

“EFFECTS OF SCHEDULE ACCELERATION ON CONSTRUCTION PERFORMANCE”

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ABSTRACT: Accelerating a project can be achievement. The outcomes can be troublesome if productivity and quality are yielded for staying in front of calendar, such that the real schedule benefits are frequently scarcely justified regardless of the exertion. The schedule acceleration and its causes and effects are often overlooked when schedule decisions are being made. Construction projects are suffered from various problems and complex factors such as cost, duration, quality and safety. Construction industry is diverse as it contains contractors, consultants, designers, owners, and others. The aim of this paper is to identify the factors constraining productivity, & quality in Indian construction industry based on the views of all technical persons. Subjective information gathered through literature review formed the basis for questionnaire surveys conducted among the target populations. The questionnaires were distributed to Project Manager, Project Engineer, Planning Engineer, Senior Engineer, Site Engineer, Estimation & Billing Engineer, quality Engineer, Productivity Engineer. An empirical investigation has been performed by using survey data collected from 49 construction practitioners working in 7 different construction sites in (Maharashtra) India. In-depth literature review revealed 5 productivity constraining factors and their 40 sub factors, 14 quality constraining factors and their 62 sub factors. Before the factor analysis were ranked according to their mean ratings. Recommendations were provided for improving construction productivity in the construction industry for addressing the productivity & quality constraints. This paper is intended to provide clients, project managers, designers, and contractors with the necessary information needed to better manage the quality of building construction projects. This paper reports the

findings of a study undertaken to determine the underlying factors affecting construction projects productivity & quality. The results of this questionnaire survey data analysis indicate that advantages of increasing the pace of work by working under schedule acceleration can be offset by losses in productivity and quality. The paper finally suggests the strategies to help the project managers to deal effectively with schedule acceleration & to improve project performance.

Keywords: Productivity, Quality, construction industry, quality factors, Productivity factors, schedule acceleration

INTRODUCTION: Working under schedule acceleration and in a stressful environment has acquire a routine phenomenon at many construction sites. Site managers regularly schedule activities aggressively to maintain the project on schedule or to retrieve from a lost schedule. Moreover, clients or developers exert acceleration on contractors by setting competitive and ever changing project objectives and intend schedules in an effort to market their projects earlier. The term “schedule acceleration” may be defined as the induced demand perceived by individuals or work groups to perform their work within a given time frame. It is often conceptualized with respect to some underlying baseline period. In spite of its significant part in construction scheduling, just a constrained measure of exploration has been distributed on the impacts that schedule acceleration has on construction performance. Specifically, next to no observational examination is accessible on this issue. Likewise, there is restricted comprehension furthermore, learning on how schedule acceleration creates dynamic effects on project performance and, more importantly, how

to counteract the negative aspects of schedule acceleration. With an end goal to address these issues, we have efficiently dissected the impacts that schedule acceleration has on construction performance. Productivity is one of the important aspects for the companies in the construction industry, which helps for survival or growth. Improvement in the productivity of the construction industry is therefore of critical importance considering its significant contribution to the GDP. Furthermore, improvement in the productivity of the construction industry has a positive impact on all other industries, as well as on the national economy. Quality has become a very popular subject in recent years due to conceptual changes in the industry. Quality and quality systems are topics which have been receiving increasing attention worldwide. The finished product in any industry should be manufactured to a required standard, one that provides customer satisfaction and value for money. The need for achieving quality of the finished product in the building construction industry is no less than in any other industry. The high cost of buildings makes it necessary to ensure quality of the finished product.

SCOPE OF THE STUDY:

The objective of this study focuses on views from the construction industry while working in the schedule acceleration to avoid or to minimize the effects on productivity and quality of the construction, and to avoid the project delay. The various factors which affecting productivity, quality are considered, and suggest appropriate measures that can be taken to improve productivity & quality. The aim is supported by the objective stated below.

1. To study factors which affecting construction performance that arise from schedule acceleration. (Factors consider are productivity & quality)
2. To suggest scheduling strategies to help project managers to deal effectively with

schedule acceleration & to improve project performance.

