

Factors Affecting the Productivity of the Construction Industry in Ernakulam

Ajith Kumar¹, Anu², P. Deepan³

^{1,2}Post Graduate, ³Assistant Professor

^{1,2,3} Mahendra Engineering College, Namakkal, Tamil Nadu.

ABSTRACT

Construction industry faces challenges with regard to problems associated with productivity and the problems are usually associated with performance of labour. Many construction industry sectors have been experiencing chronic problems such as poor safety, inferior working conditions and insufficient quality. These problems have been identified as the factors that affect construction's productivity and will affect company's performance. The aim of this study is to identify the factors affecting construction productivity in Ernakulam district on the basis of questionnaires administered to the workers and employees. Then, the analysis of questionnaire is carried out by importance index and ranks the factors according to the importance index value. In this paper the productivity factors are categorized into four groups: 1.safety, 2.quality, 3.man power factors, 4.management factors, 5. Site, material and tools related factors, 6. design related factors, and 7.external related factors. The questionnaires will be distributed to the top management and middle level management. This study will be formed as an initial investigation of a more in depth study of the Ernakulam construction industry.

Keyword: Factors affecting Productivity, Productivity Lose in construction industry.

I. INTRODUCTION

Construction is the world's largest and most challenging industry. Construction industry forms a substantial portion of any nations economic output. Improving and developing of methods and techniques to increase the economic output of construction industry are significant and important for any nation. Therefore, construction productivity improvement is one of the key focus areas of many countries and governments across the world. There is no doubt that construction is a key activity within any economy; it influences, and is influenced by, the Nation's Gross Domestic Product (GDP).

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Human resources today have a strategic role for productivity increase of any organization and this makes it superior in the industrial competition. With the effective and optimum uses of it, all the advantages supplied by the productivity growth can be obtained. Construction is a key sector of the national economy for countries all around the world, as traditionally it took up a big portion in nation's total employment and its significant contribution to a nation's revenue as whole. However, until today, construction industry is still facing number of problems regarding the low productivity, poor safety and in sufficient quality. So productivity improvement is essential for every organization.

Understanding about productivity has always been a very important issue in the construction industry. Productivity is the one of the most important factor that affect overall performance of any small or medium or large construction industry. There are number of factors that directly affect the productivity of construction industry. Productivity has now becomes an everyday watchword. It is crucial to the welfare of the construction industry in India. At the micro level, if we improved productivity, ultimately it reduces or decreases the unit cost of project and gives overall best performance of project. Originally it was used only to rate the workers according to their skills. The person who produced more either faster or harder were said to have higher productivity. In this modernized world modern equipment are there for improving productivity.

1.1 ERNAKULAM DISTRICT

The present work is to analyses the factors which influencing the productivity of the construction industry in Ernakulam. It is one of the developed districts in Kerala. Ernakulam district formed on 1st April 1958. The word Ernakulam was drawn from a Tamil word Erayanarkulam means abode of Lord Shiva's. The district included the largest metropolitan region of the state "COCHIN". Ernakulam district is the highest revenue yielding district in the state and is known as the commercial capital of Kerala.

The district covers an area 3068 km² and located on the western coastal plains of India. Ernakulam district is bestowed with all the geographical factors, which help the development of industry, and it is in the vanguard of all other districts in Kerala in the field of industry. The availability of all types of transport facilities viz., road, rail, canal, sea, air is a factor which is unique to this district. Ernakulam is the biggest commercial center in the state of Kerala. Its M.G. Road is the location of some of the biggest businesses in Kerala. This district is listed as the "most advanced" district in Kerala. The construction sector in Kerala helps to increase the GDP at the rate 10-11%.

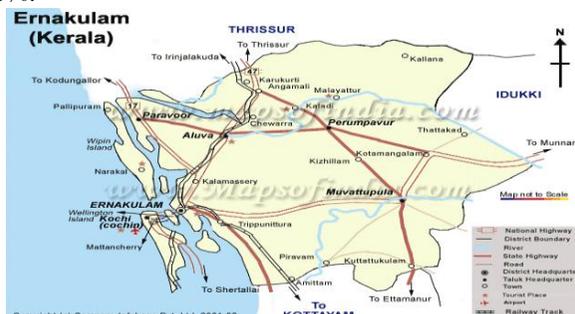


Fig.1 Ernakulam District Map

II. DEFINITION OF PRODUCTIVITY

The word productivity was invented in 1766 when it was first mentioned in an article by (Quesnay, Veggi 1987). More than a one century later 1883, the productivity is defined as “faculty to produce” by the changes of time the modification was made in the definition “the relationship between output and means employed to produce that output” was developed.

