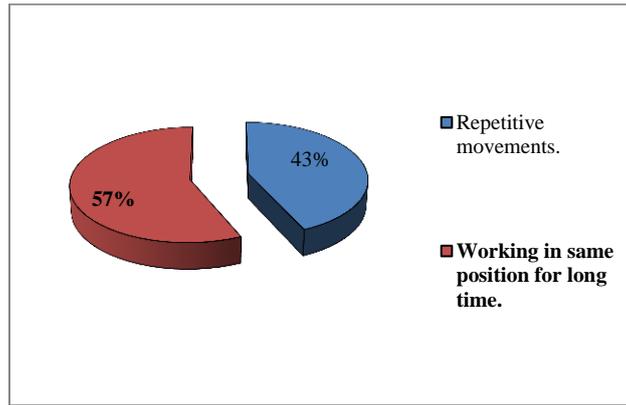


Fig.5. Repetition

Working in same position for a long time as considerable effect in repetition.

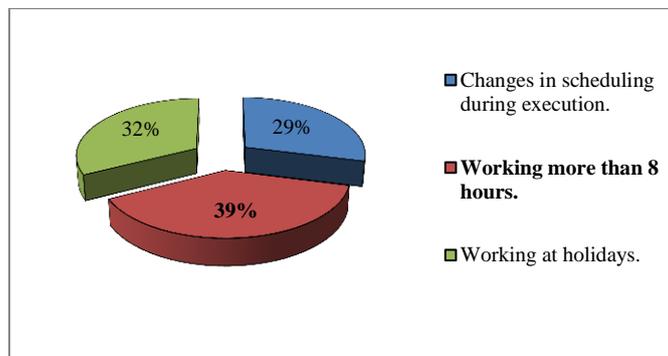


Fig.6. Duration

Working more than 8 hours has considerable effect in construction project.

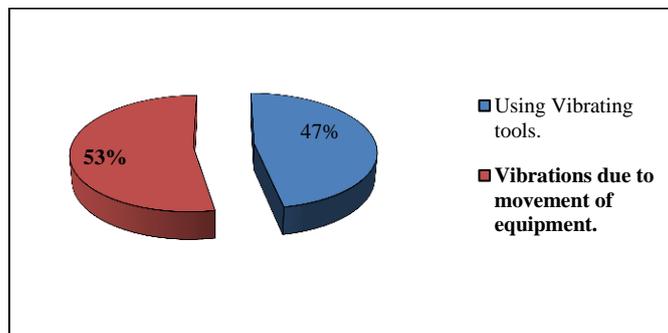


Fig.7. Vibration in site

Most of respondents said vibration due to heavy equipment effect labour productivity.

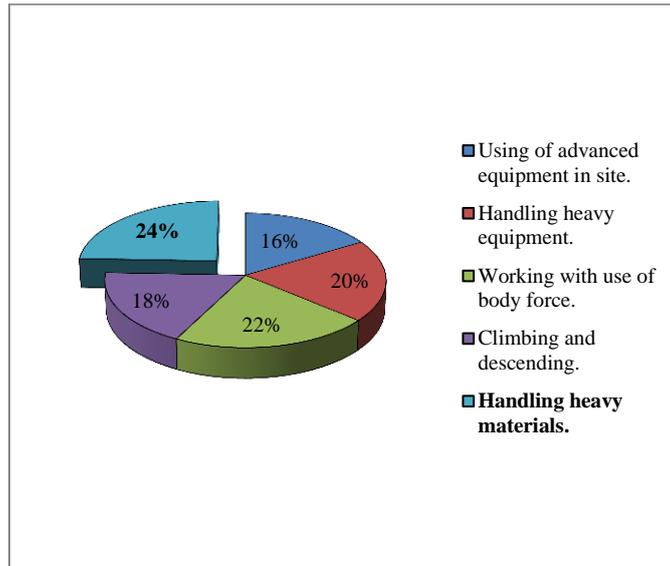


Fig.8.Tools and materials

It shows that handling heavy tools and materials affect the construction labor productivity

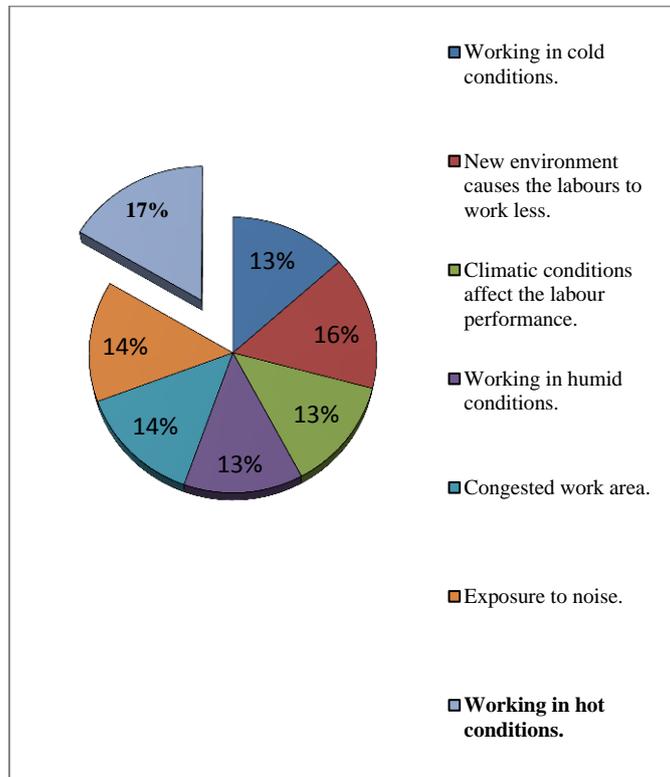


Fig.9.Working environment

Working in hot condition has considerable effect in construction project.

