

An Analytical Approach by Researchers to Find Factors Affecting Labour Productivity in the Construction industry-A Review

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Abstract:

Construction industry is one of the largest industry in the world but in this industry, through millions of labours are associated with a variety of works mostly repetitive type. Those labours are getting their skills by observation through years on site. So it is necessary to provide them safe workplace so that they do not face work-related musculoskeletal Disorders (WMSD). In this review, nearly 53 research papers from 17 different countries are studied and it was found that researchers have collected data using mainly by questionnaire. But in some cases, they have used methods like interviews, OMR sheets, video recordings, accelerometer, gyroscope etc. For analysis they have used methods like,1.PATH, 2.OWAS 3.3DSSPP, 4.MATLAB, 5.CLI, 6.MSEXCEL 7.Ergo Master 8.RULA,9.MATLAB,10.RII, 11.System Dynamics,12.Fuzzy Logic. etc It was observed that in most of the cases, due to repetitive work, labours are facing WMSD. Physical health of the labours also plays an important role in ergonomics.

IndexTerms - labour, ergonomics,productivity,WMSD.

I. Introduction

Construction Industry is one of the largest Industry in the world and provides employment to millions of people. Those people include a huge quantity of unskilled labours who are not having even basic education qualification and don't know the technical details about the work they are doing like a mason. This includes lots of points like how to perform the task, what is the procedure to be adopted to complete the task, at what point quality shall be checked/maintained etc. Only due to the above points labours suffer from Work-related Musculoskeletal problems (WMSD). They also face some problems related to job allocated. Those factors are mainly responsible for the reduction of the overall efficiency of the labours resulting in a decrease of productivity of the organization. In this review, various approach adopted by researchers was studied and summarised. For this more than 53 research papers from 17 countries are studied in detail.

II.RESEARCH METHODOLOGY

As construction industry is a very huge and spread worldwide as this contributes to one of the basic needs of human beings. The study of more than 53 papers from 17 countries was studied in detail. Details from some of the countries were given in the flow diagram. In most cases, data were collected using a questionnaire and personal interviews. In some studies, advanced equipment like accelerometers and gyroscope were also used. To collect data mobile applications was used as before calibration and after calibration for better accuracy.

III. SUMMARY OF OBSERVATIONS AND PARTICIPANTS IN THE STUDY

As per the data available in the papers, no of participants are varying from one to 1022 and in some cases no of observations are also recorded by using some equipment. But in three cases construction companies have participated. Details of some of the major participation were given in the table no 1& Types of projects and various techniques used in the study was summarised in fig no 1.

Table No 1: Details related to no.of participants in the work

Referance no	No of obervations	No of particepants	Referance no	No of particepants
2	13821	Five construction sites	24	94
9		220	25	230
11	1541	120	26	108
14		492	27	39
15		100	28	571
16		206	29	120
17		94	38	69
18		100	42	1022
22		90	47	312
23		31	48	59

Table No 2: Details related to no. of Companies participated in the work

Reference no	No of companies participaing
12	21 company
31	12 construction companies
35	12 companies

Following flow diagram shows details related to type of projects and technique used for study .

