Construction Labour Productivity and Its Improvement

Mr.C.Thiyagu - Student[1], Mr.M.Dheenadhayalan - Guide[2],Mr.S.Janagan – Class Advisor[3]

[1]*Student M.E., (CE&M), Gnanamani College of Engineering, Namakkal-637018, Tamilnadu, India*
[2] *Assistant Prof, Dept of Civil Engg, Gnanamani College of Engineering, Namakkal, Tamilnadu, India*
[3] *Assistant Prof, Dept of Civil Engg, Gnanamani College of Engineering, Namakkal, Tamilnadu, India*

ABSTRACT

The most challenging issue in Construction industry is to improving the production efficiency. Many research have been done in the past, however a deeper understanding is still needed to improve the labour productivity. The main outcome from the literature is that there is no standard definition of productivity. It covers the construction labour productivity definitions, aspects, factors affecting it. The productivity of labour is particularly important especially in developing countries, where most of the building construction work is still on manual basis.

The aim of this study is to get the latest information and to identify the key factors that affect the labour productivity in and around particular location. So survey is carried out through questionnaire and distribute to respondents who work at various projects in wide area and the questionnaires are rated by project managers, experienced engineers and also with labours using their past experiences. And the data's are collected and analysed; using this the affected factors are identified and ranked, through this necessary steps are provided to improve the labour productivity.

CHAPTER 1
INTRODUCTION

1.1 GENERAL

Construction industry faces lots of challenges with regard to problems associated with productivity. Productivity is one of the most important factors affecting the overall performance of any organization, whether large or small and the problems are usually associated with performance of labour. The performance of labour is affected by many factors and is usually linked to the performance of time, cost, and quality.

Inefficient management of construction resources can result in low productivity. Therefore, it is important for construction managers to be familiar with the methods leading to evaluate the productivity of the equipments and the labourers in different crafts. To achieve the income expected from any construction project in general, it is important to have a good controlling hand on the productivity factors that contribute in the integrated production composition, like labour, equipment, cash flow, etc... While there are several input resources in a transformation process, labour productivity plays a particular role. A deeper comprehension of the factors influencing labour productivity can enable managers to more effectively allocate limited resources, provide workers with better support, or increase workers' motivation.

1.2 OBJECTIVE

The objective of this study focuses on views from the construction industry about various factors affecting labour productivity, Analyzes factors affecting the labour productivity, impact and suggests appropriate measures that can be taken to improve labour productivity. The aim is supported by the objective stated below.

- Study and discuss various factors affecting labour productivity in construction industry
- Analyze and calculate the Relative Important of those factors affecting labour productivity
- To statistically analyze the factors affecting labour productivity
- To make recommendations to improve labour productivity in construction

1.3 BACK GROUND OF LABOUR PRODUCTIVITY

Productivity can be defined in many ways. In construction, productivity is usually taken to mean labour productivity, that is, units of work placed or produced per man-hour. The inverse of labour productivity, man- hours per unit (unit rate), is also commonly used.

Productivity is the ratio of output to all or some of the resources used to produce that output. Output can be homogenous or heterogeneous. Resources comprise: labour, capital, energy, raw materials, etc.

Productivity may then be defined as the ratio of earned to actual hours. The problem with this concept is in establishing reliable, for setting standards. It also depends on the method used to measure productivity, and on the extent to which account is taken of all the factors which affect it. At a project site, contractors are often interested in labour productivity. It can be defined in one of the following

ways.

Labour Productivity = (Output / Labour Cost)

Productivity measures can broadly be placed into two categories. Single factor, or partial, productivity measures relate a particular measure of output to a single measure of input, such as labour or capital. Multi-factor or total productivity measures (MFP) relate a particular measure of output to a group of inputs, or total inputs used. Productivity measures can also be distinguished by whether they rely on a particular measure of gross output or on a value-added concept that attempts to capture the movement of output. Of the most frequently used MFP measures, capital-labour MFP relies on a value-added concept of output while capital labour-energy- materials MFP relies on a particular measure of gross output.

The five most widely used productivity concepts are

Labour productivity, based on gross output: This productivity measurement traces the labour requirement per unit of output. It reflects the change in the input coefficient of labour by industry and is useful for the analysis of specific industry labour requirements. Its main advantage as a productivity measure is its ease of measurement and readability; particularly, the gross output measure requires only price indices on gross output. However, since labour productivity is a partial productivity measure, output typically reflects the joint influence of many different factors.

Labour productivity, based on value-added: Value-added based labour productivity is useful for the analysis of micro-macro links, such as an individual industry's contribution to economy-wide labour productivity and economic growth. From a policy perspective, it is important as a reference statistic in wage bargaining. Its main advantage as a productivity measure is its ease of measurement and readability, though it does require price indices on intermediate inputs, as well as to gross output data. In addition to its limitations as a partial productivity measure, value-added labour productivity have several theoretical and practical drawbacks including the potential for double counting production of benefits and double deflation.

Capital-labour MFP, based on value-added: This productivity measurement is useful for the analysis of micro-macro links, such as the industry contribution to economy-wide MFP growth and living standards, as well as, for analysis of structural change. Its main advantage as a productivity measure is the ease of aggregation across industries. The data for this measurement is also directly available from national accounts. The main drawback to the value-added based capital-labour MFP is that it is not a good measure of technology shifts at the industry or firm level. It also suffers the disadvantage of other value-added measures that have been double deflated with a fixed weight Laspeyres quantity index.

