

TIME DELAY IN ROAD CONSTRUCTION PROJECT

A THESIS

*Submitted in partial fulfilment of the requirements for the award of the
degree of*

**MASTER OF TECHNOLOGY
IN**

CIVIL ENGINEERING

With specialization in

CONSTRUCTION MANAGEMENT

Under the supervision

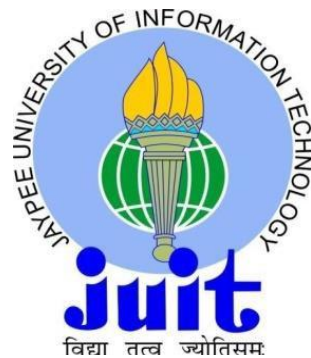
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By

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MAY-2019

STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled “**Time Delay In Road Construction Project**” submitted for partial fulfilment of the requirements for the degree of Master of Technology in Civil Engineering at **Jaypee University of Information Technology, Wagnaghat** is an authentic record of my work carried out under the supervision of **Prof. Ashok Kumar Gupta**. This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

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6th May, 2019

CERTIFICATE

This is to certify that the work which is being presented in the thesis report titled “**Time Delay in Road Construction Project**” in partial fulfilment of the requirements for the award of the degree of Master of Technology in Civil Engineering and submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Wagnaghat** is an authentic record of work carried out by **Vivek Bansal (172605)** during a period from July 2018 to May 2019 under the supervision of **Pro. Ashok Kumar Gupta**, Department of Civil Engineering, Jaypee University of Information Technology, Wagnaghat. The above statement made is correct to the best of our knowledge.

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ABSTRACT

Defer in construction industry is a global issue that occurs in most of the projects due to various causes, particular individual etc. The major objective of this research is to identify the most & least critical factor contributing delay in ongoing Parwanoo-Solan four laning road construction projects by doing a case study on it. Through profound analysing techniques the reason of delay are spot, make a possible recommendations and suggestions in order to conquer the effect of spotted defer causes that extend the duration of project and also predict the most severe factors that affect the project in future. The techniques use for analysis is RII & AI for the ranking of delay causes and SPSS is use for statistical analysis. The major factors that causes defer are due to terrible topographical region, designer, owner and contractor. The most critical delay were effect of sub-surface conditions (soil, rock, water table etc.), design disputes / errors, deliver the furnish site to the contractor, delay in resource allocation, indecent planning and scheduling, strikes and so on. The terrible effects of delay due to these causes were the incremental overall project cost, wastage of time due to postponement of activities at site, resource and problem in resource allocation etc. we can only reduce the effective delay and defer cannot be entirely eliminated, it can control or minimize by improving the management skills & understanding individual responsibilities towards their duty.

Keywords: Factor contributing delay, effects of delay, conquer the effect.

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LIST OF SYMBOLS & ABBREVIATIONS

RII	Relative Importance Index
AI	Average Index
SPSS	Statistical Package for the Social Sciences
DG	Delay Groups
VLI	Very Low Important
LI	Low Important
MI	Moderate Important
HI	High Important
EI	Extreme Important
ORLS	Owner related Likert scale factor
CRLS	Contractor related Likert scale factor
CTLS	Consultant related Likert scale factor
MLLS	Material related Likert scale factor
ETLS	Equipment related Likert scale factor
LRLS	Labour related Likert scale factor
DRLS	Designer related Likert scale factor
OFLS	Other factor Likert scale factor

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Construction industry is the fastest growing industry in the world. Construction industry of any country contributes the huge economical boost to their country or in other language generates huge revenue. But occurrence of delay in the construction project (whether it is government, private, semi government) is the most common problem face by the construction industry either it is road construction project, building project, multi-storey commercial complex, any recreational project, any type of project faces this problem of delay. Due to this the time lag is take place or time extension to the project will take place, due to this time overrun over budget is also invested to the project to complete the project on time or in short cost overrun take place. Delay cannot be totally eliminated but it can control or we can minimize the effect of delay by rectifying the factors causing defer to the construction project and the most important thing we can only minimize the effective delay in the construction project. Due to occurrence of delay the value of project or preciousness will decrease by days passing. If Defer in the construction project will occur then question arises why they occur or you can say that, what are the causes of occurrence of delay in the construction project? And what are the effect of it weather it is good or bad, or we can say that what are the effects of delay in the construction project? And the next question is how they can be effectively minimized? There are various factors causing defer in any type of construction project and these factors are further subdivide into eight different groups under which these factor justifies, these groups are shown in fig-1 and effects of delay in the construction project are various components realizing postponement few of them are: several are within the legally binding labourer's commitment and some are within owner's hazard. It is hard to disclose them because of the covering idea of the occasions of which the venture members are dependable. It is discovered that postpone issues are cause because of the question, cost overwhelm, time invade arrangement absolute renunciation, Litigation, claim, relinquishment and so on. Effects of Defer is shown in fig-2 because of these concern venture individuals agrees for the cases for the additional economy and extra time associated with development defer. The results of deferral are diverse for various undertaking members which additionally rely upon the sort of task.

The general outcomes are cost invade, time overwhelm and so forth. For the proprietor/customer delay is the wastage of time, wastage of cash, and wastage of other resource and so on. For the temporary worker, defer implies the loss of riches for more consumption on equipment's, different materials and for employing highly skilled manpower, as well as resources.

