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A Pilot-Validated Framework for Identification of Factors Affecting Labour Productivity in Indian Construction Industry

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Abstract

Labour productivity is an important factor that determines the performance of projects in the Indian construction industry which impacts directly on cost, time, and efficiency. Despite extensive studies, limited studies have been done on region-specific factors affecting the productivity of Central Gujarat. This research has filled the gap in a structured multi-phase manner. In the first phase, a pilot study was carried out at different construction sites in Nadiad and Ahmedabad, the construction activities considered were masonry, concreting, plastering and tile installation works. The observations made showed significant differences in productivity mainly resulting from labour skill levels, origin of workforce, use of equipment and supervisory practices. In the second phase, a full literature review over studies published between 2005 and 2024 allowed to identify an initial list of 66 productivity-related factors. These factors were refined further in structured expert consultations with contractors, site engineers and supervisors. As a result, the factors were pared down to 42 by eliminating overlaps, combining similar variables, and ensuring that the factors were relevant in the region. The final factors were organized into 9 major categories which created a structured basis for subsequent quantitative evaluation using established methods of productivity assessment.

Keywords: *Labour productivity, construction industry, critical factors, pilot study, criteria framework, RII, construction management.*

1. Introduction

The construction sector occupies a strategic importance in Indian economy. It is the second largest employment generating sector, after agriculture, in terms of the number of employees involved more than 55 million and share in GDP around eight to nine percent. Labour costs normally account for 30 to 50 percent of overall project expenditure and this makes the efficiency of the workforce a key variable. Lower-than-expected labour productivity has been identified time and time again as a major cause of project delays and cost overruns. The Central Gujarat region - including Ahmedabad, Vadodara, Anand and Nadiad - has witnessed amazing increase in the construction of

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buildings. Despite this growth, systematic research which has studied factors that hinder or boost labour productivity in this region has been sparse. The present study addresses this gap through a structured, multi-stage investigation which includes a pilot study at three active sites, a literature review resulting in 66 factors and expert consultation reducing to 42 validated factors that were classified in 9 major groups.

1.1 Objectives of the Study

To carry out pilot study at live construction sites of Central Gujarat to see productivity pattern. To identify the broad scope of factors affecting the construction labour productivity by literature review. To refine factors through expert consultations and develop a nine group criteria framework. To introduce the methodology for further ranking by using RII and Importance Index methodologies.

2. Literature Review

Talhouni [3] classified the productivity factors into management, site conditions, design and weather. A technological vs. administrative classification was suggested by Herbsman and Ellis [13]. Aynur et al., [1] found 18 determinants under socio-psychological and economic groups where monetary considerations dominated but socio-psychological factors were gaining significance. Parviz et al. [9] conducted a survey on 60 CEOs of construction companies in Iran in which 31 factors in seven categories were identified. Brent and Ellis [5] studied the case of Trinidad and Tobago and identified lack of proper monitoring and scheduling of work, leadership, and delayed payment as important management factors. In the Indian context, Mistry and Bhatt [6] made a study of South Gujarat and concluded that material shortage, weather and lack of equipment were critical. Shashank et al. [11] emphasised on management practices and workforce competence. Patel and Patel [14] observed that project management deficiencies, rework and motivation were the most impacting ones. This regional variation is the motivation for the present location specific investigation Table 1.

3. Research Methodology

The research methodology comprises three types, native place, experience and day's sequential phases: (1) pilot study at construction sites, (2) literature review for factor identification, and (3) expert consultation for factor refinement, (4) Reduction of factor, (5) Criteria framework Preparation. Figure 1 illustrates the research methodology flow.