Capital productivity, based on value-added: Changes in capital productivity denote the degree to which output growth can be achieved with lower welfare costs in the form of foregone consumption. Its main advantage as a productivity measure is its ease of readability but capital productivity suffers the same limitations as other partial productivity measurements.

Multi-factor productivity: It is used in the analysis of industry-level and sectoral technical change. It is the most appropriate tool to measure technical change by industry because it fully acknowledges the role of intermediate inputs in production. Domar' s aggregation of MFP across industries renders an accurate assessment of the contributions of industries to aggregate MFP change. The major drawback to MFP is its significant data requirements, in particular timely availability of input-output tables that are consistent with national accounts. It is also more difficult to communicate inter industry links and aggregation across industries using MFP than in the case of value-added based MFP measures.

1.3.1 Productivity and Labour

On any construction site the contractor's financial gain is dependent, amongst other things, on completion of the work in good time and at the least cost, and the productivity of labour has a direct bearing on this being achieved.

The factors affecting the performance of labour generally fall into three categories.

i. The human capacity for work
ii. The competence of site management
iii. The motivation of the workers

1.3.2 The Human Factor

Table 1.1 Factors affecting the human capacity for work

Factor	Explanation	Suggestions for improving the capacity
Age	Peak capacity for physical work is generally reached between the age of 20-35	In older persons, especially in skilled jobs, experience and efficiency compensate for lower work capacity.
Nutrition	Capacity is related to calorie protein content of food	Establish project canteens to provide balanced meals. Arrange talks on nutrition.
Temperaturehumidity	Affect the rate at which heat can be dissipated from the human body by radiation, convention and evaporation of sweat, heat and humidity increase dangers of heat stroke and reduce work capacity	Start work at first light and avoid working during the heat of the day.
Health	Resistance to disease is affected by diet. Good hygiene and sanitation is essential to avoid occurrence of debilitating intestinal parasites.	Enforce strict site hygiene. Arrange talks on hygiene and sanitation.
Acclimatization,adaptation, Learning.	New workers, or workers given new tasks, need time for their bodies and muscles to adapt to the work.	Unpracticed workers would initially have a lower productivity which would improve as they become acclimatized to the work, and are instructed in the best methods of working.

1.3.3 Competence of Site Management

The various measures that may be taken to improve the physical work capacity or to motivate the workers will not be effective if site management is substandard. It is essential for the workers to have confidence in their supervisors. If the workers observe that site management is poor, unfair or corrupt, their morale, motivation and consequent productivity will be reduced. Examples of management shortcomings which reduce efficiency and productivity in this way include

- Delayed, unclear or inadequate instructions
- Delays in delivery of materials, tools or equipment
- Provision of poor tools and equipment
- Unbalanced work gangs
- Use of wrong methods
- Bad advance planning or allocation of work tasks

1.3.4 Motivation of Workers

Workers are motivated in their work by a variety of methods, all of which may be present in varying degrees. They include

- Fear
- Discipline
- Job Satisfaction
- Financial Incentives

Fear: This includes fear of the supervisor and fear of loosing a job and being out of work and destitute, especially in a country where no form of social security exists. This is a negative and unsatisfactory form of incentive.

Discipline: This is exemplified by punctuality, lack of absenteeism, good standards of workmanship and the observance of site cleanliness and hygiene. When discipline is lacking, site morale is generally low and productivity is unsatisfactory.

Ways of achieving site discipline include:

- Site rules drawn up and explained to all workers by either supervisors
- Supervisors; by personal example, setting a high standard in self-discipline
- Workers encouraged to feel that they are working with, rather than under, the supervisor (but at the same time the supervisor should leave no doubt in their minds that he is the leader)
- Retribution should be a matter of inevitability rather than severity. No breach of discipline should go unchecked

- Developing self-discipline through pride in achievement. Good work should always be praised
- Taking a personal interest in the worker, discussing problems fairly, never showing favoritism
- Disciplinary action should be taken as soon after an infringement as possible

Job Satisfaction: Apart from work providing the means of satisfying the workers basic needs as to food, clothing and shelter, job satisfaction is obtained when the higher psychological needs of the worker, e.g. self-respect and personal dignity, are met. Individuals have a need to belong and for their usefulness to be apparent. Job satisfaction is obtained through a sense of achievement as to quality, output or other contributions, particularly if that achievement as to quality, output or other contributions, particularly if that achievement is recognized and acknowledged. Pride in craft and skill and a sense of responsibility are to be encouraged, and rewarded with opportunities for advancement and promotion. Negative aspects which detract from job satisfaction and morale, and which consequently affect productivity, are to be avoided. These are generally aspects which imply that the worker is held in low esteem by management and include:

- Poor working conditions and terms of employment
- Poor or subservient relations with supervisors

Financial Incentives: Incentive schemes of this nature are widely used in industrialized countries, but are often a source of contention and dispute between management and workforce. The schemes enable workers to earn bonuses over and above the normal rate of pay for achieving a rate of output at or above a predetermined standard. It is not always easy to work out what this standard performance should be, so that the output targets set by management of which the bonus earnings depend are often inaccurate.

