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Analysis of Factors Influencing Productivity: Survey of Construction Projects in Central Gujarat Region of India

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Abstract
- Productivity in construction projects is usually an economic measure which acts as a game changer. Productivity can be an influential factor in minimizing the project losses or increased profits. A loss of billions of rupees every year is occurred due to loss or lack of productivity. In spite of various researches been done in the last decade, a deeper understanding can help to improve the productivity. Productivity helps in attaining the maximum possible efficiency and thus can help in reduction of time, effort etc. Productivity can help a company gain competitive advantage and slim profit margins. Hence, to gain an advantage in profit, productivity study is important. The aim of this study was to get the latest information, identify and rank the key factors affecting the project level productivity. This paper presents various factors affecting construction productivity ranked in accordance with the most affecting factors based on a survey. It also gives interrelations between the perspectives of owners, engineers, etc. Such a study may prove to be beneficial to all the agencies involved in construction by a providing a benchmark for achieving necessary productivity and also act as a foundation for future studies.

Keywords: Productivity, Construction, Survey, Relative Importance Index (RII).

Introduction

Productivity could be defined as "the ratio of output of required quality to the inputs for a specific production situation; in the construction industry". In simple terminology

$$\text{Productivity} = \frac{Output}{Resources\ Used}$$

Productivity is the ratio of output to all or some of the resources used to produce that output. Resources comprise: labour, capital, energy, raw materials, etc. There are two basic forms of productivity, namely: Total productivity (sometimes known as total factor productivity); Partial productivity (sometimes called partial factor productivity). In general, productivity signifies the measurement of how well an individual entity uses its resources to produce outputs from inputs.

Productivity is one of the key components of every company's success and competitiveness in the market. Productivity translates directly into cost savings and profitability. It is necessary to improve productivity continuously or risk losing important contracts.

There are several factors that affect productivity, partially or fully or in minor or major context. These factors were gathered from literature reviews of previous studies. The factors can be structured as major groups and under it lie the sub factors. The various factors which affect productivity on construction sites have been identified. Some of these factors are controlled by the owner, some are controlled by the designer and some are controlled by the contractor.

Objectives of the Study

This paper has an objective to act as a foundation for future studies and its results will become worthwhile information in efforts to improve the productivity in the construction industry.

Research Methodology

The data collected to determine the most influential factors on productivity of the project was done through a survey by explorative questionnaire to the respondents who are involved in the management of projects in various regions in the central Gujarat region of India. The questionnaire was designed so respondents can give the rank to their answers based on the Likert scale. The analysis of this data can be done by a method named relative importance index (RII) method as well as statistical methods using the statistical package for the social sciences (SPSS) software.

Data Collection

A total number of 99 respondents were surveyed from the central Gujarat region of India, namely cities like Ahmedabad, Anand, Nadiad and Vadodara out of which 40 respondents were owners, 30 engineers, 13 were project managers, 7 architects, 2 consultants and 6 supervisors. A ranking of the factors was achieved from the Relative Importance Index (RII) method and statistical package for the social sciences software (SPSS). Also ranking comparisons between owners, engineers, project managers, consultants, architects and supervisors are shown below.

Data Analysis By Relative Importance Index (RII) Method

The data collected was manually analysed by the RII method with the help of which a decimal figure for each factor is obtained which is known as its Importance index. This index is used to rank the factors.

Table No 1: Ranking of Factors

RANKING OF FACTORS BY RELATIVE IMPORTANCE INDEX (RII) METHOD		
NAME	RII	RANK
Low payment	0.8729	1
Poor construction methods	0.8562	2
Use of technology/Level of mechanization	0.852	3
Delays in materials delivery	0.85	4
Defective plans and specifications	0.8416	5
Scarce labour	0.8333	6
Contractor's actions	0.8291	7
Improper Planning and scheduling	0.8291	7
Defective tools and equipment	0.827	9
Lack of materials	0.8229	10
Plan changes	0.8166	11
Rework	0.8104	12
Lack of management support	0.8041	13
Management control or project team	0.8	14
Unavailability of tools and equipment	0.8	14
Schedule delays	0.7979	16
Change of orders	0.7958	17
Lack of qualified inspectors	0.7958	17
scope changes	0.7875	19
Lack of Coordination	0.7875	19
Delays of permits or design	0.7854	21
Lack of Communication	0.7854	21
Poor materials handling	0.775	23
Lack of leadership	0.7666	24
Unclear or incorrect communication	0.7648	25

Correlation Among Perspectives Of The Entities Involved In A Project

1. Owners

According to the survey conducted, the owners who participated (40) had their perspective on the factors which affect productivity the most. The top five factors, according to them are mentioned below:

- Low payment
- Use of technology/ level of mechanization
- Scarce labour
- Absenteeism
- Contractor's actions

2. Engineers

According to the survey conducted, the engineers who participated (30) had their perspective on the factors which affect the productivity the most. The top five factors, according to them are mentioned below:

- Delays in material delivery
- Poor construction methods
- Rework
- Defective plans and specifications
- Defective tools and equipment's

3. Project Managers

According to the survey conducted, the project managers who participated (13) had their perspective on the factors which affect the productivity the most. The top five factors, according to them are mentioned below:

- Low payments

- Lack of management support
- Defective plans and specifications
- Scope changes
- Management control or project team.