RESEARCH METHODOLOGY:

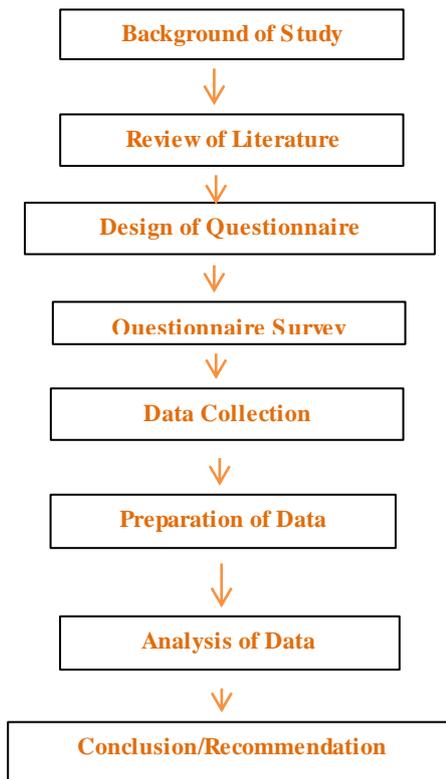
“Survey research is defined as collection of different data by asking people questions”

The data collection process used in this paper 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 face to face questions, an appropriate response. A questionnaire in a survey format comparatively requires less duration and saves cost while permits respondents to response the questionnaire at their personal ease. Data was collected from literature reviews from books, journals, articles, seminar conferences, and websites which emphasize construction's productivity quality & delay. A survey was given to employees from different trades involved with the construction project.

Survey Planning:

For this study, collecting general information on various factors affecting productivity quality & delay in construction all over 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 collected in order to maintain confidentiality, and the output was recorded. Results included the overall statistics as well as individual statistics.

Following chart No. 1 shows the flow-chart describing various stages and its structure.



DATA COLLECTION:

Data Collected from the questionnaire Survey

In successfully achieving main objective of the study, one of the most important phases is collection of accurate data. Data collection is a procedure of collecting crucial data records for a certain sample or population of observations. A total of 62 questionnaires were sent to construction professional, a total of 55(88.70%) questionnaires were received, Missing data frequently occur after the respondent chooses not to response a question or when the respondent rejects to answer the question. The most serious concern presented in the responses was some missing data. Some of the unclear response was clarified. A total of 6 (9.67%) invalid data received were deleted from study. The reason to discard the data was incompleteness and invalid responses. The actual data used for study is 49 (79.03%).

Table No. 1 Statistical Data of Questionnaires Sent and Received

	No.	Percentage of Total (%)
Total questionnaires sent	62	
Total questionnaires received	55	88.70
Invalid data	06	9.67
Used for study	49	79.03

Measurement of Data Collected from the Web Survey

It is commonly believed, while performing different task on construction projects, disturbances can exist with diverse degrees of danger. In order to overcome with these different degrees, it was decided to consider four condition levels: not applicable, does not affect it, somewhat affects it, and directly affects it. A clear specification of the standard conditions was necessary to enable respondents to clearly distinguish the degree of each adverse condition level. Standard conditions discussing to four different degrees of severity for each field were recognized. In order to select the suitable technique of study, the level of measurement is to be studied. For each measurement type, there is (are) (an) appropriate method(s) that can be applied. In this paper, ordinal scales were used. An ordinal scale, as shown in Table, is a ranking or a rating of data that normally uses integers in ascending or descending order. The numbers assigned (1, 2, 3, 4) neither indicate the intervals between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on a Likert scale, we have Table

Table No. 2 Ordinal Scale Used for Data Measurement for productivity

Item	Not applicable	Does not affect it	Somewhat affects it	Directly affects it
Scale	1	2	3	4

The form of questioning varied from factual data to subjective responses. The main objective in question design is to make questions asked clear, concise and unambiguous. Extensive use was made of ordinal scale measures for eliciting data on respondent's perceptions. The respondents were asked to assess the main factors and sub-factors affecting quality in building construction projects on a five point scale, where 1 represents very low important, 2 represents low important, 3 represents medium important, 4 represents important and 5 represents very important.

Table No. 3 Ordinal Scale Used for Data Measurement for quality.

Item	Very low important	Low important	Medium important	Important	Very important
Scale	1	2	3	4	5

ANALYSIS METHOD USED:

The weighted average method

To define the relative importance of each main factor, the weight of the sub-factors of in the questionnaire was calculated using the following formula.

Factor Average Weight =

(Summation of scores of sub-factor in each group)

(Total No. of factors in each group*Total No. of respondents)

Comparing of results for ranking the main factors and the sub-factors and by using the weighted average method.

PARETO ANALYSIS:

In order to classify the distribution pattern of the quality factors obtained, Pareto analysis was carried out. The data collected from ranking the sub-factors in the questionnaire are analysed, concluding the score and relative percentage of each factor. The results of Pareto Analysis are shown and illustrated in They show the main factors affecting quality together with the

contribution of each factor as average score and a percentage respectively.