The American association of cost engineers, moreover, define the productivity as a “relative measure of labour efficiency, either good or bad, when compared to a stabilized base or norm” (Salmon et al. 2000) while (Arditindmochtar 2000) regard to productivity as “the ratio between total output expressed in dollars and total inputs expressed in dollars as well” (honer and duf 2001) expressed productivity as “how much is produced per unit input”. According to the production unit the definition of productivity will be changed.

The term “productivity” expresses the relationship between outputs and inputs (Borcherding and Liou, 1986). Output and input differ from one industry to another. Also, the productivity definition varies when applied to different areas of the same industry. Labor is one of the basic requirements in the construction industry. Labor productivity usually relates manpower in terms of labor cost to the quantity of outputs produced (Borcherding and Liou, 1986). In other words, the definition of labor productivity is the amount of goods and services produced by a productive factor (manpower) in the unit of time (Drewin, 1982).

In 1883, Littre defined productivity as the “faculty to produce,” that is, the desire to produce (Jarkas, 2005). In 1950, the Organization for European Economic Cooperation (OECC) introduced the definition of productivity as a quotient obtained by dividing the output by one of the production factors (Sumanth, 1984). Depending on measurement objectives and the availability of data, several productivity definitions are encountered. The U.S. Department of Commerce defined productivity as “dollars of output per person-hour of labor input” (Adrian, 1987).

At the project site, contractors are defined productivity in terms of labour productivity and in the following ways-

Labour productivity = OUTPUT/ (LABOUR COST)

Or

Labour productivity = OUTPUT/WORKHOUR

There is no standard definition of productivity and some contractors use the inverse of above,

Labour

Productivity = (LABOURCOST/WORKHOUR)/OUTPUT

III. OBJECTIVE

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

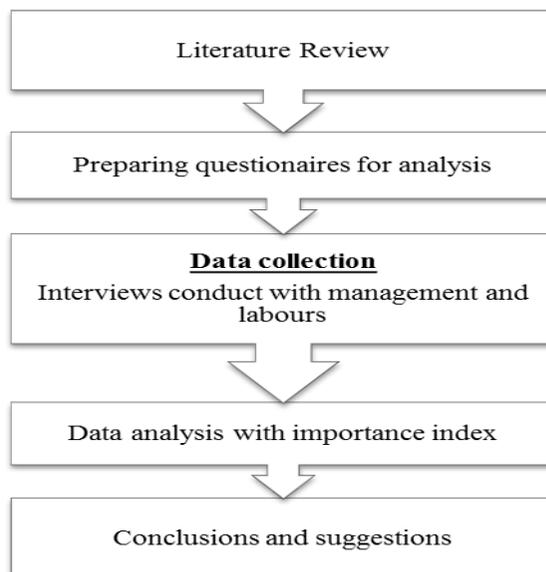
- i. Study and discuss various factors affecting productivity in construction industry.
- ii. Analyze and calculate the Important Index of those factors.
- iii. To make recommendations to improve productivity in construction.

IV. RESEARCH METHODOLOGY

“Survey research is defined as collection of different data by asking people questions” (Fowler, 1993). 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, an appropriate response. Data was collected from literature reviews from books, journals, articles, seminar conferences, and websites which emphasize building construction productivity. A survey was given to employees from different trades involved with the construction project. The questionnaire was prepared according to the four main factors which affecting the construction productivity and their sub factors.

V. ANALYSIS METHODOLOGY

For measuring the factors which affecting construction productivity, an ordinal measurement scale or rating scale 1 to 5 was used and as shown in below



Then the importance index was derived for each factor using the following formula

Table 1. Rating Scale

Strongly disagree	Disagree	Average	Agree	Strongly agree
1	2	3	4	5

$$\text{Importance index} = (5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5) / (5(n_1 + n_2 + n_3 + n_4 + n_5))$$

Where,

n_1 = the number of respondents who answered “strongly disagree”

n_2 = the number of respondents who answered “disagree”

n_3 = the number of respondents who answered “average”

n_4 = the number of respondents who answered “agree”

n_5 = the number of respondents who answered “strongly agree”

After that rank the factors according to the importance index. The higher value of importance index is ranked as first and same as on.