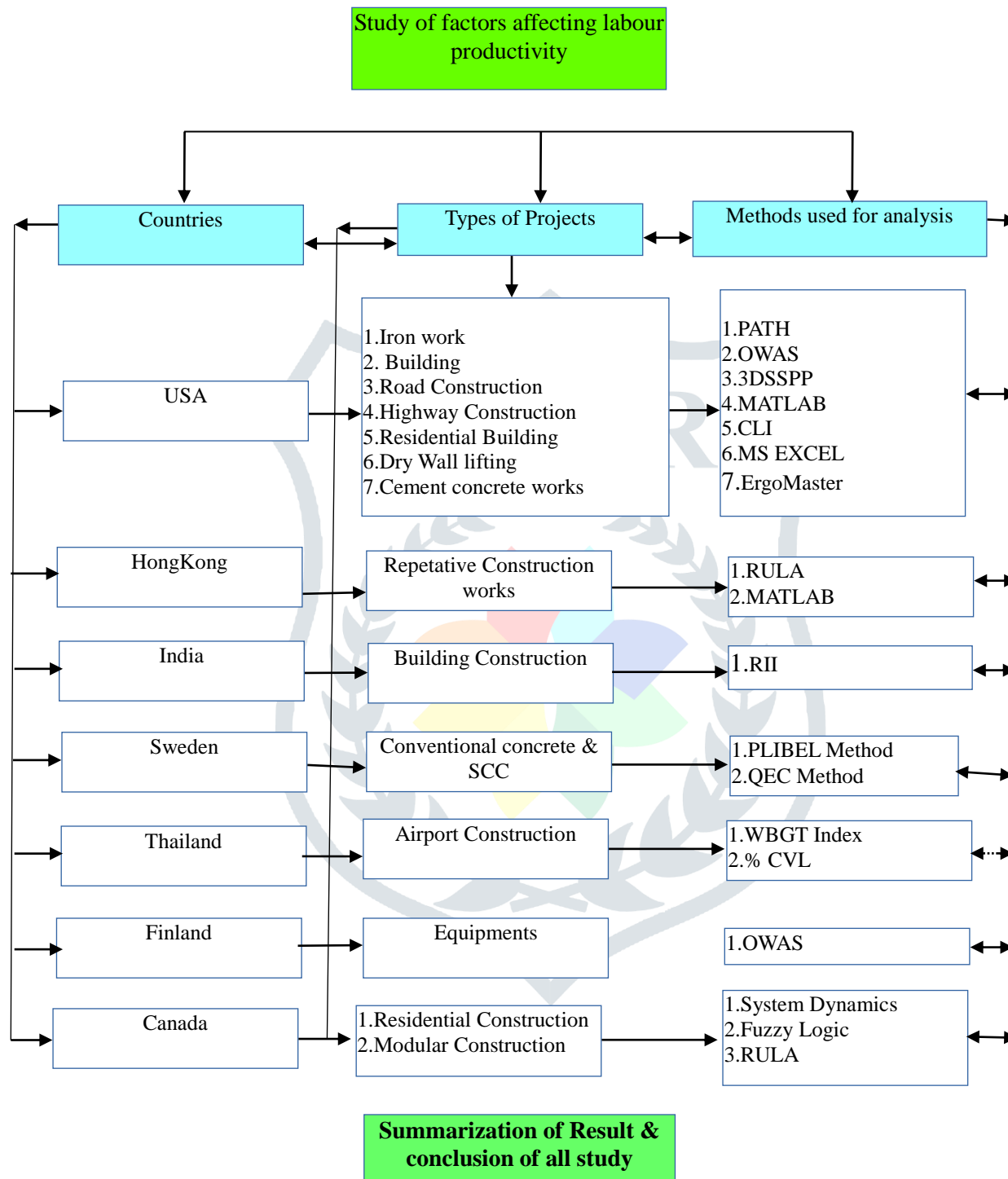


Fig No : Types of projects and various techniques used in study.

IV.RESEARCH WORK DONE IN VARIOUS COUNTRIES

Research Work done in the USA:

According to the data given in the table no 1, total 13821 observations were made by the researcher(Martin S Forde, Bryan Buchholz) studied seven specific ironwork tasks. He has used PATH method for analysis and found that For RIW(RW) and SIW(B), trunk flexion, twisting, and side bending was seen on 35% of the work sampling observations. Also, the load handled by the workers during MMH activities shall be than 50 lb (<223N), but ironworkers are handling loads exceeding 100 lb (>446N) frequently particularly for RIW(RW) and SIW(B) ironwork. Also, non-neutral trunk postures are approximately 17% higher for RIW and SIW compared to OIW and MMRIW.²

For construction and non-repetitive works study was carried out (Bryan Buchholz, Victor Paquet, Laura Punnett & Diane Lee and Susan Moir) using PATH (Posture, Activity, Tools, and Handling), and Ovako Work Posture Analysing System (OWAS), methods. He found that the laborers spent large proportions of time in nonneutral trunk postures, with exposures to different trunk postures varying among operations. The proportion of time that laborers spent in the nonneutral trunk postures during each operation also varied among workers and days. The laborers handled light loads (often tools) for much of the working day. Workers performed manual material handling activities between 10 and 41% of the time in each operation. Workers spend nearly while shoveling, workers spent over 70% of the time with their trunks bent and twisted in all the observed operations.⁵

work done on Physical ergonomic hazards in highway tunnel construction, (SangWoo Tak, Bryan Buchholz, Laura Punnett, Susan Moir, Victor Paquet, Scott Fulmer, Helen Marucci-Wellman, David Wegman) covering 120 construction workers and PATH method for 73 days found that, workers in highway and tunnel projects are having high exposure to multiple ergonomic hazards which are known to represent the risk of musculoskeletal disorders to the back, knees, and other joints. Trunk flexion ranged from 35% to 55% of work time, on average, by trade. Squatting and kneeling were uncommon overall but represented more than 10% of work time in certain operations. Construction workers also regularly handled materials or tools. Loads handled in construction vary tremendously in terms of object or tool type, size, and weight. Most of those that we observed weighed less than 15 pounds, but occasional very heavy loads were handled.¹¹

Occupational ergonomic health issues in highway construction were studied by (Sang D CHOI, Lisa HUDSON, Peter KANGAS, Brett JUNGEN, Jennifer Maple & chevon BOWEN) collecting data from 21 companies having a total of 10414 employees and found that hand and finger injury caused in manual handling of heavy materials frequently. This requires to conduct safety programs at construction site which shall create awareness to ergonomics.¹²