1.4 VARIOUS FACTORS AFFECTING LABOUR PRODUCTIVITY

Identification and evaluation of factors affecting labour construction productivity have become a critical issue facing project managers for a long time in order to increase productivity in construction. Understanding critical factors affecting productivity of both positive and negative can be used to prepare a strategy to reduce inefficiencies and to improve the effectiveness of project performance.

Knowledge and understanding of the various factors affecting construction labour productivity is needed to determine the focus of the necessary steps in an effort to reduce project cost overrun and project completion delay, thereby increasing productivity and overall project performance.

Based on the study, Factors affecting construction labour productivity have been identified and are grouped into 15 categories according to their characteristics, namely

- Design factors
- Execution plan factors
- Material factors
- Equipment factors
- Labour factors
- Health and safety factors
- Supervision factors
- Working time factors
- Project factors
- Quality factors
- Financial factors
- Leadership and coordination factors
- Organization factors
- Owner/consultant factors
- External factors

1.4.1 The top ten factors that affect the small and medium company

- Lack of material
- Labour strikes
- Delay in arrival of materials
- Financial difficulties of the owner
- Unclear instruction to labourer and high absentees of labours
- Bad weather (e.g. rain, heat, etc.)
- Non discipline labour and use of alcohol and drugs
- No supervision method, design changes, repairs and repetition of work, and bad resources management
- Bad supervisors absenteeism and far away from location of material storage
- Bad leadership

1.4.2 The top ten factors that affect large companies

- Unclear instruction to labourer
- Delay in arrival of materials

- Lack of material and financial difficulties of the owner
- There is no definite schedule
- Low supervisor's capability/incompetence supervisors
- No supervision method, lack of equipment, and high absenteeism of labours Supervisors absenteeism, frequent damage of equipments, and labour strikes
- Design changes
- Incomplete drawing and inspection delay
- Poor communication in site and inaccurate design.

1.4.3 Factors that affect in general all

- Lack of material
- Delay in arrival of materials
- Unclear instruction to labourer
- Labour strikes
- Financial difficulties of the owner
- High absenteeism of labours
- No supervision method
- Supervisors absenteeism
- Lack of equipment and design changes
- There is no definite schedule
- Poor management
- Unproductive time (internal delay, extra break, waiting & relaxation)
- Lack of skill, Supervision delay
- Lack of tools & equipment
- Poor instructions
- Poor quality of labour
- Supervision factor
- Material factor
- Execution plan factor
- Health & safety factors
- Labour shortages
- Working time factor
- Accidents
- Organization factors
- Improper training
- Bad weather

1.5 MISUNDERSTANDINGS ABOUT LABOUR PRODUCTIVITY

A study from (Adrian 1990) states the following general misconceptions about labour productivity

- Key factor for low productivity in construction industry is labour
- Because the construction industry is controlled by the weather, productivity cannot be improved
- The construction industry always has an unfavourable relationship

1.6 FACTS ABOUT LABOUR PRODUCTIVITY

Following are a few facts about the construction productivity studied by Adrian (1990)

- Tuesday is studied as most productive day of the week 10 a.m. is studied as most productive time of the day
- The least productive time frame for labour is right before the finishing time
- A labourer is capable of lifting approximately 94 pounds on his own
- If the labourer is engaged in performing the same task repeatedly, there is a chance of low productivity after 60-70 minutes of performing the same work
- Friday has been proven to be the least productive day of the week

CHAPTER 2
METHODOLOGY

2.1 GENERAL

Survey research is defined as collection of different data by asking people questions. The data collection process used in this research had the option of two basic methods: questionnaires and personal interviews. A questionnaire was preferred as the best effective and suitable data-collection technique for the study. It was concluded that the questionnaire was described as a self-administered tool with web-design questions, an appropriate response. A questionnaire in a web-survey format comparatively requires less duration and saves cost for the researcher while permits respondents to response the questionnaire at their personal ease. However, for this approach the reply rate is usually lower as compared to face-to-face interviews. Data was collected from literature reviews from books, journals, articles, seminar conferences, and websites which emphasize building construction's labour productivity.

2.2 SURVEY PLANNING

For the research study, email technology was used to send the survey questionnaire. Collecting general information on various factors affecting labor

productivity in building construction all over Madurai was the basic aim of the survey. The purpose and approach used in the survey was fully explained to the respondents. Guidelines were provided to the respondents to ensure that the procedure was followed properly to reduce errors. During the survey period, some oversights were provided to help ensure the process was going smoothly and consistently. The data were stored in order to maintain confidentiality, and the output was received from the Group Discussion Center (GDC) in the form of electronic mail, which included raw data sheets, summary sheets, and computer databases. Results included the overall statistics as well as individual statistics.

2.3 DESIGN OF QUESTIONNAIRE

The questionnaire design practice advanced on a communicating basis. It was categorized into profile of the respondent and various factors affecting labour productivity in building construction. Questions in the respondent profile were created to collect information such as job position, experience of the work, locations of the current and/or previous works and contact information. It was studied, these questions in the survey were of great important to the research by analyzing productivity loss concerns from a variety of different profiles from different regions. It was practical to anticipate that a location can have an impact on the loss of productivity due to various field disturbances, especially geographical and climatic conditions.