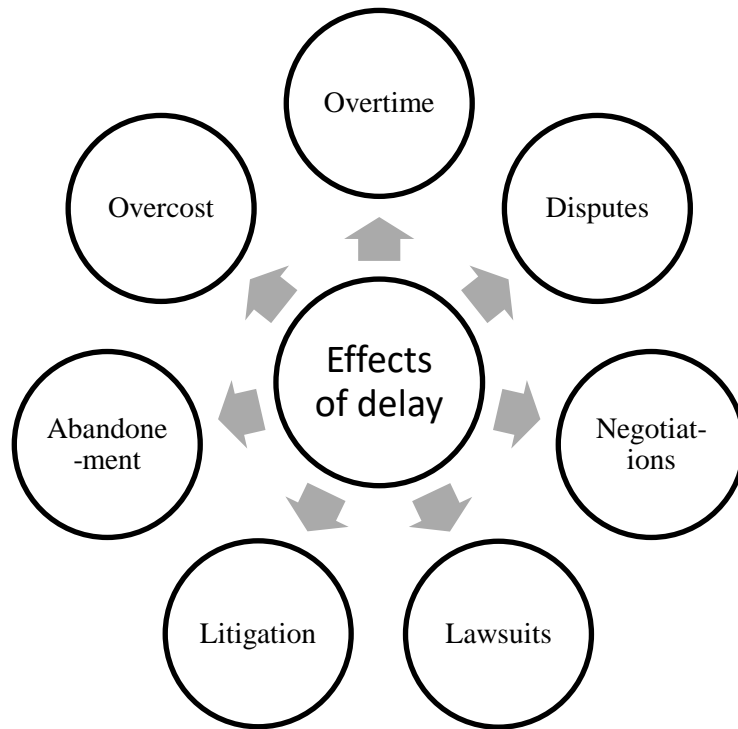


Fig.1. Effects of delay in construction project.

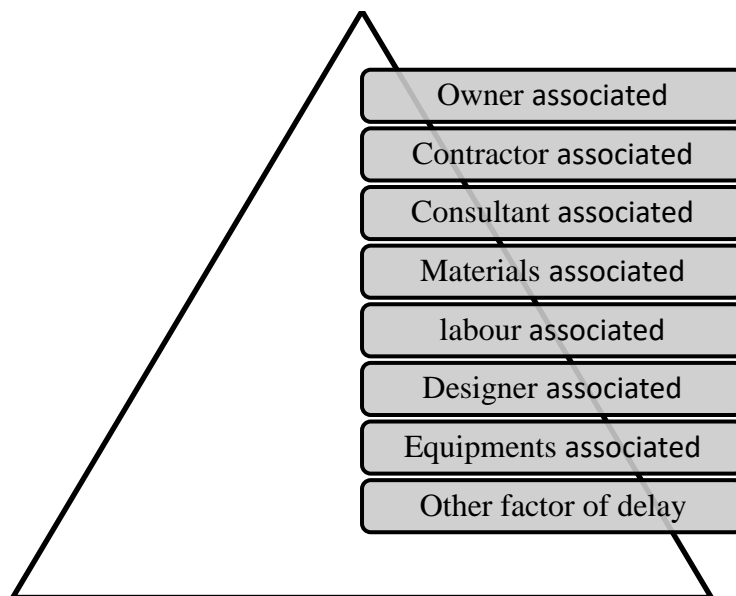


Fig.2. Group of delays in construction project

1.2 DEFINITION AND TYPE OF DELAY

In simple language delay is defined as the time overrun or extension of time to complete the project due to deviation in the construction schedule and by other various factors like unproductivity of man power and resources, improper project planning & scheduling etc. Delay is expensive generally because it increase the overall cost of the construction project because of the extra utilization of the resource to complete the project on extended time. Whether it is road construction project, building project, commercial complex construction, it is significant to recognize the types on which a particular delay falls into prior to analyzing construction defer. To commence the auxiliary improvement efforts and to change it into a good point, it requires a clear understanding of particular delays type is essential. The delays are categorized into below ways:

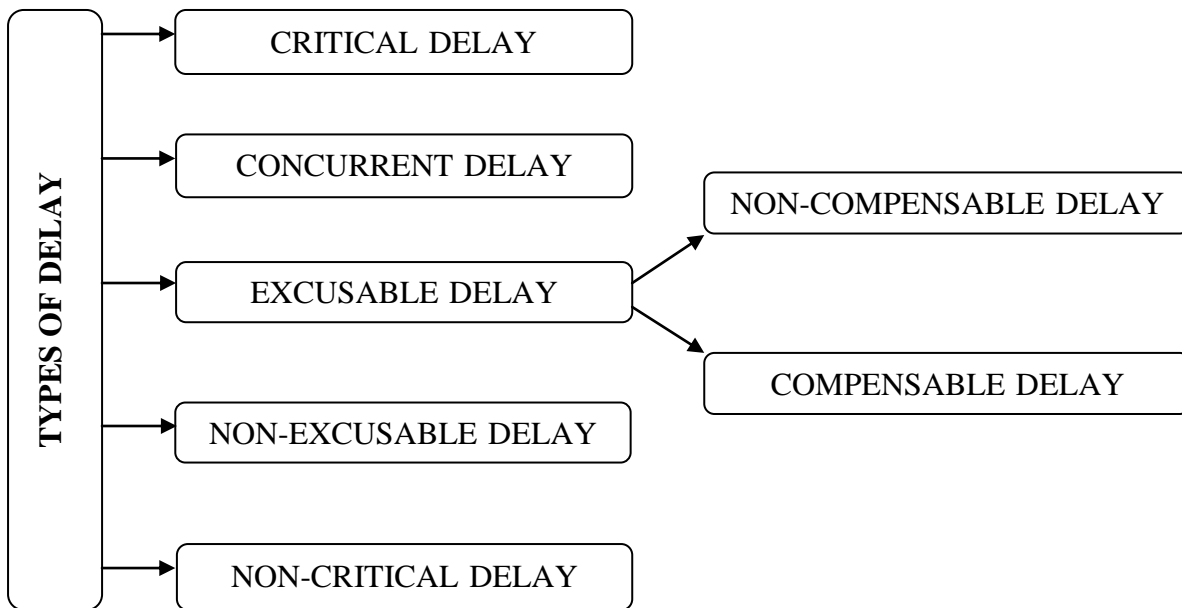


Fig.3. Classification of delays

It is also require identifying with the incorporation between the categories before decisive the impact of defer on the construction project. Determine whether the delay is critical or non-critical. Moreover, all delays are either excusable or non-excusable. Excusable delays can be further broken down into compensable or non-compensable delays.