VI. TERMS OF SURVEY ANALYSIS

A questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents. Although they are often designed for statistical analysis of the responses, this is not always the case. The questionnaire was invented by Sir Francis Galton. Questionnaires have advantages over some other types of surveys in that they are cheap, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data.

6.1 SURVEY QUESTIONNAIRES

The data for this survey 7 factor are considered and these factors are taken from different literature reviews. The factors are,

1. Safety
2. Quality
3. Manpower factors
4. Management factors
5. Site material and tool related factors
6. Design factors and
7. External related factors.

The data will collect important information on the current status of the company’s projects and provide insight for the identification of key factors affecting productivity, along with possible actions for improvement.

VII.SURVEY RESULTS ANALYSIS

For the analysis of factors importance index of each factor is found out and rank them as the higher value of importance index is ranked as first and same as on. After processing the information from the questionnaires, some clear trends were observed with respect to the main factors influencing productivity, as summarized in below tables, it defines the importance index to state the ranking of the most relevant influence items. From the below table we clearly understand external related factor got first rank having importance index 0.851 so the most important factor affecting productivity is external factor from my survey. After that site material and tool, then management factor, then manpower related and so on.

Table 2. Ranking of Factors

SL.NO	FACTORES	IMPORTANT INDEX	RANK
1	External related	0.851	1
2	Site material and tools related	0.668	2
3	Management related	0.501	3
4	Manpower related	0.492	4
5	Safety related	0.461	5
6	Quality related	0.428	6
7	Design related	0.309	7

I. External Related Factor

Table 3. Ranking of External Factors

External Factors	Importance index	Rank
corruption	0.981	1
Natural disaster	0.872	2
Proper security	0.7	3

From the table we can clearly understand corruption factor got higher rank with importance index 0.981. In the survey 98% says they are strongly disagree with corruption factor. This result justified as Ernakulam district in terms of its ability to control corruption is ranked in highest. Construction activities are vulnerable to corruption, especially in the procurement process. The remaining 2% is come under on this process. The second factor that has an impact on productivity is natural disaster. Earthquake, soil erosion etc., problems are less in Ernakulam district. The only problem is heavy rain in rainy seasons that delays the construction works. This problem is only seasonal. Then the next factor is security, in this 60%

says they are not provided proper security and the 40% says they are provided security. But this 60%peoples have not get any huge problem related to security. From this we can say that the external factors are not affecting negatively to the construction productivity in Ernakulam district.

II. Site Material and Tools Related

The below table summarizes the site material and tool related factor according to their importance. The results in below table demonstrate 8 factors in the site material and tool related group and were ranked according to their importance. Findings indicate that low quality materials with an importance index of 0.882 is the most important of all material and tool factors. in this 96% are strongly disagree, that means they are using good quality raw materials and 4% use low quality raw material in small minor works

Factor	Importance index	Rank
• Low quality raw materials	0.882	1
• Delay due to interference with other crew members	0.860	2
• Congested work area	0.847	3
• Rework	0.645	4
• work stoppages due to equipment break down and planning errors	0.645	4
• delay in material delivery	0.627	5
• material shortage	0.545	6
• quality measures	0.3	7

Table 4. Ranking of Site material and tool Related

Delay due to interference with crew members is ranked in position 2 of material/tools group. This is mainly due to the lack of communication within the crew members and this may form delay in their work. Even though it was not considered a major problem, the reasons given were small work areas, excessive numbers of people assigned to an area and lack of coordination between crews. Then next important factor is congested work areas. 70% says that they don't have congested worksite and the 30% says that average. Congested work areas always create delay. The next important factor is rework. 60% says that rework is occurring their Construction site. 40% says rework is not occurring in there site. Workers indicated that primary cause of rework was related to change orders made by clients. Then the secondary cause was design errors and lack of project definition. Rework and work stoppages due to equipment break down or planning errors got same rank with importance index 0.645. 50% agreed them having work stoppages due to equipment break down. The main reason stated for equipment problems was an insufficient number of equipment's for the construction site. Second, equipment was

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unavailable when required, broken or breaks down when needed, and not replaced when broken.