The set of questions, was targeting the factors affecting labour productivity in the different groups. It included factors affecting labor productivity. Respondents simply furnished of factors affecting productivity for given typical condition. Hence, each respondent had a choice to select only one option for each factor. The responses were to be based on the understanding, knowledge and experience of the respondents and not related to any definite project. This simple and straight method was selected to establish a means of developing a list of factors affecting labor productivity in building construction.

2.4 PILOT SURVEY AND QUESTIONNAIRE REVISION

To improve the questionnaire section, a pilot study was accompanied. This section contained identification of different causes, collection, and conclusions of data. The application of this section benefited in better formation of the web-survey development , were sent by e-mail to laborers, contractors, architectures, owners, project managers, and project engineers of various building construction organizations. It was expected to complete and submit the response within 2 weeks. By the end of 2nd week, 25 responses collected from the pilot survey, 5 of those were incomplete and were removed from the set, leaving a total of 20 respondents in the database. Information obtained and the recommendations provided in from pilot survey are discussed below.

- Questionnaire should always start with the general information of the organization
- Some factors are not related to construction. They should be removed or modified.
- To get more suitable and consistence meaning some factors should be rearranged.
- Some factors should be revised with additional information.
- Factors repeated with similar meaning should be removed.
- Some factors should be changed to give clearer importance and understanding.

Better and accurate questionnaire related to the topic was achieved from the pilot study. The perfections related to the organization of the questionnaire and the response time. In terms of organization, the web survey was created using a light appearance and pleasant-looking font colors. It also included a percentage bar for the completed survey and had an option to navigate to any question at any given time. All the information entered via the web had an auto-save option and the respondents had the luxury to return to the survey within the allotted duration Respondents were informed about the confidentiality of the responses. The list of questions used for the web survey can be found .

2.5 METHODOLOGY FLOW CHAT

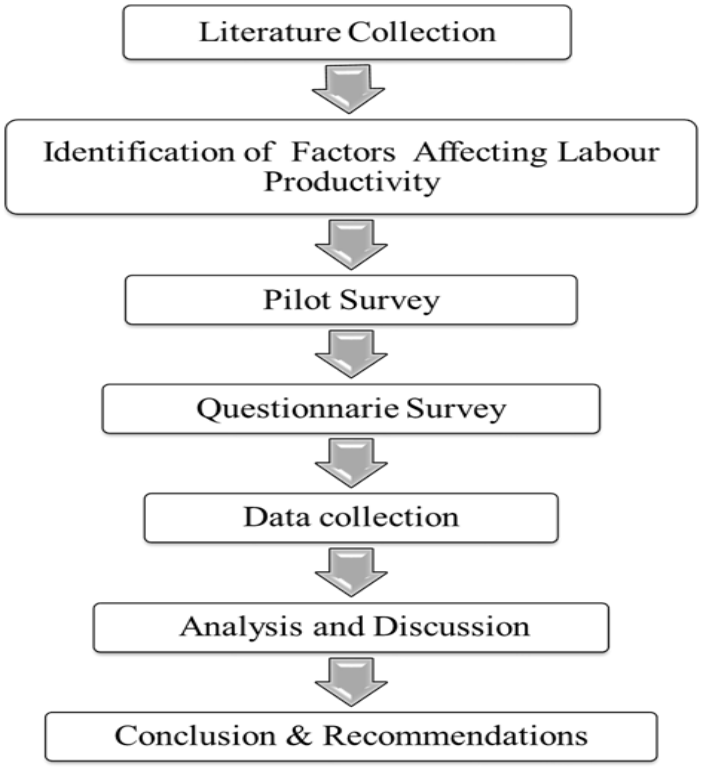

Fig 2.1 Flow Chart for Methodology

CHAPTER 3
RESULTS AND DISCUSSION

3.1 SPSS (Statistical Package for the Social Sciences)

Statistics is a software package used for statistical analysis. Long produced by SPSS Inc., it was acquired by IBM in 2009. SPSS is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. In addition to statistical analysis, data management (case selection, file reshaping, creating derived data) and data documentation (a metadata dictionary was stored in the data file) are features of the base software. In Civil Engineering field Statistical package for the social science (SPSS) software is mainly used for analyzing the questionnaires.

Statistics included in the base software:

- Descriptive statistics: Cross tabulation, Frequencies, Descriptives, Explore, Descriptive Ratio Statistics
- Means, t-test, ANOVA, Correlation (bivariate, partial, distances), Nonparametric tests
- Prediction for numerical outcomes: Linear regression
- Prediction for identifying groups: Factor analysis, cluster analysis (two-step, K-means, hierarchical), Discriminant

SPSS Statistics places constraints on internal file structure, data types, data processing, and matching files, which together considerably simplify programming. SPSS datasets have a two-dimensional table structure, where the rows typically represent cases (such as individuals or households) and the columns represent measurements (such as age, sex, or household income). Only two data types are defined: numeric and text (or "string"). All data processing occurs sequentially case-by-case through the file. Files can be matched one-to-one and one-to-many, but not many-to-many.

Larger datasets such as statistical surveys are more often created in data entry software, or entered during computer-assisted personal interviewing, by scanning and using optical character recognition and optical mark recognition software, or by direct capture from online questionnaires. These datasets are then read into SPSS.