The type of defer are supplementary defined as follows:

A) Critical / non-critical Delays:

A delay that's answerable for extending project time period is alleged to be crucial delay. Few results are intensive field overhead, unabsorbed main office overhead, inactive labor & instrumentality price and labor & material cost step-up and plenty of additional. A delay that's not answerable for the extension of project time period is named non-critical delay; on the opposite hand, it'll have a sway in terms of activities accomplishment completed late than regular action. These activities also will have an effect on project price estimates are inactive labour & instrumentality cost, labour & material price appreciation and plenty of additional.

B) Excusable & non-excusable Delay

Defer once the contractor is entitled for extension of your time or compensation or each, below the terms & conditions of contract is understood as excusable delay. during this case, contractor doesn't have any management on the activity obtaining delayed. The causes is also, force reckon clause, seemingly calamities, political/social conflict, terrorist attacks, postponement from consumer (approvals, decisions, etc.), etc. A delay once the contractor is totally in charge of the conduct or activities obtaining delayed and resulted in extending project time length (responsible for important delays) are known as non-excusable delays. During this scenario, the contractor should bear the danger of value penalty together with the obligation to pay compensation for itself however in all probability for the opposite parties further. The causes during this case might be; delayed achievement, delayed procurance, delayed submission of vital documents, designing & programming, essential events that weren't tinted to consumer on right time, etc.

C) Concurrent Delays

A situation when more than one delay event occurs at the same time affecting multiple activities at the same time/autonomously affecting the completion is **concurrent delay**. However, not all those events facilitate the contractor to be entitled for extension of time & cost claim. Significantly, it is the causes of delay rather the delay themselves, that must overlap.

D) Compensable or non-compensable

A Situation when contractor is answerable for Time Extension & Cost compensation is **compensable delays**. All compensable delays fall under excusable delays-Whereas, if the contractor is uniquely at fault for a delay event, it is termed as **non-compensable delay**.

However, non-compensable may fall under critical, non-critical, excusable or non-excusable; depending upon the situation it has created and conditions of contract.

1.3 FACTORS AFFECTING DELAY IN ROAD CONSTRUCTION PROJECT

Table 1: Causes of Delay

GROUP OF DELAYS	DELAY'S CAUSES
A. Factors related owner	Defer in progress payments by owner
	Delay to furnish & deliver to site by the owner to the contractor
	Changes order & extra order's by the owner during construction
	Delay in approving drawings & sample materials
	Late in changing & approving designed documents by the owner
	Slow & late decision making by the owner
	Type of lowest project bidding & awards
	Stopping of ongoing work by the owner
	Lack of communication by owner with other fellow construction parties
	Delay in projects by owner side
	Late handover of land by the owner
	Lack of involvement and experience of owner in particular project
	Unprofitable delay penalties
	Unreachable to professional construction management.
B. Factors related to contractor	Problem in financing project by the contractor side
	Lack of communication between contractors
	Frequent change in project schedule
	Lack of resource management
	Improper safety management by the contractor due to unsafe working condition
	Disputes between contractors and other parties
	Lake of supervision & site management
	Lack of qualification of contractor's technical staff
	Bad estimation of project time
	Inadequate construction method

	Delay in starting of project
C. Factor related to consultant	Lack of inspectors
	Lack of skilled consultant's engineering staff members
	Delay in approving drawings & sample tested materials
	Deviation & mistakes in document design
	Incapable inspectors
	Lack of planning & project schedule by consultant side
D. Factor related to materials	Poor efficiency of equipments
	Lack of equipments
	Changes in materials and specifications
	Lack of construction materials in market
	Issue arising while transportation of material
	Fluctuation in material price
	Deterioration of material while they are needed urgently
	Retard in special building materials
	Lack of quality materials
	Unexpected increase in quality of material needed in construction
E. Factor related to labour	Lack of labour
	Conflicts between labours and management team
	Conflicts between labour
	Strikes of labour at site
	Hazardous condition of labour safety & health due to lack of knowledge
	Lack of qualified workforce
	Less amount of labours is used to do particular work
	Lack of nourishment (food) to labour & technical staff
	Delay due to operation of equipment by unskilled labour
F. Factors related designer	Discrepancies made in design document
	Delay in design work
	Insufficient & inappropriate data collection and design
	Use of preliminary engineering design software
	Insufficient and unclear detail in drawing
	Budgeting problems

	Misunderstanding of owners
	Requirements by design engineers
G. Factors related projects	Bad terrain condition
	Insufficient construction area
	Interference to public activities
	Assign project to lowest offer(bid) price
	Disputes with neighbour
	Tragedy during construction
	Inadequate soil quality of construction ground
	Traffic interruption and restriction at job site
H. Factors related to equipments	Lack of heavy equipments when needed
	Less efficiency of equipments
	Failure of equipments
	Poor level of equipment skilled operators
	Shortage of advance hi-tech & special equipments
	Due to cheap labour cost limited mechanization
	Difficult in hiring and transporting to the site
I. Other factor of delay	Poor weather effect
	Changes in rule and regulation by government
	Poor communication between parties
	Changes in policy for loans by bankers
	Frequent changes in policies
	Exchange rate fluctuations
	Strike, earthquake and riot etc
	Delay in inspection & certification by third party
	Delay permit by government
	Interference of local public live in nearby of construction project
	Tragedy during construction
	Restriction and heavy traffic at site
	Public strikes
	Economic crisis
	Restrictions by government agency
Type of project offer and award	