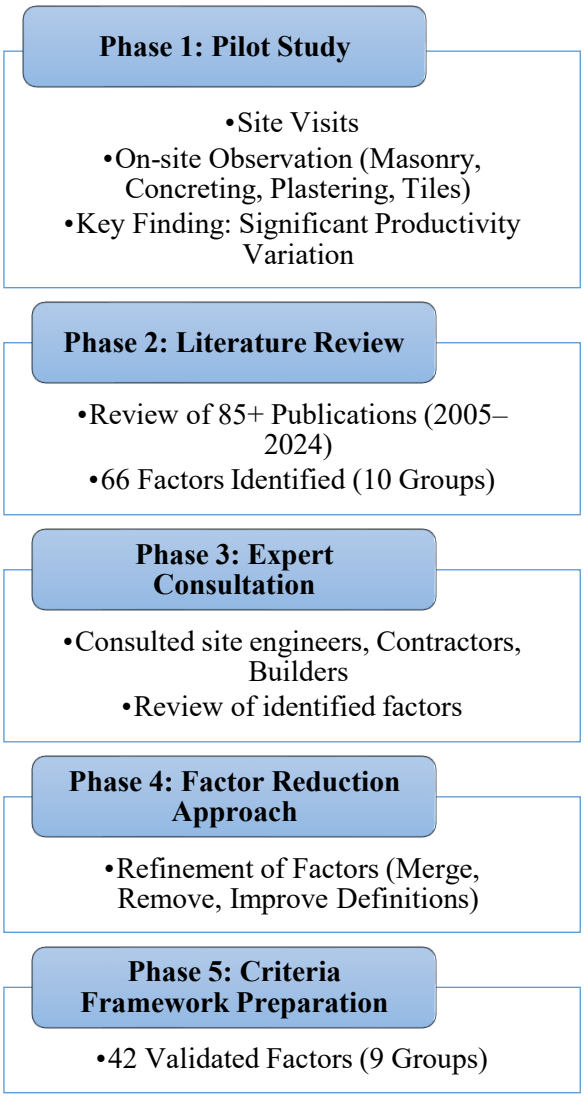

Figure 1 Flow Chart of Research Methodology

3.1 Phase 1: Pilot Study

The first phase included a pilot study at three active construction sites of buildings in Central Gujarat. Both qualitative and quantitative information were collected through field observation at sites and responses from builders, contractors, supervisors and workers through an interview. Details about labour productivity, for masonry, concreting, plastering and

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tiles installation were recorded Table 2.

Table 1 Pilot Study Site Details

Parameter	Site 1: Ohm Gloria	Site 2: Hari Krishna Heights	Site 3: The Nest
Location	Nadiad	Nadiad	Ahmedabad
Storeys	7	8 (5 Blocks)	10 (2 Blocks)
Period	Jan 2020–Jan 2023	Jun 2017–Jan 2023	Jan 2021–Jan 2023
Area (sq.ft.)	49,000	1,44,000	1,75,000
Contact	Ajaz Momin (Site Engr.)	Bharatbhai Virani (Contractor)	Jay Gajera (Builder)
Skilled Workers	Mason-4, Cement-4, Concrete-2	Mason-25, Cement-7, Concrete-2	Mason-2, Cement-4, Concrete-2
Worker Origin	Dahod	M.P. / Dahod	Rajasthan / Dahod

Table 2 Comparative Labour Productivity

Activity	Crew	Site 1	Site 2	Site 3
Masonry	1 Mason + 1 Helper	40 sqft/9hr	50 sqft/9hr	120 sqft/8hr
Concreting	2 Workers + Helpers	1750 cuft/10hr	1800 cuft/10hr	4000 cuft/10hr (RMC)
Plastering	1 Cement Mason + 1 Helper	40 sqft/9hr	120 sqft/9hr	175 sqft/8hr
Tiles	1 Mason + 1–2 Helpers	40 sqft/9hr	100 sqft/9hr	160 sqft/8hr

3.1.1 Key Observations

Productivity variation: Masonry varied from 40 sq.ft/9hr (Site 1) to 120 sq.ft/8hr (Site 3) - a threefold difference. Similar variation in plastering 40-175 sq.ft and tiles 40-160 sq.ft. Concreting varied between 1,750 and 4,000 cu.ft of RMC at Site 3.

Worker origin effects: The workers from Rajasthan (Site 3) demonstrated the highest output, indicating better masonry traditions. Workers from Dahod and M.P. had comparatively less but consistent output.

Technology impact: Site 3 employing RMC achieved more than twice the concreting output pointing to benefits from mechanisation.