3.2 RELATIVE IMPORTANT INDEX (RII)

The questionnaires are collected and analysed using statistical software package SPSS v 21. The ranking of factors was calculated based on Relative Importance Index

$$RII(\%) = \Sigma a * \frac{n}{N} * \frac{100}{5}$$

Where :
RII = Relative Important Index
a = constant expression weight
n = frequency of response
N = total number of response

3.3 DATA COLLECTED FROM THE SURVEY

In successfully achieving main objective of the study, one of the most important phase is collection of accurate data. Data collection is a procedure of collecting crucial data records for a certain sample or population of observations (Bohrnstedt and Knoke, 1994). A total of 125 questionnaires were sent to construction professional through e-mail in early November 2014. By the due date, a total of 77 questionnaires were received, resulting in a nearly 66.4% reply rate (Table 4.1). Missing data frequently occur after the respondent chooses not to response a question or when the respondent rejects to answer the question. (Kim, 1993).

The most serious concern presented in the responses was some missing data. Some of the unclear response was clarified over the phone. A total of 6 (i.e., 4.8%) invalid data received were deleted from research study. The reason to discard the data was incompleteness and invalid responses.

Table 3.1 Statistical Data of Questionnaires Sent and Received

Description	No.	Percentage of Total (%)
Total Questionnaires Sent	125	100
Total Questionnaires Received	83	66.4
Invalid Data	6	4.8
Used for Study	77	61.6

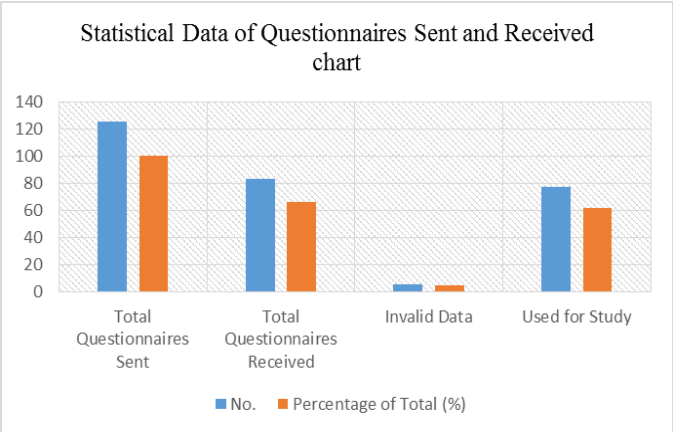

Fig 3.1 Statistical Data of Questionnaires Sent and Received

3.4 SIZE OF ORGANIZATION (Employees)

The average number of employees in an organization was 36. Only building construction projects were considered for the study.

3.5 NUMBER OF PROJECTS PER YEAR

The average number of construction projects undertaken per year was 3-5. Only building construction projects were considered for the study.

3.6 TYPE OF CONSTRUCTION PROJECTS

The type of construction organizations that responded is shown in Table- 4.2 Only building construction project were considered.

Table 3.2 Types of Organizations that Responded

Construction Organizations	Respondents
Residential	36
Commercial	7
Industrial	17
Government	7

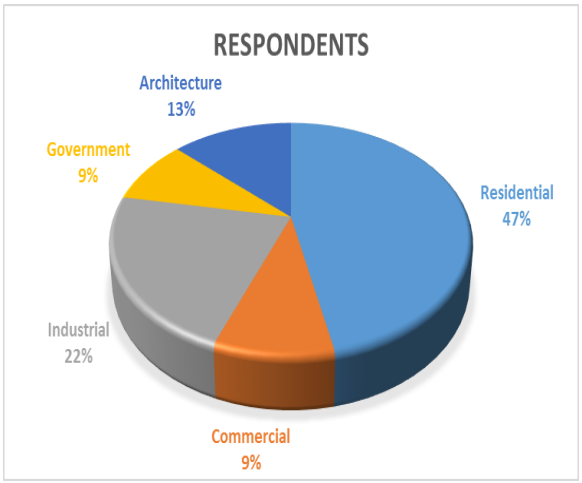

Fig: 3.2 Types of Organizations that Responded

3.7 TYPICAL SIZE OF PROJECTS

The size of the projects in Indian rupees undertaken by the respondents' companies is shown in Table 4.3. Only building construction projects were considered for the study. Table 4.5. Typical Size of Projects,Research was performed considering, factors affecting labour productivity for building construction were identified, and their RII was calculated.

These factors were classified into five groups: manpower factors, external factors, communication factors, resources factors, and miscellaneous factors. Different groups used in the study are discussed in detail.

Table : 3.3 Typical Size of Projects

Typical Size of Project	No. of Projects
0-5 lakhs	-
5-10 lakhs	-
10-100 lakhs	43
<100 lakhs	34

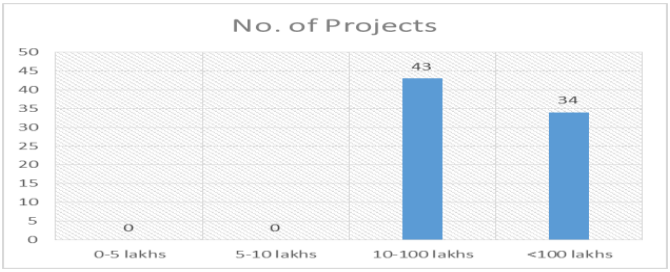

Fig: 3.3 Typical Size of Projects

3.8 RANKING OF FACTORS

Hierarchal assessment of factors was carried out to determine ranking of the factors based on level of significance. It was assessed based on Relative important index (RII) value and calculated for each group of respondent's i.e. contractor, consultant and owners and also the overall respondents as presented. It shows that top 10 most significant factors of overall respondents .