I. Other factor of delay	Late finalisation of rates
	Effect of social and cultural factors
	Poor site clearance due to restrictions
	Checking process for quality
	Extra items
	Disputes with neighbour
	Inadequate project document & management
	Lack of communication between owners and contractors and sub contractors
	Shortage of overall organizational structure
	Process of taking legal action between various parties in between construction
	Lack of government judicial system for construction conflicts settlement
	Delay due to sudden change in alignment due to obligatory points (historical rail bridges & temple etc)
	Due to difficulty in good resource management
	Due to poor working environment for efficient progressive construction
	Delay due to rework of unaccepted quality of work
Delay due to the forestry department for clearance of expensive trees in between construction project	

1.4 WORK PLAN METHODOLOGY

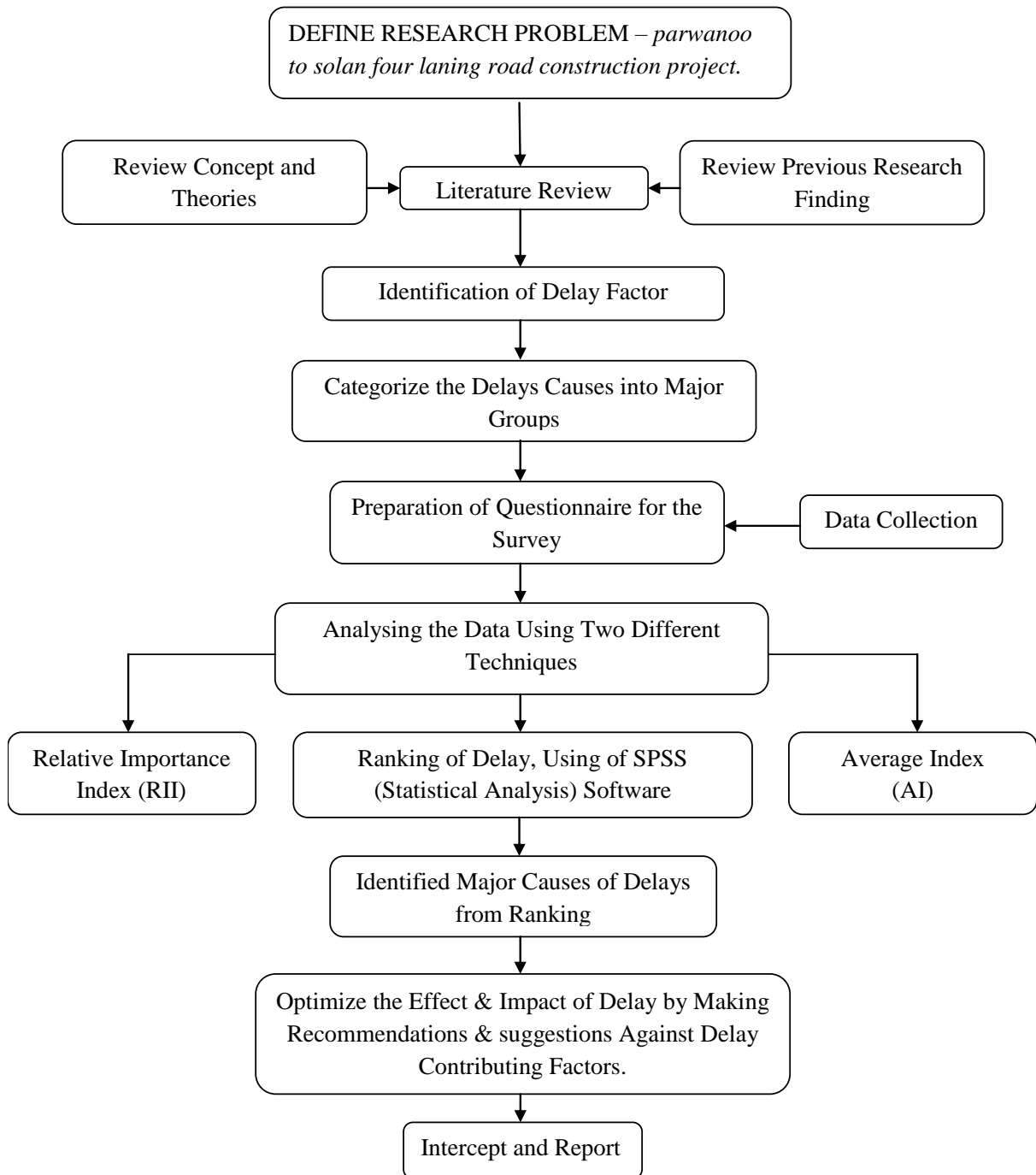


Fig.4. Methodology flow chart

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

A standout amongst the most essential issues in the Construction business is delay. Deferrals happen in each development venture and the size of these postponements fluctuates significantly from undertaking to extend. A few ventures are just a couple of days behind the timetable; some are postponed over a year. So it is basic to characterize the genuine reasons for postponement so as to limit and keep away from the deferrals in any development venture.