Delay in material delivery got 5th position in ranking. 30% agree with this statement, 20% says average and 40% disagree with this statement. 6th position goes to material shortage in this 60% agree with this statement. Everyone says that there is shortage for getting river sand but this problem was replaced by M sand. Then the last factor is quality measures. 95% agree that they all take quality measures of raw materials.

III. Management Related

Table 5. Ranking of Management Factors

Factors	Importance Index	Rank
• Stop work orders because of infringements of government regulations	0.863	1
• Payment delay problem from top management	0.618	2
• Lack of employees	0.609	3
• Weekly toolbox meeting & inspection from top management	0.509	4
• Top management pressurize for deadline work	0.454	5
• Yearly salary increments to employees	0.445	6
• Employees enjoy project benefits	0.436	7
• Periodical meetings	0.427	8
• Proper transportation facilities	0.427	9
• Financial incentives	0.408	10
• Domestic facilities for employees	0.318	11

Stop work orders due to infringements of government regulation with an importance index of 0.863 is ranked in position of 1. 95% disagree with this statement, which there is no problem related to government regulations. Payment delay problem is not affected so much because everyone says that there is no such delay from top management. 70% says there is problem related to lack of employees. Everyone says they hire other state workers but they don't get skilled employees. 70% companies don't have weekly toolbox meeting and inspection from top management. 90% companies pressurize

For work but only in friendly manner then only works completed in time. Yearly salary increments are given to employees and they are enjoying the project benefits. Every company conducted periodical meetings only 30% are not conducting periodical meetings. Proper

transportation facilities are given to employees from office to site. Periodical meetings and proper transportation facilities have same rank with importance index 0.427.85% agree that management are provided incentives mainly in festivals and also they agree with management provided proper domestic facilities.

IV. Manpower Related

Table 6. Ranking of Manpower factors

Factors	Importance Index	Rank
• Labour Disruption Like Manpower Shortages, Strikes	0.763	1
• Communication Problems With Foreign Workers	0.681	2
• Construction Accidents	0.645	3
• Labour Turn Over	0.573	4
• Absenteeism	0.573	4
• Recruitment Of Workers	0.536	5
• Alcoholism	0.518	6
• Motivational Programs	0.495	7
• Age Factor Of Workers	0.427	8
• Punctuality	0.390	9
• Do The Specification And Implementation Match	0.290	10
• Proper Resting Hours	0.272	11

80% disagree the statement labour disruption like manpower shortages, strikes. There are no such problems in Ernakulum district. Only 50% have communication problems with foreign workers.45% agree that accidents are occurs in their construction site but frequently. 70% companies have labour turnover. Salary (better salary offers or salary expectations) was the important reason indicated by the workers for high turnover in the company. Other reasons were personal problems, preference for working close to home etc. labour turnover and absenteeism has same. Rank with importance index 0.573. Labour turnover is affected more than absenteeism. 80% agree that there is difficulty in recruitment of workers. 75% says alcoholism used workers are more. Alcoholism usage mainly seen under own state workers and other state workers mainly used pan items. 90% companies arrange motivational programs to their employees. Every company is concern about the age factor of workers. Mostly companies prefer workers below 70 years old .90% agree that there workers keep punctuality. Proper resting hours are also provided by all companies.

V. Safety Related

Table 7. Ranking of Safety Factors

Factor	Importance Index	Rank
• Safety bulletin board for workers	0.572	1
• Safety inspector	0.536	2
• Safety meetings	0.427	3
• Safety training	0.417	4
• Safety equipment's	0.327	5
• First aid facilities	0.263	6

A 40% companies don't display safety bulletin board for workers it will produce accidents. 60% companies have safety inspector post but no one is there for inspecting safety for workers. Only large construction companies carried out the safety inspection for workers. Safety meetings, safety trainings, safety equipment's & first aid facilities are all provided in construction companies in my survey but actually these are not carried out in construction site.

VI Quality Related

Table 8. Ranking of Quality factors

Factors	Importance Index	Rank
• Quality inspector	0.6	1
• Quality motto	0.486	2
• ISO standards	0.363	3
• Proper quality measures are taken in your firm	0.263	4

40% companies have quality inspector, 50% companies don't have quality inspector and 10% says average. Only name sake they are saying they have quality inspector but actually there is no inspection is carried out in construction site. Next factor is quality motto with importance index 0.486. Medium and large scale companies have quality motto. "Let them stop their work but keep the quality" is the motto for Puruvankara ltd Construction Company. ISO standards

got 3rd position with importance index 0.363. All most every companies follow ISO standards and proper quality measures.