Table:3.4 Ranking of Factors

Item Statistics					
S. No	**Factors**	**Mean**	**SD**	**N**	**Rank**
1	Age	2.78	1.059	77	72
2	Lack of experience	3.71	1.011	77	20
3	Misunderstanding among labourers	3.82	0.956	77	8
4	Lack of competition between the labourers	2.99	1057	77	66
5	Disloyalty	2.99	0.752	77	66
6	Personal problems	3.13	0.656	77	56
7	alcoholism	4.17	0.979	77	3
8	Absenteeism	3.62	0.974	77	31
9	Poor access with in construction job site	3.66	1.034	77	26
10	Supervision delays	3.74	1.018	77	14
11	Lack of supervision delays	3.68	1.006	77	23
12	Re work due to improper guide	3.66	1.021	77	26
13	Inspection delays from the authorities	3.53	1.083	77	39
14	Unfavourable weather conditions	3	0.363	77	60
15	Inappropriate government laws	3.58	1.056	77	35
16	Accident due to construction	3.75	1.002	77	12
17	Change order from the designer	3.83	0.965	77	7
18	Change order from the owners	3.68	0.993	77	23
19	Disputes with owners	3	0.363	77	60
20	Disputes with designer	3.7	1.014	77	22
21	Poor communication and coordination between owner and contractor	3.64	1.087	77	29
22	Suspension of work by owner	3.73	0.955	77	16
23	Lack of consultant experience in construction projects	3.75	0.975	77	12
24	Delay in performing inspection and testing	3.68	1.106	77	23
25	Implementation of government laws	3.82	1.01	77	8
26	Lack of required construction materials	3.74	1.018	77	14
27	Increase in the price of materials	3.51	1.154	77	40
28	Material storage location	3.66	1.165	77	26
29	Late delivery of materials	3.71	1.011	77	20
30	Poor procurement of construction materials	3.58	1.116	77	35
31	Poor quality of construction materials	3.82	1.085	77	8
32	Shortage of construction materials	4.08	0.757	77	5
33	Variations in the drawings	3.22	1.273	77	54
34	Complex design in the provided drawings	2.81	0.918	77	71

35	In complete drawings	2.86	1.315	77	70
36	Design change	3.42	1.151	77	45
37	Mistakes in producing design documents	3.73	1.008	77	16
38	Un clear and inadequate details in drawings	3.73	1.008	77	16
39	Shortage of water and power supply	3	0.363	77	60
40	Working over time	4.16	1.027	77	4
41	Rework due to errors	3.61	1.09	77	33
42	Project objective is not well defined	3.35	1.222	77	48
43	Lack of required tools and equipment's	2.95	0.56	77	68
44	Equipment allocation problem	3.29	1.145	77	50
45	Frequent equipment break down problem	3	0.363	77	60
46	Improper equipment	3.82	1.01	77	8
47	Inadequate Morden equipment	3.03	1.308	77	59
48	Low efficiency of equipment	3.78	1.034	77	11
49	Shortage of equipment	3.43	1.152	77	42
50	Shortage of equipment operators	3.45	1.107	77	41
51	Payment delays	3.99	1.164	77	6
52	Mode of financing and payment for completed work	3.43	1.175	77	42
53	Lack of financial motivational system	3.26	1.185	77	52
54	Quality of rework	3.26	1.197	77	52
55	Differing site conditions from plan	3.57	1.186	77	38
56	Poor site condition	3.39	1.359	77	47
57	Inadequate construction method	3.3	1.396	77	49
58	Slowness in decision making	3	1.136	77	60
59	Selecting inappropriate contractors	3.62	1.039	77	31
60	Long period between design and time of bidding tendering	3.42	1.341	77	45
61	Proper communication	2.94	1.207	77	69
62	Inadequate transportation facilities for workers	3.05	0.944	77	58
63	Misunderstanding between the owner the contractor and the supervisor	3.29	1.202	77	50
64	Misunderstanding between labours and the supervisor	3.14	1.254	77	55
65	Violations of safety laws	3.43	1.152	77	42
66	Safety meeting	3.61	1.183	77	33
67	Availability of safety materials	3.58	1.239	77	35
68	Labour injuries on site	4.26	0.768	77	2
69	Labour in tin shed and plastic sheet shed	3.73	1.108	77	16
70	Self-constructed temporary sheds	4.08	0.757	77	5
71	Sanitation and hygiene of the construction site and temporary shed	4.34	0.754	77	1
72	Drinking water facility	3.64	1.05	77	29