There is a wide scope of perspectives for the reasons for time delays for building and development ventures. Some are owing to a solitary gathering, others can be credited to a few quarters and many relate more to fundamental flaws or inadequacies instead of to a gathering or gatherings. The fruitful execution of development ventures and keeping them inside assessed cost and recommended plans rely upon a system that requires sound designing judgment. [1]

2.2 PREVIOUS STUDY

1. **Mahamid et al. (2012) [18]** According to their study, they identified 52 delay causes who severely cause the delay in road construction project in West bank in Palestine. To identify the causes of delay and severity through a questionnaire survey which was filled by contractors and consultants etc. by the help of severity index percentage. They rank the delay causes and concluded the top 5 delay causes are political situation, award to lowest bid price , progress payment delay by owner, shortage of equipment ,sectionalisation of the West bank and restricted movement between areas.
2. **San Santoso et al.(2016) [19]** In their study they identified 64 factors causes delay in road construction project in Cambodia. By the help of questionnaire survey filled by engineers, contractors and consultants. They analyse the data by importance index and firstly it was necessary to calculate the severity and frequency index. Through this index they rank the top 10 major factor causes delay in Cambodia and then make recommendation to minimize the impact of factor causes delay and the major factor contributed delay in their project was the rain and flooding.

3. **Mohamed M. Marzouk et al. (2014) [22]** In their study they evaluate and categorized the 7 delay group factor causes delay in Egyptian construction projects and then they obtain the feedback of construction through experts (owners, consultants and contractor's organizations). Through interviews and questionnaire survey and collected data was analyzed by calculating the frequency index, severity index and importance index and through this index they determine the top delay group causes delay in Egyptian construction projects. Delay was majorly contributed by owner related delay group and secondly the contractor related delay group and then recommendation was made to achieve delay reduction in construction project.
4. **Khalid Khair et al. (2018) [23]** In their study they proposed the management framework to reduce the effect and causes of delay in Sudan road construction project and this management framework was based on the stage gate approach controls and project lifecycle assessment and they categorize the stage with phase and these stage is related with activities consisted with project like stage 1 was pre- project phase, stage 2 was project feasibility phase , stage 3 was engineering development phase and stage 4 was construct a closing phase and this framework was initiated before the assessment of the factor causes delay in construction project and through this study they concluded the finance competence group caused huge effect on delay in road construction.
5. **Hemanta Doloi et.al. (2012) [24]** The objective of their study was to find and minimized the effect and causes of delay in Indian construction project. Firstly they identified the 45 key factors causing delay in Indian construction projects and then the questionnaire survey and personal interviews was conducted for the data collection and this data was analyzed by RII to rank the causes of delay and they use two statistical techniques that was regression modelling and factor analysis was applied for predictive study, from their study they concluded that lack of commitment, poor site coordination, inefficient site management etc. was the primary factor causes delay.
6. **Remon F. Aziz, Asmaa A. Abdel-Hakam (2016) [25].** In their study they determine the most crucial and least crucial causes of delay in highway construction in Egypt for this they prepared a questionnaire consists of 293 delay causes and this was filled by 389 construction participants (consultants, contractors, site engineers etc). This collected data was assessed by RII and ORII technique for rank the crucial delay causes from their study they found owner financial problems was the most crucial delay factor followed by shortage of equipment, inadequate contractor experience etc and the least crucial factor was nationality of labours,

public holidays, changing of banker policy etc. from this conclusion they make some future recommendation in order to minimize, control the factors influences delay.

7. **Sadi A. Assaf, Sadiq Al-Heji (2006) [26]**. Their study evaluated the causes of delay and their importance of various kind of construction project in Saudi Arabia through questionnaire field survey. Which was filled by 23 contractors,15 owners and 19 consultants. Where they identified 73 factors causes delay, this causes was combined into nine groups. This collected data were formulated by importance index, through their formulation they concluded 56% of consultant and 76% of contractor indicated that average time invade was between 10% to 30% of original time duration and rest 25% of consultants indicate 30% to 50% of time over run , change in order by owner side during construction is one of the most critical common cause between all the parties and least important causes was change in government regulations, effect of cultural and social factors.
8. **Ibrahim Mahamid (2011) [27]** Their study identify the risk matrix prevailing time delay in highway construction project in the west bank in Palestine from owner's point of view and they determine 43 factors that dispense delay ,then they put this delay factor in tabulated questionnaire form and that was filled by 25 public owner from their opinion on factor causes delay in construction project from their analyses they concluded that 6 factors was fall under low risk level zone, 29 factors fall under moderate risk level and 8 factors located under critical factor that influence delay in west bank. The most severe factors they identified was poor communication between construction parties, delay due to insufficient inspection and poor resource management.
9. **Ogunlana et al. (1996) [14]** identified 26 postpone causes influencing construction industry in a quickly developing economy in Thailand feline classified them into 6 gatherings, and information were gathered by visiting locales and mailing to 17 temporary workers, 18 advisors and plan firms and one anticipate proprietor. 8 contractual workers and 6 advisors gave endorsement of which just 12 ventures were chosen for visits. Meetings were directed nearby utilizing organized and unstructured meeting plans. An aggregate of 30 people, speaking to 2.5 people per venture, were between seen. The consequence of the review has been contrasted and contemplates from other creating economies. The consequences of the investigation bolster the view that development industry issues in creating economies can be settled in three layers: (a) problems of deficiencies or insufficiencies in industry foundation (principally supply of assets); (b) issues brought about by customers and advisors and (c) issues brought about by contractual worker incompetence/insufficiencies.