DATA ANALYSIS & DISCUSSION:

GROUP OF FACTORS AFFECTING PRODUCTIVITY

Group ranking according to the respective factors affecting productivity is shown in Table No.4 and Figure No.1 It was calculated by taking into consideration the average weight value for all the factors that affect productivity in construction. Manpower factors were the top group, with an average weight 3.49, and the miscellaneous group was at the bottom, with average weight 3.37.

Table No. 4 Group of factors affecting productivity

Sr. No.	Main Factor	Average score	Average weight	Average weight %	Cumulative weight %
1	Manpower factors	171.11	3.49	20.37	20.37
2	External factors	168.90	3.45	20.10	40.47
3	Communication	168.83	3.45	20.09	60.56
4	Resource factors	166.36	3.40	19.80	80.36
5	Miscellaneous Factors	165.00	3.37	19.64	100.00

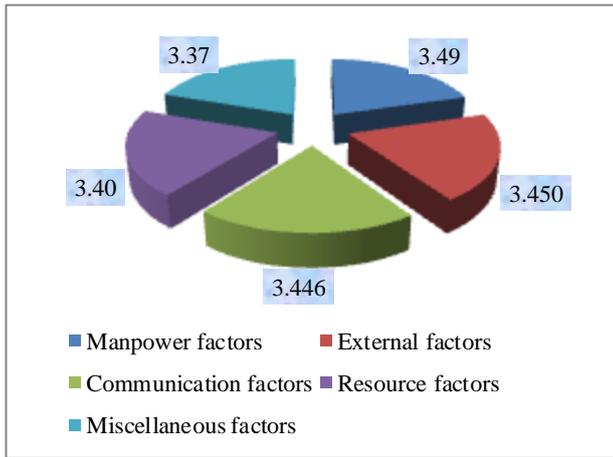


Fig. No. 1 Average weight of factors

4	Subcontractors	177.50	3.62	7.20	33.69
5	Material	174.20	3.56	7.07	40.76
6	Labour	173.80	3.55	7.05	47.81
7	Systems	170.20	3.47	6.91	54.72
8	Environment	169.67	3.463	6.89	61.61
9	Contract	169.60	3.461	6.88	68.49
10	Execution	166.75	3.40	6.77	75.26
11	Equipment	161.60	3.30	6.56	81.81
12	Site layout	158.50	3.23	6.43	88.25
13	Owner	152.50	3.11	6.19	94.44
14	Project	137.00	2.80	5.56	100

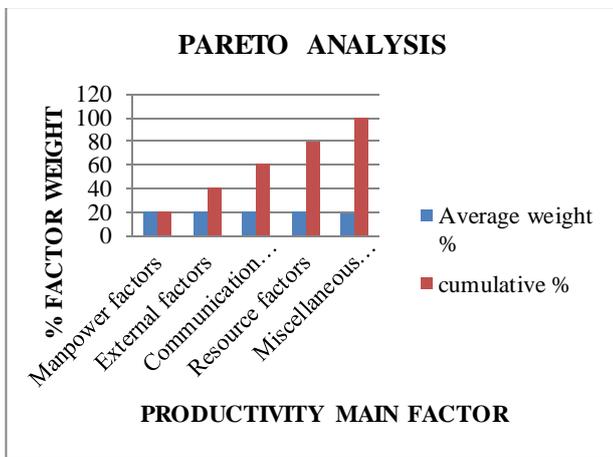


Fig. No. 2 Pareto analysis of Productivity factors

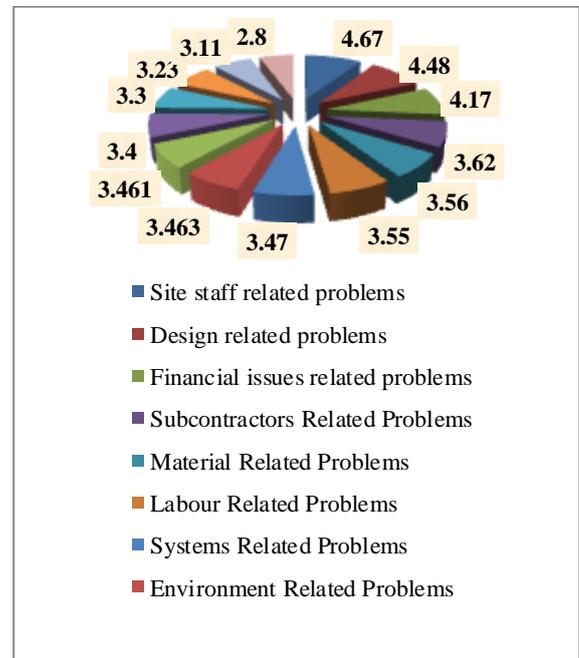


Fig No. 3 Average weight of factors

GROUP OF FACTORS AFFECTING QUALITY:

Group ranking according to the respective factors affecting Quality is shown in Table No.5 and Figure No.3. It was calculated by taking into consideration the average weight value for all the factors that affect Quality in construction. Site staff factors was the top group, with an average weight 4.67, and the Project related factors was at the bottom, with average weight 2.80.