3.9 RANKING OF TOP TEN FACTORS

Table:3.5 Ranking of top ten factors

S.No	FACTORS	Mean	Rank
1	Sanitation and hygiene of the construction site and the temporary shed	4.34	1
2	Labour injuries on site	4.26	2
3	Alcoholism	4.17	3
4	Working overtime	4.16	4
5	Shortage of construction materials	4.08	5
6	Payment delays	3.99	6
7	Change orders from the designers	3.83	7
8	Improper Equipment	3.82	8

9	Poor Quality of construction materials	3.82	8
10	Misunderstanding among labours	3.82	8

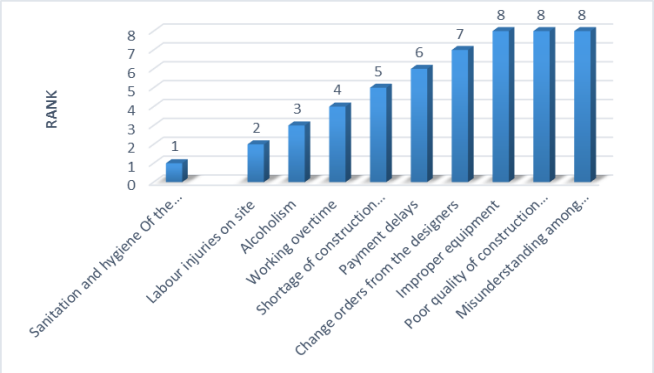

Fig : 3.4 Ranking of Top Ten Factors

3.10 FREQUENCY TABLE

Table 3.6 Sanitation and hygiene of the construction site and the temporary –shed

Desc.		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	1.3	1.3	1.3
	Neither agree not disagree	10	13	13	14.3
	Agree	28	36.4	36.4	50.6
	Strongly agree	38	49.4	49.4	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 1.3 % are average critical factors affecting the performance of construction project are due to "Sanitation and hygiene Of the construction site and the temporary shed", 36.4 % of the respondent says agree ,49.4% of the respondent says strongly agree .

Table: 3.7 Labour injuries on site					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither agree nor disagree	15	19.5	19.5	19.5
	Agree	27	35.1	35.1	54.5
	Strongly agree	35	45.5	45.5	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 19.5 % are average critical factors affecting the performance of construction project are due to "Labour injuries on site", 35.1 % of the respondent says agree ,45.5% of the respondent says strongly agree .

Table: 3.8 Alcoholism and similar problems among workforce					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	6	7.8	7.8	7.8
	Neither agree nor disagree	13	16.9	16.9	24.7
	Agree	20	26	26	50.6
	Strongly agree	38	49.4	49.4	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 7.8 % are average critical factors affecting the performance of construction project are due to "Alcoholism and similar problems among workforce", 26 % of the respondent says agree ,49.4% of the respondent says strongly agree

Table: 3.9 Working overtime				
	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Strongly disagree	1	1.3	1.3	1.3
	Disagree	6	7.8	7.8	9.1
	Neither agree nor disagree	11	14.3	14.3	23.4
	Agree	21	27.3	27.3	50.6
	Strongly agree	38	49.4	49.4	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 1.3 % are average critical factors affecting the performance of construction project are due to "Working overtime", 27.3 % of the respondent says agree ,49.4% of the respondent says strongly agree .

Table: 3.10 Shortage of construction materials

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.6	2.6	2.6
	Neither agree nor disagree	13	16.9	16.9	19.5
	Agree	39	50.6	50.6	70.1
	Strongly agree	23	29.9	29.9	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 2.6 % are average critical factors affecting the performance of construction project are due to "Shortage of construction materials", 50.6 % of the respondent says agree ,29.9% of the respondent says strongly agree.

Table:3.11 Payment delays

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	2.6	2.6	2.6
	Disagree	7	9.1	9.1	11.7
	Neither agree nor disagree	19	24.7	24.7	36.4
	Agree	11	14.3	14.3	50.6
	Strongly agree	38	49.4	49.4	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 2.6 % are average critical factors affecting the performance of construction project are due to "Payment delays",14.3 % of the respondent says agree ,49.4 % of the respondent says strongly agree.

Table: 3.12 Change orders from the designers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	7	9.1	9.1	9.1
	Neither agree nor disagree	22	28.6	28.6	37.7
	Agree	25	32.5	32.5	70.1
	Strongly agree	23	29.9	29.9	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 9.1 % are average critical factors affecting the performance of construction

project are due to "Change orders from the designers", 32.5 % of the respondent says agree ,29.9 % of the respondent says strongly agree.

Table:3.13 Improper equipment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	1.3	1.3	1.3
	Disagree	7	9.1	9.1	10.4
	Neither agree nor disagree	19	24.7	24.7	35.1
	Agree	29	37.7	37.7	72.7
	Strongly agree	20	26	26	98.7
	6	1	1.3	1.3	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 1.3 % are average critical factors affecting the performance of construction project are due to "Improper equipment", 37.7 % of the respondent says agree, 26.0 % of the respondent says strongly agree.

Table: 3.14 Poor quality of construction materials

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	2.6	2.6	2.6
	Disagree	8	10.4	10.4	13
	Neither agree nor disagree	17	22.1	22.1	35.1
	Agree	25	32.5	32.5	67.5
	Strongly agree	25	32.5	32.5	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 2.6 % are average critical factors affecting the performance of construction project are due to "Implementation of government laws", 32.5 % of the respondent says agree ,32.5 % of the respondent says strongly agree.