4. Architects

According to the survey conducted, the architects who participated (7) had their perspective on the factors which affect the productivity the most. The top five factors, according to them are mentioned below:

- Engineering errors and omissions
- Improper planning and scheduling
- Contractors actions
- Defective plans and specifications
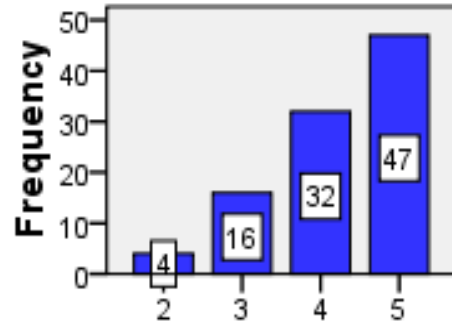- Poor construction methods

5. Supervisors

According to the survey conducted, the supervisors who participated (13) had their perspective on the factors which affect the productivity the most. The top five factors, according to them are mentioned below:

- Low payments
- Incentives
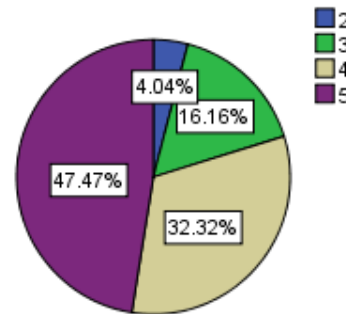- Scarce labour
- Morale and attitude
- Lack of motivation

6. Consultants

According to the survey conducted, the consultants who participated (13) had their perspective on the factors which affect the productivity the most. The top five factors, according to them are mentioned below:

- Contractors actions
- Change of orders
- Poor construction methods
- Defective plans and specifications
- Incomplete design

Data Analysis By SPSS Method

Rank-1 : Low Payment

For low payment, Respondents' maximum and minimum level of opinions are 47.47 % (Very Large) and 0% (Small) respectively. The number of respondents associated are 47 and 0 respectively as shown in Graph No. 1, 2 and Table No 2.

Graph 1: Bar chart denoting frequency of respondents for each option.

Graph 2: Pie chart denoting % frequency of respondents for each option

Table 2: Frequency Distribution for Low Payment

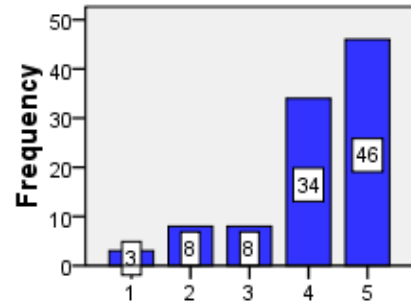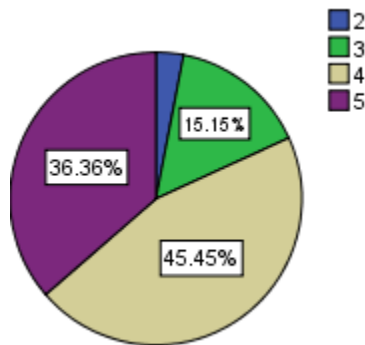|		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	4	4.0	4.0	4.0
	3	16	16.2	16.2	20.2
	4	32	32.3	32.3	52.5
	5	47	47.5	47.5	100.0
	Total	99	100.0	100.0	

➢ **Rank-2: Poor Construction Methods**

For low payment, Respondents' maximum and minimum level of opinions are 47.47 % (Large) and 0% (Small) respectively. The number of respondents associated are 47 and 0 respectively as shown in Graph No. 3, 4 and Table No 3.
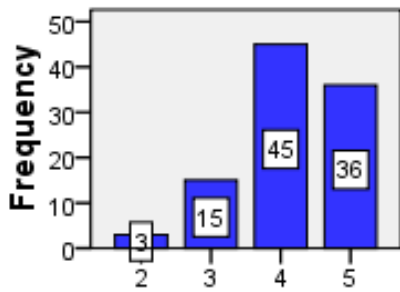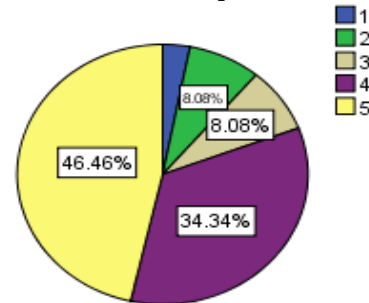
Graph 3: Bar chart denoting frequency of respondents for each option.

Graph 4: Pie chart denoting % frequency of respondents for each option

Table 3: Frequency Distribution for Poor Construction methods

	Frequency	Percent	Valid Percent	Cumulative Percent
2	3	3.0	3.0	3.0
3	15	15.2	15.2	18.2
4	45	45.5	45.5	63.6
5	36	36.4	36.4	100.0
Total	99	100.0	100.0	

➢ **Rank-3: use of technology/ level of mechanization.**

For low payment, Respondents' maximum and minimum level of opinions are 46.5 % (Very Large) and 3.0% (Small) respectively. The number of respondents associated are 46 and 3 respectively as shown in Graph No. 5, 6 and Table No 4.

Graph 5: Bar chart denoting frequency of respondents for each option.

Graph 6: Pie chart denoting % frequency of respondents for each option

Table 4: Frequency Distribution for Use of Technology/ Level of Mechanization

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1	3	3.0	3.0	3.0
2	8	8.1	8.1	11.1
3	8	8.1	8.1	19.2
4	34	34.3	34.3	53.5
5	46	46.5	46.5	100.0
Total	99	100.0	100.0	

Conclusion

Among the top factors which affects productivity based on the survey conducted in the central Gujarat region were low payment, poor construction methods, use of technology/level of mechanization, delays in material delivery etc. These factors affect productivity the most and must be taken care of. Also correlation or deviation of the perspectives of different entities in a construction project was studied and was concluded that the variation was till a considerable extent although some factors were common.

Acknowledgments

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