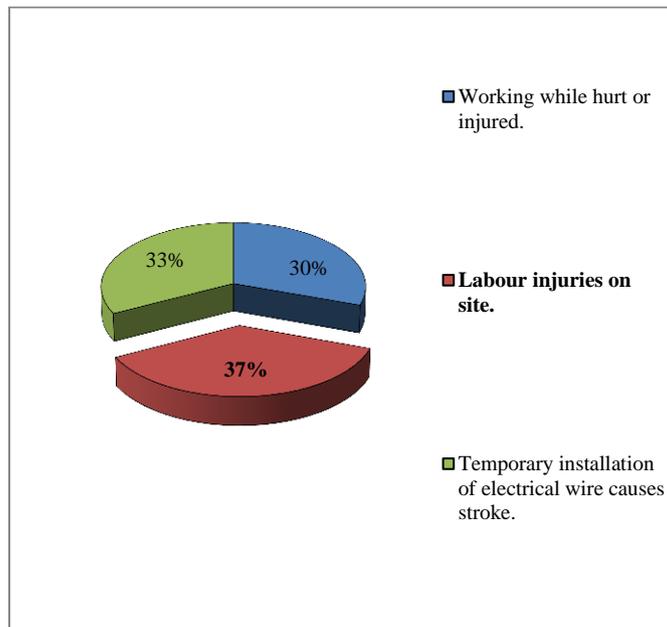


Fig.10. Stress and pains

Labour injuries on site causes stress and pains and gradually decreases productivity.

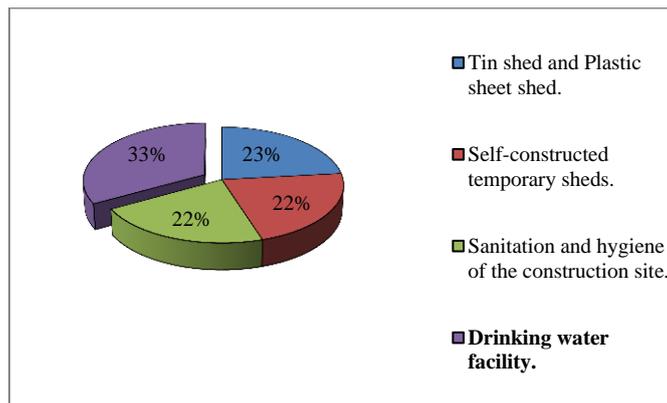


Fig.11. Accommodations for labors

A basic need of drinking water is important factor while considered in accommodation for labors.

C. Results and Discussions

Questionnaire survey was conducted and responses are analyzed by using RII. The inference made from the analysis is discussed in the following table according to the priorities.

TABLE III TOP FACTORS AFFECTING THE ERGONOMIC CONDITION IN CONSTRUCTION PROJECT

FACTORS	MEAN VALUE	Rank
Handling more loads for long distances	0.7533	1
Handling heavy materials	0.7133	2
Working in hot conditions	0.6999	3
Labor injuries on site	0.6800	4
Drinking water facility	0.6800	4
Working more than 8 hours	0.6482	5
Working in same position for long		

time	0.6315	6
Vibration due to movement of equipment	0.5333	7

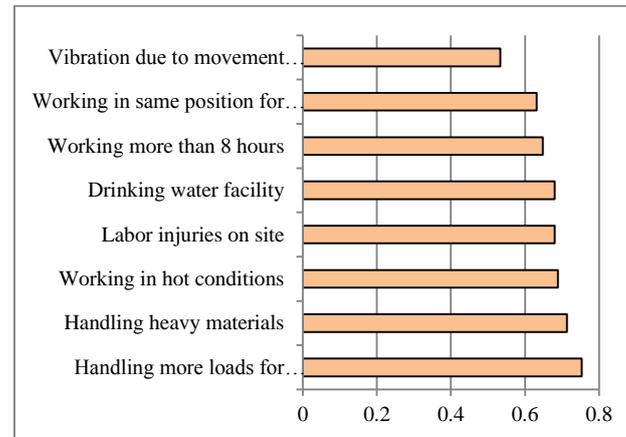


Fig.12. Critical factors

V. CONCLUSION

Even though all human activities are carried out in a built environment, only a few studies seem to be available about a labour productivity based on an ergonomic approach. The human-centered labour productivity methodology presented here yield inspiration from the holistic approach of ergonomics. In a workstation the labour productivity gets affected due to discomforts and several other factors such as forceful exertions, repetition, duration, vibration in site, working environment, tools and materials, stress and pains, accommodation for labours. The various factors affecting construction productivity are identified from literature review. Based on literature study a detailed questionnaire was prepared and survey was conducted from labours from various companies through direct survey. From that, 115 responses were collected and analyzed by using, Relative Important Index (RII) based on the results the factors are ranked as handling more loads for long distance,

- heavy materials,
- working in hot conditions,
- handling heavy materials,
- labour injuries on site,
- drinking water facility,
- working more than 8 hours,
- working in same position for long time,
- vibration due to movement of equipment are the major factors which affecting the labour productivity.

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