Scale vs. coordination: Site 2 with 25 masons failed to exhibit highest per-worker output, suggesting coordination overhead with larger crews.

These observations persuaded that productivity depends on origin of the worker, the skill, the equipment, the supervision and the conditions at the site-what motivated systematic factor identification.

3.1 Phase 2: Literature Review

A comprehensive literature review using Scopus, Web of Science and Google Scholar of 85+ publications (2005-2024) resulted in 66 factors grouped into ten groups. The complete 66 factor inventory is presented in Table 3

Table 3 Factors from Literature Review

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No.	Factor	Group
1	Increase of age	Labour
2	Lack of skill	
3	Labour fatigue	
4	Late arrival	
5	Early quit	
6	Frequent unscheduled break	
7	Lack of work discipline	
8	Absenteeism	
9	Strikes	
10	Unavailability of skilled labour	
11	Personal conflicts among labours	
12	Lack of construction management leadership	Management
13	Lack of qualified supervision	
14	Unavailability of execution drawings	
15	Delay in approving shop drawings	
16	Poor communication & coordination	
17	Slow decision making by owner	
18	No incentives for finishing ahead	
19	Unclear instruction to labour	
20	Delay in inspection & testing	
21	Lack of training programme	
22	Working overtime of labour	
23	Lack of periodic meetings	
24	Conflicts between contractor & labour	
25	Ineffective planning & scheduling	
26	Unrealistic scheduling expectations	
27	Improper construction methods	Project
28	Insufficient data collection before design	
29	Suspension of work by owner	
30	Rework due to construction errors	
31	Change orders during construction	
32	Changes in material types & specs	Material & Equipment
33	Delay in material delivery	
34	Damage of stored material	
35	Delay in manufacturing special materials	
36	Late procurement of materials	
37	Late selection of finishing materials	
38	Lack of proper tools & equipment	
39	Equipment breakdowns	
40	Shortage of equipment	
41	Low operator skill level	
42	Low equipment productivity	
43	Distance from home to site	Site Condition
44	Location of site	
45	Traffic control at job site	
46	Non-provision of transport	
47	Working with confined space	Working Env.
48	Insufficient lighting	
49	Bad ventilation	
50	Noise	
51	Unavailability of utilities at site	
52	Delay in payment	Economical
53	No payment for extra work	
54	Insufficient remuneration	
55	Lack of financial motivation	Motivation
56	Lack of recognition programme	
57	Lack of social insurance	
58	Lack of job security	
59	Accident during construction	Safety
60	Lack of safety tools & equipment	
61	Non-availability of safety officer	
62	Working at height	
63	Rain effect on construction	Weather
64	High temperature	
65	Wind	
66	Adverse winter	

3.1 Phase 3: Expert Consultation

Phase 3 was about validating and refining the factors found from the literature review by expert consultation. A panel of industry professionals, and

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including experienced contractors, site engineers and supervisors, and was chosen based on their practical experience using construction projects Table 3. The identified factors were presented for evaluation by the experts in terms of relevance, clarity and applicability to actual construction situations. Structured discussions and feedback were used to identify things that overlap, ambiguous There are definitions, and some context specific limitations. Based on inputs of experts, necessary changes were made, including combining like things, reword unclear items and trimming out unimportant or unnecessary variables. This phase ensured that the factors selected were both of the following: theoretically based and practically applicable.

3.1 Phase 4: Factor Reduction

In Phase 4 a systematic process of reduction of factors was done to refine the validated list of factors into an easy to work with short list of critical factors The basis of this reducing mainly based on expert's consensus, frequency of occurrence in literature and practiced importance in construction projects Factors that were redundant and less influential were one removed, while very closely related were grouped into common categories so as to clarify purposes and to simplify things Table 4. This process led to a result of classifying a set of key factors into well-defined groups for more manageable analysis an interpretation. The barren reduced list of factors allowed the process of data collection that ensued to be focused, efficient and in line to the researches goals.