Table No. 5 Group of factors affecting quality

Sr. No.	Main Factor	Average score	Average weight	Average weight %	Cumulative weight %
1	Site staff	228.75	4.67	9.28	9.28
2	Design	219.60	4.48	8.91	18.19
3	Financial issues	204.33	4.17	8.29	26.49

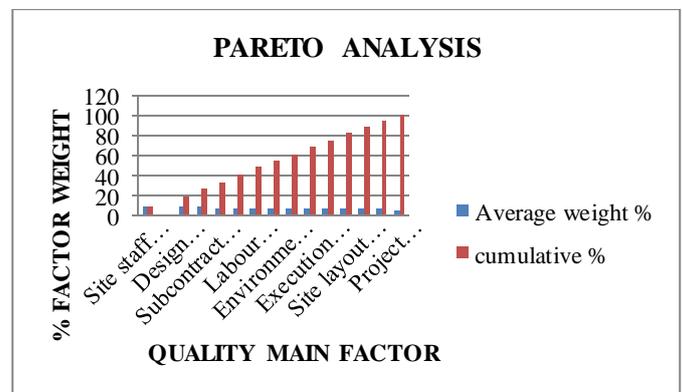


Fig. No. 4 Pareto analysis of Quality factors

DISCUSSION & RECOMMENDATION:

Construction tasks are expensive and frequently cause in arguments and claims, which generally affects progress of construction projects. The environment of construction organizations should be suitable to implement projects with successful completion. In the construction industry, it is necessary to find the weaknesses of particular task in order to solve and overcome them.

The outcome of analysis from this study can be said to be of great relevance to the construction industry. Majority of the respondents are fully involved in the construction industry with at least 10 years of construction experience, meaning that the respondents have wealth of knowledge and could supply the necessary information on the question sent out in the questionnaires.

Mentioned below are the recommendations which were found to be important factors for improving productivity & quality in the construction industry & similarly identified the important factors causing delay in the construction industry while working in the schedule acceleration.

• **Discussion on factors affecting productivity of construction projects**

- I. A detail schedule of material supply schedule for each project should be provided by the contractors. It should contain the time required to supply materials and the availability of the local market to furnish the required materials in time. Extra attention is required on quality of construction materials and tools used in their projects because using suitable materials and tools reduces both the time taken to finish the work and wastage of materials. Using suitable materials and tools also has a positive effect on the task and thus, better productivity can be achieved.
- II. Organizations should make sure there is enough lighting present at the construction sites which can indirectly reduce the number of accidents. Continuous safety training and

meetings should be arranged to achieve better performance in productivity.

- III. Purchased material should be stored at appropriate location and should be easily accessible and close to constructed buildings to avoid wasting labour time for multiple-handling materials.
- IV. Recruiting manager and project managers should recruit appropriate candidate to particular task. Friendly relations should be maintained with labours and made aware of their importance to the organization.
- V. To achieve desired results, time required implementing change orders and to make corrections in drawings and specifications should be estimated and scheduled without affecting the project-time completion. Regular meetings should be arranged with the project authorities.
- VI. Various external and natural factor risks should be considered in the budget estimation to minimize delays due to closures and material shortages. There should be suitable emergency budget to cover cost of increased material.
- VII. A financial incentive in the form of best employee of the year should be implemented to create competition among the employees, thus achieving better productivity.
- VIII. Strict drug and alcohol tests should be implemented on a surprise basis and strict action should be taken with the employees who test positive.
- IX. Complex design and incomplete drawings should be avoided and care should be taken to avoid confusion among the various construction agencies.
- X. If the construction sites are present in remote geographical locations where public or employees' own transportation facilities cannot be made available, appropriate organized transportation should be given to the employees.
- XI. Change orders and design error should be avoided as much as possible. These factors can be costly and time consuming if the work has been done. Work sequences can also be affected due to rework.