Table: 3.15 Misunderstanding among labourers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	7	9.1	9.1	9.1
	Neither agree nor disagree	22	28.6	28.6	37.7
	Agree	26	33.8	33.8	71.4
	Strongly agree	22	28.6	28.6	100
	Total	77	100	100	

INFERENCE

The inference made from response of construction employees and owners 9.1 % are average critical factors affecting the performance of construction project are due to "Implementation of government laws", 33.8 % of the respondent says agree ,28.6 % of the respondent says strongly agree.

CHAPTER 4
CONCLUSIONS

4.1 CONCLUSIONS

The theoretical model of this study proposed fifteen independent groups affecting the variation of Labour Productivity in the construction projects namely Labour factors , Supervision factors , External factors , Owner/consultant factors , Execution plan factors , Designer , Working time factors , Equipment factors , Financial factors , Quality factors , Project factors , Organization factors , Leadership and coordination factors , Health and safety factors. This research is intended to identify the causes of probable factors

affecting labour productivity in building construction. This study investigates all possible factors through a structured questionnaire administered all over Madurai. The survey results are subjected to analysis, and the ranking of factors is calculated using the Relative Important Index. The basic ideas of the research is to study various factors affecting labor productivity on construction.

The target groups in this study were construction professionals. Total of 125 questionnaires were distributed, and 83 questionnaires (66.4 % response rate) were returned. Because project engineers, project managers have vast experience in construction, their adequate experiences were a proper suggestion to study about the various construction factors affecting labor productivity.

From the result and analysis the top most factors affected the labour productivity are given Sanitation and hygiene Of the construction site and the temporary shed; Labour injuries on site; Alcoholism; Working overtime; Shortage of construction materials; Payment delays; Change orders from the designers; Improper equipment; Poor quality of construction materials; Misunderstanding among laborers. So we have to recommend some ideas to develop the labour productivity from this research.

4.2 RECOMMANDATION

Firstly, the Motivation factor has the highest impact on Labour Productivity variation. The low labour satisfaction could have negative impact on labour productivity. So, the construction company should increase labour satisfaction by paying a reasonable salary, developing financial reward or recognition program and improving the living condition on site.

This study focused on constraints to construction on-site productivity; however, there are several aspects to construction productivity. Future studies should explore other influencing factors affecting construction productivity at all stages of the procurement process such as Properly training to the labourers; Advance site layout; Systematic flow of work; On time payment to the workers; Motivation to workers towards project completion; Pre plan to avoid work stop; Properly , clearly & in time supervision; Maintain work discipline; Facilities to the labourers; Advance equipment and material planning; Maximum use of machinery and automation system; Properly and in advance material procurement and management; Clearance of legal documents before starting of work; Systematic planning of funds in advance.

4.2.1 Use of scheduling techniques

It is necessary to use project scheduling techniques such as computer-aided construction project management in each project to optimize the times of related activities and make sure that works allow continuous task performance so as to reduce the idleness of the labor force to a minimum.

4.2.2 Use of motivation system

It is important for each contracting companies to adopt motivational or personnel management measures to boost workers' morale. For example, tie compensation to performance; ensure that pay, fringe benefits, safety, and working conditions are all at least adequate; and enlarge the jobs to include challenge, variety, wholeness, and self-regulation.

4.2.3 Productivity study

Contracting companies have to conduct productivity study at the activity/operation level such as studying factors affecting labor productivity and labor productivity measurement in order to find out problem areas and propose ways to improve labor productivity. Also contracting companies are encouraged to keep historical data of productivity study in finished projects to improve the effectiveness and accuracy of cost estimation of future projects.

4.2.4 Project procurement system

There is a need to change the traditional system of project procurement to design build system. This new procurement system will enable contractors to participate in design process which minimize change orders during project execution.

4.2.5 Improving contract condition

It is necessary to improve the contract condition towards adopting more use of management practices. Contract should include statements about time planning and productivity management to be implemented in a regular base through projects life cycle.

4.2.6 Training in productivity improvement programs

It is necessary to conduct training courses and seminars in the topics that will improve productivity in construction projects. The training effort should be tailored to improve the abilities to use the project scheduling techniques such as Microsoft project and Primavera. Also the training effort should be tailored to improve the methods of studying productivity and ways of productivity improvement in construction sites.

4.2.7 Trade's schools

There is a need to increase the number of trade's schools which focus on teaching construction trades such as block work, formwork, painting, plastering, plumbing etc to improve the abilities and skills of craftsmen working in construction projects.

4.2.8 Transferring of technology

More efforts should be spent by contracting companies to get the use of what other developed countries had achieved through transferring of technology and best use of benchmarking.

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BIOGRAPHIES

Mr.C.Thiyagu, [1]*Student M.E., (CE&M), Gnanamani College of Engineering, Namakkal-637018, Tamilnadu, India*

Mr.M.Dheenadhayalan, [2] Assistant Prof, Dept of Civil Engg, Gnanamani College of Engineering, Namakkal, Tamilnadu, India

Mr.S.Janagan, [3] Assistant Prof, Dept of Civil Engg, Gnanamani College of Engineering, Namakkal, Tamilnadu, India