3.1 Phase 5: Criteria Framework Preparation

Phase 5 involved the creation of a structured criteria framework that was based on the finalized factors and their respective groupings. Each factor was grouped under logical categories, which represent different dimensions with respect to labour productivity, such as managerial, technical, environmental and human-related aspect Table 5. This framework was used as the basis of the design of the questionnaire survey and based on which each of the factors could be converted to measurable items using an appropriate rating scale. The criteria framework assisted the consistent, complete and logical flow of data collection which can improve the reliability and validity of the study.

The basis for the refinement was threefold: (a) merging of overlapped factors (eg. "Late arrival" and "Early quit" were combined as "Late arrival and early quitting habits"); (b) removal of rare and context specific items (eg. Strikes, unavailability of safety officer); and (c) clarification of ambiguous definitions in order that they could be measured. This refinement removed redundancy and simplified the survey (fewer items - 66 to 42) and guaranteed sound analysis. The reduction is summarised in the table 4.

Table 4 Factor Reduction Summary

S.No.	Factor Group	Initial	Refined
1	Labour-related	11	7
2	Management-related	15	8
3	Project-related	5	5
4	Material & Equipment	11	5
5	Site Condition & Working Env.	9	4
6	Safety-related	4	3
7	Economical	3	4
8	Motivational	4	3
9	External Factors	4	3
	Total	66	42

The final 42 factor criteria framework is presented in table 5.

Table 5 Refined Factors

No.	Factor	Group
1	Increase of age of workers	Labour

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2	Lack of skill and experience	
3	Labour fatigue	
4	Late arrival & early quitting habits	
5	Absenteeism	
6	Labour turnover & unavailability of skilled labour	
7	Alcoholism, substance use & personal conflicts	
8	Lack of construction management leadership	Management
9	Lack of qualified supervision	
10	Unavailability of drawings & delay in approvals	
11	Poor communication & coordination	
12	Unclear instruction to labour	
13	Lack of training programme for labour	
14	Ineffective planning & scheduling	
15	Lack of periodic meetings with labour	
16	Improper construction methods	Project
17	Insufficient data collection before design	
18	Rework due to construction errors	
19	Change orders & suspension by owner	
20	Unrealistic scheduling expectations	
21	Changes in material types & specs	Material & Equip.
22	Delay in material delivery & late procurement	
23	Lack of proper tools & equipment	
24	Shortage of equipment & breakdowns	
25	Low equipment productivity & efficiency	
26	Confined space & overcrowding	Site Cond. & Env.
27	Insufficient lighting & ventilation	
28	Unavailability of utilities at site	
29	Noise & dust at workplace	
30	Accidents & working at height	Safety
31	Lack of safety tools & PPE	
32	Absence of safety training	
33	Delay in wage payment	Economical
34	No payment for overtime & extra work	
35	Insufficient remuneration	
36	Material price fluctuations	
37	Lack of financial motivation & incentives	Motivational
38	Lack of labour recognition programme	
39	Lack of job security & social insurance	
40	Rain effect on construction	External
41	High temperature & adverse weather	
42	Political & social disturbances	

3.6 Proposed Ranking Methods

3.6.1 Relative Importance Index

RII = ΣW / (A × N), where W = weight assigned by respondent, A = highest Likert weight, N = total respondents. Higher RII indicates greater significance.

3.6.2 Importance Index

F.I.(%) = [Σa(n/N)×100]/4; S.I.(%) = [Σa(n/N)×100]/4; IMP.I.(%) = [F.I.×S.I.]/100. This dual-dimension approach takes account of both frequency and severity.

3.6.3 Spearman's Correlation

$r = 1 - (6\Sigma d^2)/(n^3 - n)$, used to evaluate agreement

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between stakeholder groups.

Conclusion

This study has found and classified labour productivity affecting factors of construction projects of Central Gujarat (India). The pilot study at three sites established considerable amounts of variation in productivity (masonry: 40 to 120 sq.ft/shift; concreting: 1,750-4,000 cu.ft) based on the origin, skill, technology, and supervision of the workers. A literature review revealed 66 factors, less than 10 groups. Expert consultation reduced these to the 42 factors structured in 9 factors: labour, management, project, material/equipment, site condition, safety, economical, motivational and external. This framework is a validated foundation for further quantitative ranking by the RII and Importance Index methods.

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