10. **Greenwood et al.(2001)** [3] pronounced that medical clinic ventures are especially helpless to delays, some of which give off an impression of being regular to the development of huge emergency clinics wherever they are assembled. In various studies of development experts, a standout amongst the most influential reasons for postponement on vast open ventures has been observed to be managerial reasons, and expected to utilize these investigations as a reason for investigating the effect of regulatory deferrals on the development of medical clinics.
11. **Odeh and Battaineh (2002)** [13] –identified 28 defer causes influencing development ventures with customary sort of agreements in Jordan; first, a study poll was created to survey the view of temporary workers and specialists of the overall significance of development postpone causes. Second, the poll was dispersed to an arbitrary example of contractual workers and advisors taking a shot at huge activities in Jordan. The Spear-man's rank relationship coefficient was then used to test relationship between the temporary workers and experts positioning. The investigation uncovered that Owner obstruction, deficient temporary worker experience, financing and instalments, work efficiency, moderate basic leadership, ill-advised arranging, and subcontractors are among the ten most vital variables, as per contractual workers, and work profitability was the most vital defer factor. Lacking temporary worker experience was the most essential postpone factor to experts.
12. **Aibinu and Odeyinka (2006)** [1] surveyed reasons for postponements by concentrating on activities and inactions of undertaking members and outside variables. The investigation broke down quantitative information from finished structure undertakings to evaluate the degree of postponements, and information acquired from a poll study of development administrators to survey the degree to which 44 identified variables added to generally delays on a common task they have been included with. The findings demonstrated that the components could be organized. Be that as it may, Pareto examination uncovered that 88% of the variables (speaking to 39 most elevated need factors) were in charge of 90% of the general deferrals. There is no perceive capable distinction among the diverse defer variables and none truly emerges as adding to a substantial level of the issue. A one-example t test further confirmed that the greater part of the variables are imperative supporters of postponements.
13. **Lo et al. (2006)** [10] gone for social affair the impression of common development experts on how significant are the reasons for deferral. The degree of the distinctions in observation

among the diverse respondent gatherings was additionally analyzed utilizing the rank understanding component (RAF), rate understanding (PA), and rate contradiction (PD). The distinctions in the perceptions of the respondents on the significance of deferrals and the real reasons for postponements for the six ventures contemplated were likewise analyzed. A solid accord was found between the customer and expert gatherings on the significance of the different reasons for postponement (PA = 74%) and the adequacy of alleviation measures (PA = 67%) contrasted and different sets of gatherings. The specialist and temporary worker bunches held amazingly unique recognitions with respect to the significance of different defer causes (RAF = 4.9 and PD = 32%) and the viability of relating alleviation measures (RAF = 6.2 and PD = 47%). It is trusted that the findings can give substantially more knowledge to the development professionals just as the specialists and in this manner help to improve the profitability and in general execution of structural building ventures in Hong Kong.

14. **Hegab and Smith (2007)** [6] defined delay in microtunneling as the nonworking time of a microtunneling venture because of any reason other than booked stops. There were more purposes behind defer, for example, mechanical disappointment of framework parts, spillage of water powered hoses, blockage of slurry pipes, and hanging tight time for unearthed materials pulling gear. Postpone information were gathered from 35 microtunneling activities. Gathered postpone information were defer term, postpone reason, time, and area from the begin to the ceasing point. Five classes of defer causes were utilized in the investigation. Forecast of postpone time will upgrade the estimation precision of microtunneling venture length. A prescient model utilizing a probabilistic methodology was chosen to speak to the defer time. In light of information qualities, a Weibull dissemination was resolved to best speak to the general postpone span in microtunneling ventures. Utilizing "relapse with life information," expected in general postponement in a microtunneling venture could be anticipated as a component of driven length. The model will assist contractual workers with estimating all out task time with sensible precision. Realizing the foreseen defer time will enable contractual workers to have a point of correlation for real execution.
15. **Le-Hoai et al.(2008)** [29] identified 21 concede explanations behind sweeping advancement stretches out in Vietnam, recorded in six separate get-togethers through field diagram strategy and composing reviews, a pilot survey was prepared and 6 pros in Vietnamese improvement industry (VCI) were incorporated to in a general sense review the arrangement and structure of the survey then it was set up to audit. A total of 285 overviews are sent to improvement

specialists, and 87 full responses are obtained showing a response rate of 30.5%. The data are taken care of through three documents: repeat list, Severity record, and essentialness rundown and thereafter to separate the comprehension between each two social affairs as to the explanations behind deferral was evaluated using Spearman's rank association coefficients. From the results it is seen that poor site the officials and supervision, poor endeavour the board help, financial difficulties of owner, financial difficulties of brief specialist, plan changes are five most relentless, genuine and basic causes.

16. **Toor and Ogunlana (2008) [16]** created poll reviews and meetings that were directed on a noteworthy development venture in Thailand to investigate the most noteworthy issues exhibit development defers. Components identified with creators, contractual workers and specialists were appraised among the top issues. Issues, for example, absence of assets, poor contractual worker the executives, lack of work, structure deferrals, arranging and booking deficiencies, changed requests and temporary workers' financial difficulties were likewise featured amid the meetings. Eminently, issues, for example, 'multicultural and multilingual condition causing incapable correspondence', 'huge number of members of undertaking' and 'contribution of a few remote fashioners and temporary workers' were appraised among the last 10 issues in the 75-thing issue stock.
17. **Sweis et al. (2008) [15]** identified and classified the purposes behind advancement delays in private endeavours according to Drewin's Open Conversion System. The most generally perceived causes were evaluated by using both, the data assembled in an investigation coordinated to private endeavours master planners, brief labourers, and owners, and gatherings with senior specialists in the field. Most columnists agreed that, financial difficulties looked by the impermanent specialist and too many change orchestrates by the owner are the primary wellsprings of improvement delay. Outrageous atmosphere conditions and changes in government rules and laws situated among the least basic causes.
18. **Hegazy and Menesi (2008) [7]** acquainted enhancements with an electronic calendar investigation show so it will create exact and repeatable outcomes. The model considered various pattern refreshes because of changes in the lengths of the exercises and the sensible connections among them, just as the effect of asset over distribution. The model utilized a day by day window measure so as to consider all fluctuations in the basic ways and utilizations an intelligible portrayal of advancement data to precisely allocate deferrals and increasing velocities among venture parties. A straightforward contextual investigation has

been actualized to exhibit the precision and handiness of the proposed defer examination demonstrate.