In another study (David P. Gilkey, Thomas J. Keefe, Philip L. Bigelow, Robin E. Herron Kirby Duvall, Jacob E. Hautaluoma, John S. Rosecrance & Richard Seseck) 44 major carpentry task was selected. Mean source was calculated and found that it was ranging between 1.051 to 3.082 when the beam was installed manually using hand. The standard deviation for the highest mean source was 1.36 shows that carpenters have a very high strain level for the given task.²⁴ Study was done on the workers related to lifting drywall to find biomechanical stresses (Christopher S. Pan, Sharon S. Chiou). For this video analysis was done. A computer simulation was carried out of 60, 80 & 100 lb. For simulation 3DSSPPTM program was used and found that only a limited percentage of the male population has sufficient strength capability to perform the task. The estimated L5/S1 and L4/L5 disc compression forces were consistently high, ranging from 655 to 1363 lb for various loads and postures analyzed.³⁰

Work carried out in Hongkong:

Study on Biomechanical analysis of risk factors was carried out (M.F. Antwi-Afari, H. Li, D.J. Edwards, E.A. Pärn, J. Seo, A.Y.L. Wong) to find work-related musculoskeletal disorders during a repetitive lifting task. surface electromyography (SEMG) was used to measure spinal biomechanics during repetitive work. They found that risk factors such as lifting weights, repetitions and lifting postures may alleviate the risk of developing WMSDs.⁸

Work carried out in India:

Study on Man-machine interaction at the construction sites was carried out by (RatriParida, Pradip Kumar Ray) using RII method. 30 factors were classified into three primary classifications. They found that construction work system shall be studied thoroughly because of the high irregular work period transient nature of construction occupations, changing work environment and variability. psychosocial and physical work-related factors are the most important factors associated with work ability. As construction work varies depending on site conditions.⁹

(Teena Babu, Annie Sonia Xavier) has carried out a study on labours working at building construction site and data was collected using questionnaire containing 28 factors. They found that Kneeling has Relative Importance Index is 0.709 and have rank I for Mason and for Helpers Relative Importance Index is 0.48 and have rank I for Lower back pain.²³

Work carried out in Sweden:

Peter Simonsson and Romuald Rwamamara has studied ergonomic exposure from the usage of conventional and SCC. They used PLIBEL & QEC checklist method and found that WMSD risk exposure in the casting of conventional concrete has high levels and causes risk exposure at the back and shoulders due to manual lifting, vibration etc. Also concluded that for an increase in productivity, quality and a reduction in waste, it is required to shift from conventional concrete to SCC.¹⁶

Work carried out in Thailand :

In this study thermal the environment was used to study ergonomics for 108 airport construction workers by (Pongjan Yoopat, Pornkamon Toicharoen, Thirayudh Glinsukon, Kamiel Vanwonderghem & Veikko Louhevaara) using WBGT Index and relative cardiovascular load (%CVL). They found that In Thailand, physiological strain during auxiliary type jobs is high and may result in negative consequences for health, safety, well-being, and productivity. Also, Physiological strain is due to both heavy dynamic muscular work and high heat stress.²⁶

Work carried out in Finland :

Study to lighten the workload of construction workers was carried out by (Anneli Kaukiainen, Jarmo Sillanpää, Jorma Lappalainen, Matti Viljanen & Mika Nyberg) using OWAS method. In this study, four pieces pieces of equipment for cutting moulding, cutting reinforcement rods, carrying carpet rolls, and fitting drain pipes can lighten the workload of construction work. They found that The cutter for reinforcement rods proved to be useful, bent back postures decreased by 11%. The carrying of carpet rolls became less loading on the lower and upper extremities. According to the men, the workload was lower in fitting drain pipes, especially on the lower extremities and in the neck and shoulder region.²⁷

Work carried out in Canada:

Alireza Golabchi, SangUk Han, and Aminah Robinson Fayek has used fuzzy logic to study the posture -based ergonomics for field observations & assessment of construction manual operations. They found that that the fuzzy logic approach to ergonomic analysis is capable of dealing robustly with human perception issues, particularly those occurring at close-to-border angles in ergonomic methods. Reliable assessment of ergonomic risk is essential in preventing WMSDs as ergonomic injuries are gradually developed over time.³⁹

Study related to the improvement of productivity was also carried out in the countries like Portugal, South Africa,

Germany, Nigeria, Lithuania, Iran, Malaysia, UK. All those studies indicate that effective implementation of ergonomics on the construction site definitely improves labour productivity. Most of the studies focus on WMSD only. Some researchers have a focus on occupational health and safety of the construction workers.

V. CONCLUSION

1. Statistical analysis gives pinpoint conclusion related to problems faced by the labours.
 1. In most of the research paper, type of construction site used for data collection was not mentioned correctly.
 2. RULA,RUBA,OWAS, RII etc are the most frequently used methods.
 3. In only one case Wearable insole pressure system was used to find Foot plantar pressure.
 4. Contractors shall focus on health and safety of the labours working on construction site.
 5. If required care has not been taken then the considerable risk to the health of the labours.
 6. The aim of this study is to provide summarize information about the the research work carried out related to factors affecting labour productivity in the construction industry.

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