VII. Design Related

All design factors have a high impact on productivity and were ranked according to their importance in table 4.8. 70% companies are adopted new techniques in construction methods other 30% are adopted conventional methods. All most companies use Auto cadd, MS project like conventional software's, they are not ready to study new software tools like rivet software, 3dx max, Sketch up, primavera etc. Designs are carried out by IS codes. 98% companies follow IS codes. Almost all drawings are understandable and it is properly checked before implementation.

Table 9. Ranking of Design Factors

Factor	Importance Index	Rank
• New techniques	0.445	1
• Usage of software tools	0.361	2
• Designs are carried out by IS codes	0.295	3
• Drawings are understandable	0.238	4
• Before implementation is it properly checked	0.209	5

7.1 COMPARISON AMONG DIFFERENT COMPANIES

A comparison is carried out among 4 companies and the companies are selected according to their projects. The companies selected are,

- Sobha Developers
- Puruvankara Ltd
- Prestige Ltd
- Brigade Group

From the below figure we can clearly understand that the importance of factors are different in 4 companies. X axis shows the factors and Y axis shows the index number. Design factors are considered more in Prestige ltd than Sobha developers. Puruvankara ltd and Brigade group considered only 16%. Quality measures taken almost same in four companies. Puruvankara ltd adopted more safety than Brigade groups then followed by Prestige ltd and Sobha developers. Manpower is more in Sobha developers than Brigade groups. Management factor is more considered in Puruvankara ltd than Brigade group and Prestige ltd. Site material

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and tool related factors consider more in Puruvankara ltd then it followed by Prestige ltd and Brigade groups. In terms of external factors Brigade groups came first with only 10%.

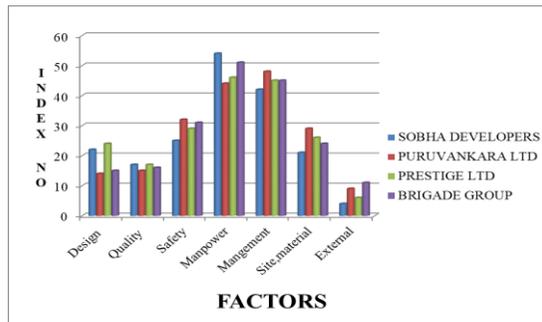


Figure 2. Comparison among different companies

VIII. CONCLUSION AND SUGGESTIONS

In today's world, the construction industry is rated as one of the key industry. It helps in developing and achieving the goal of society. Study and knowledge of construction productivity are very important because they cause losses to the governing agencies and also influence the economics of the construction industry. This study is helpful to identify the causes of probable factors affecting construction productivity in Ernakulam district. This study has found that there have been construction productivity problems and disclosed the significant factors. These findings should enable construction stakeholder's to easily identify their strengths and weaknesses and apply new techniques to reduce the negative impact of factors, which leads to increase productivity. The result indicates that the main factors negatively influencing construction productivity in Ernakulam are:

- Rework
- Lack of employees
- Pressurization
- Labour turnover
- Difficulty in the recruitment of workers
- Alcoholism
- Improper safety measures.

In addition, 51 factors considered in the study were divided into seven groups which were ranked according to their importance index as

- External factors
- Site material and tool related factors
- Management related factors
- Manpower related factors
- Safety related factors
- Quality related factors

- Design related factors.

XI. BARRIERS TO IMPROVING CONSTRUCTION PRODUCTIVITY

There are some barriers to improve the productivity and these barriers are as follows:

Lack of alignment of goal

1. Difficulties in measuring productivity
2. Lack of labour focus
3. Weak commitment to continuous improvement

9.1 GUIDELINES FOR IMPROVING THE CONSTRUCTION PRODUCTIVITY

- Systematic flow of work
- Systematic planning of funds in advance
- Pre monsoon plan to avoid work stop
- Maximum use of machinery and automation system
- On time payment to the workers
- Properly in time supervision
- Properly and in advance material procurement and management
- Proper training provided to the workers
- Maintain work disciplines.

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