19. **Kaliba et al. (2009) [8]** intended to recognize conditions and final products of cost increasing and plan delays in street improvement adventures. Using a point by point composing review, sorted out gatherings and survey diagrams, the results of the examination confirmed the inescapability of cost increasing and plan delays in street development stretches out in Zambia. The examination set up that horrendous or unforgiving atmosphere due to overpowering storms and floods, scope changes, environmental affirmation and lightening costs, plan delay, strikes, specific troubles, inflation and neighbourhood government loads were the genuine purposes behind cost increasing speed in Zambia's street advancement adventures.
20. **Al-Kharashi and Skitmore (2009) [2]** separated another review in Kingdom of Saudi Arabia that utilizes the majority of the parts from the past work and measures for both current element of impact on deferrals and how much each can be inside and out that truly matters improved. These are contained in seven groupings: customer, con-tractor, ace, materials, work, contract and relationship-related causes. The examination covers an instance of 86 customers, con-tractors and masters working in the Saudi headway industry. The examination found that the most influencing current reason behind postponement is the nonappearance of qualified and experienced individual nil credited to the basic extent of colossal, imaginative, improvement expands and related current Undersupply of work in the business.
21. **Yang and Wei (2010) [17]** identified 35 defer causes, 15 causes in the arranging stage and 20 causes in the plan stage for development extends in Taiwan by sending an organized poll to engineers at the An/E organizations for open development extends in Taiwan bringing about 95 substantial reactions recognizing the postpone causes. This investigation utilized the Likert scale in poll configuration to plot the significance recurrence framework and positioned the variables by the significance and recurrence of postpones utilizing the Relative Importance Index at that point determined the seriousness file. Logical outcomes uncover that adjustments in customers prerequisite are the primary driver of deferral in both arranging and configuration stages.
22. **Soliman (2010) [30]** identified 29 defer causes influencing development extends in Kuwait through refining past looks into, arranged them into six gatherings at that point exposed to a poll study including 30 respondents made up of 9 contractual workers, 5 proprietors and 16 specialists. Information gathered were broke down by significance file and after that an

understanding examination was determined utilizing the Spearman's rank connection coefficient to demonstrate the level of understanding between the rankings of any two gatherings. The examination uncovered that the financial and configuration related reasons for postponements are the most imperative and incessant causes. The top five postpone causes that were come about because of contractual workers class were: deferral of report accommodation from specialist, postponing of instalments from proprietor, conflicts among temporary worker and expert, in-suitable proprietor delegate's administration style and proprietor financial issues, While the five top defer causes from advisors classification are: proprietor financial issues, temporary worker financial issues, inefficient the executives ability of contract based worker staff, conflict among contractual worker and advisor, and no arranging before undertaking begin.

23. **Haseb et al.(2011)** [5] identified 37 delay causes impacting improvement industry in Pakistan. A survey was coordinated through sent 200 surveys that were flowed in government, private and semi government relationship out of which 120 were given response and in specific affiliations interviews were vocally taken by the works or private firms. The delay factors are studied by the essential evaluation criteria; for instance, mean concede factor range, mode and fundamental record. The audit results showed that a large portion of defer factors are noteworthy to client factor which must have strong moderate limit and financial game-plan for endeavour, precisely time decision. Most factors related to master are a result of not understanding the client necessities, not having authentic endeavour information, nonappearance of some detail in delineation. Besides, due to brief labourer most concede factors occur in light of deficient in getting ground breaking supplies, shocking material used being developed. Client must be normally and financial strong for starting another endeavour on account of which delays can be lessened in endeavours.
24. **Kazaz et al.(2012)** [9] inspected the reasons for time expansions in the Turkish development industry and dimensions of their significance together. Altogether, 34 most factors influencing venture length were considered. A poll study, including these components, was then connected to 71 development organizations in Turkey, & the results were assessed by methods for factual examinations. As indicated by the outcomes, "structure & material changes" was observed to be the most dominating element, trailed by "postponement of instalments" & "money flow issues". Regarding significance dimensions of factor gatherings, financial factors were observed to be the first gathering, while natural components were the least successful gathering. It ought to be likewise noticed that administrative reasons for time

expansions are experienced in created and creating nations, while financial causes are knowledgeable about creating nations as it were.

25. **Niazai and Gidado (2012) [31]** identified 83 concede causes impacting advancement industry in Afghanistan requested them into nine social affairs, through in depth composing examines overviews were made & sent to a 60 meticulously picked improvement industry accomplices including: 20 client, 25 contractual worker, & 15 counsel in Afghanistan. The hugeness record was used to separate the data collected and the comprehension between each two social occasions with respect to the purposes behind deferral was assessed using Spearman's rank association coefficients. The detection exhibit that the principal essential factors that reason improvement defers in Afghanistan are: security, degradation, poor qualification of transitory labourer's particular staff, portion defers by clients, and poor site the administrators and supervision by legally binding specialist. The respondents itemized that concurrence with under a year extraordinarily adds to delays and the most broadly perceived time spent for the most deferred exercises in Afghanistan is between 1 to a half year.
26. **Dinesh kumar R (2016) [28]** in their study they evaluate the most significant delay factor effected Indian construction projects by the help of questionnaire survey, from their study they identified 103 causes of delay which was further subdivided into 8 different groups. The severity of occurrence of their causes was evaluated by (contractors, consultants, owners and other) then this surveyed data was analysed by RII method, from their analysed data they rank the delay causes and from their research they concluded that deficient contractor's work experience & poor risk management was the major issue which causes delay and also gave alternatives to reduce or minimize the delay causes.
27. **Gunduz et al. (2013) [32]** the aim of their study was to identify and rank the most critical factors affecting delay in Turkey. In their research they determine 83 different delay factor and through their conducted survey within expert participants, they analyzed the collected survey data with the use of Relative Importance Index method, by this they wrap up with the result that inadequate contractor experience & unproductive project planning and scheduling was the top or major rank delay cause, slow site clearance was the least rank delay cause that prevail time overrun in the construction projects.