- XII. Absenteeism at work site can be reduced with inclusion of appropriate paid time off and vacations to all employees.
- **Discussion on factors affecting quality of construction projects**
 - i. The study shows that Site Staff (both contractor and consultant staff) is found to be very important and is ranked first. The skills and experience of the contractor and supervision staff showed the highest score among the sub-factors influencing quality as shown in Table. The contractor's involvement in supervision is important especially if work is subcontracted. As shown in Table. The contractor's procedure of selecting subcontractors and the cooperation between the subcontractors and the contractor are among the major factors influencing quality. Lack of information and overlapping activities, which are common on construction sites, may result in rework, high costs, and low quality performance. Effective coordination by the different teams of Site staff may increase the effectiveness of the work and project completion.
 - ii. Design documents are shown to have the second priority in importance. Drawings and specifications are the two sets of documents given to the contractor that provide technical information on materials, performance of the construction facility, and quality requirements. Drawings are the only documents given to the contractor that show the design concept, size and scope of the job, number and size of materials or items, and how they are assembled into a final project. All these sub-factors are summarized in terms of importance in Table No.5.
 - iii. The financial power of the contractor has a pivot role in completing the project on time and with the stated performance requirements. Financial problems and lack of cash flow will adversely affect the progress of construction.
 - iv. The adaptation of a good material management system helps in improving quality of the project. Controlling the delivery time of construction material to the site leads to easement of implementation of different construction activities and decreases interruptions. One of the major sub-factors highlighted by the respondents that affect quality is the availability of good quality construction materials. Therefore, the availability of good material with reasonable market prices is not guaranteed at most times.
 - v. Labours have an important role toward improving quality of the project. Highly experienced labour is among the main sub-factors influencing quality.
 - vi. The different systems used in the construction project are found to be important factors affecting quality. Quality assurance and quality control are among these systems.
 - vii. Tools and techniques like time scheduling are ranked among the major sub-factors that help in improving the overall quality of the project. In terms of material availability, construction materials conformance to standards, prices fluctuation, and cash flow interruption. These factors caused the delay of most projects in addition to many disputes with the supervision staff due to the low quality material. As indicated in Table, many sub-factors contribute to quality in varying degrees. The interrelationships among these sub-factors and quantification of these relationships are currently under investigation.
- CONCLUSIONS:**
- i. Aggressive project schedules or targets and the receptive reaction of the development site through to delays regularly welcome undesirable outcomes on a task's expense and schedule as a consequence of the dynamic nature of schedule acceleration. This circumstance is expected for the most part to an absence of comprehension of the

- trade-offs and the cause-and effect connections of schedule acceleration.
- ii. In this paper we address this issue by dissecting the impacts that schedule acceleration has on development execution, concentrating on the trade-offs in planning arrangements and the labourers' reactions against them. Our exploration results propose that a technique of increasing speed may cause more mistake inclined execution.
 - iii. We have shown that the efficiency, rate, and nature of work tend to decay as the schedule acceleration increments over its typical level. This study shows that while a moderate level of schedule acceleration may increase profitability perhaps by expanding specialist readiness and consideration schedule acceleration over a specific level prompts specialists compromising, builds the measure of out-of sequence work and the quantity of deformities, and makes labourers lose their inspiration to work gainfully.
 - iv. The discoveries of this paper may contribute emphatically to numerous parts of the development procedure. Through examination, our outcome gives knowledge to development site supervisors on how schedule acceleration can affect negative impacts on development execution.
 - v. Allocating an optimum amount of schedule acceleration at the operative level is, therefore, a key to achieving a maximum level of labour output and, consequently, to providing greater savings to contractors. The effects of schedule acceleration is relevant because labour costs in construction constitute a significant fraction of the overall project cost and because construction productivity depends greatly upon the performance of its workers

FUTURE SCOPE:

The current study was limited to the construction industry in the (Maharashtra) India. Future study could be done in other parts of the India & world and could emphasize specific types of building construction, including commercial, education, government buildings,

skyscrapers, etc. A similar present study is needed for transportation projects to find factors that affect the productivity quality of highway construction, which will help departments of transportation to minimize unnecessary cost escalations and project-schedule delays. Central and state governments invest significant amounts of capital on road construction. Improvements in the aspect of work related to these factors should make it possible progressively to improve quality productivity in construction projects. The results showed that there is an obvious need for extensive studies on how to improve quality productivity on both national and a company level. The present study is an essential first step towards highlighting the major issues that need attention to improve the quality of construction projects In India. More efforts is still needed to investigate ways to formulate management systems (policies and procedures) to handle each factor individually.

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