2.3 OBJECTIVES

The aim of this thesis is to study the factors affecting delay in Parwanoo–Solan road construction project by GR INFRA PROJECTS LTD.

The objectives of this thesis are:

1. To determine top & base 15 rank factors according to their importance in delay project by Relative Importance Index (RII) & Average Index (AI) techniques.
2. To analysis defer factors by various model of Statistical Package for the Social Sciences (SPSS).
3. To optimize the delay by making recommendations and suggestion against major delay factor identified in Parwanoo-Solan road construction project.

CHAPTER 3

PROJECT STATEMENT AND DATA COLLECTION

3.1 ABOUT THE PROJECT

Good road connectivity is very essential for any country to boost their economy this can be happen by providing the four lane to the particular place. So himachal Pradesh government decide construct the four lane between three major places which is Parwanoo-Solan-Shimla. (National Highway Authority of India)NHAI float a tender of this project, which can further divided into 3 phases 1st phase is from Parwanoo-Solan, whose length is around 39 km and 2nd phase is from Solan-Kaithali Ghat, whose length is around 23 km, 3rd phase is from Kaithali Ghat-Dhali (Shimla), whose length is around 27 km. The total estimate cost of this Parwanoo-Shimla four lane highway of total length 89 km is around Rs 2,518 crore.

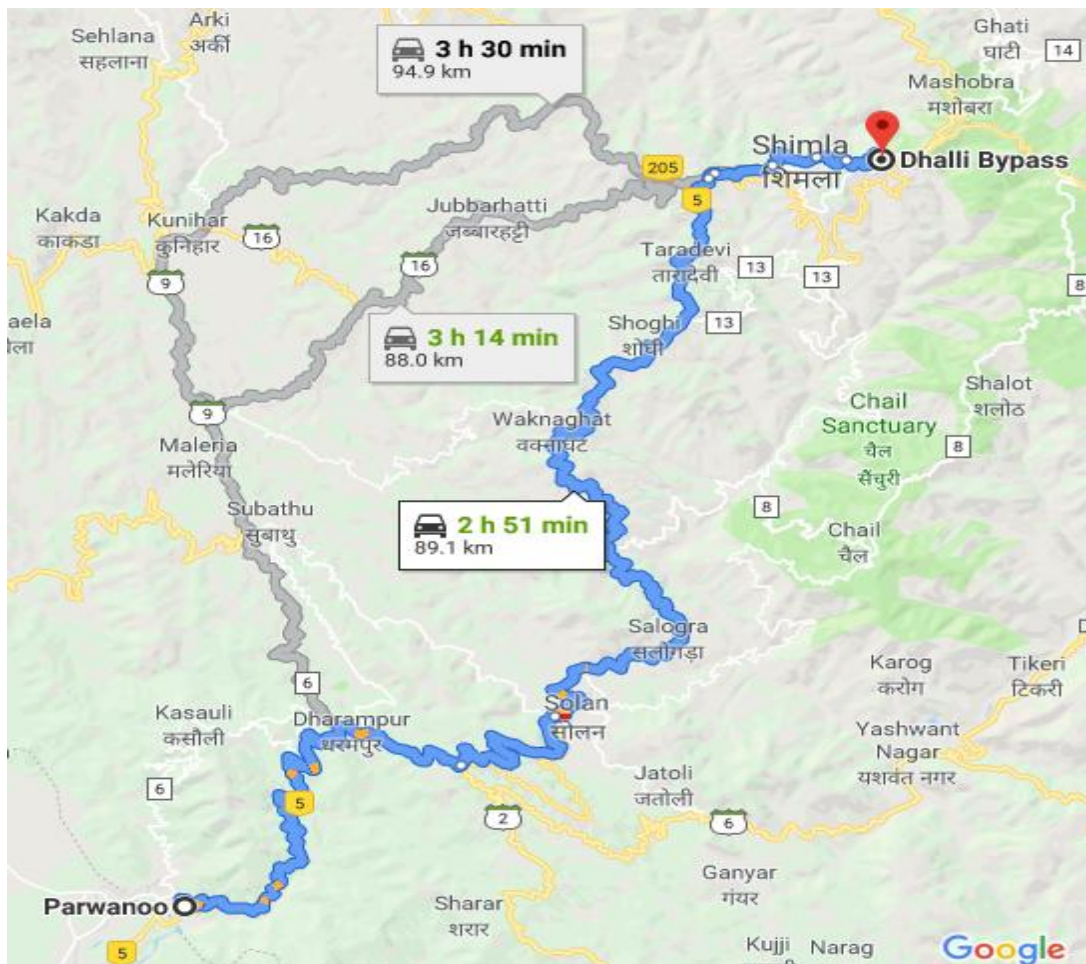


Fig.5. Map of Parwanoo to Shimla (Dhali) four lane construction project.

The research objective of study is to study the factor causing delay in 1st phase of the Parwanoo-Shimla four lane highway project, which is parwanoo-Solan whose length is 39 km and project estimate cost is around Rs 748 crores, this stretch work is awarded to G R INFRAPROJECT LIMITED. Project duration of this Parwanoo-Solan project is 30 months after providing the 80 percent of land available for the construction work by government authority, which were starts from September 2015 to March 2018, forest clearance of 37 hectares of land within limited time period of 30 months has been set for the completion of project on time.

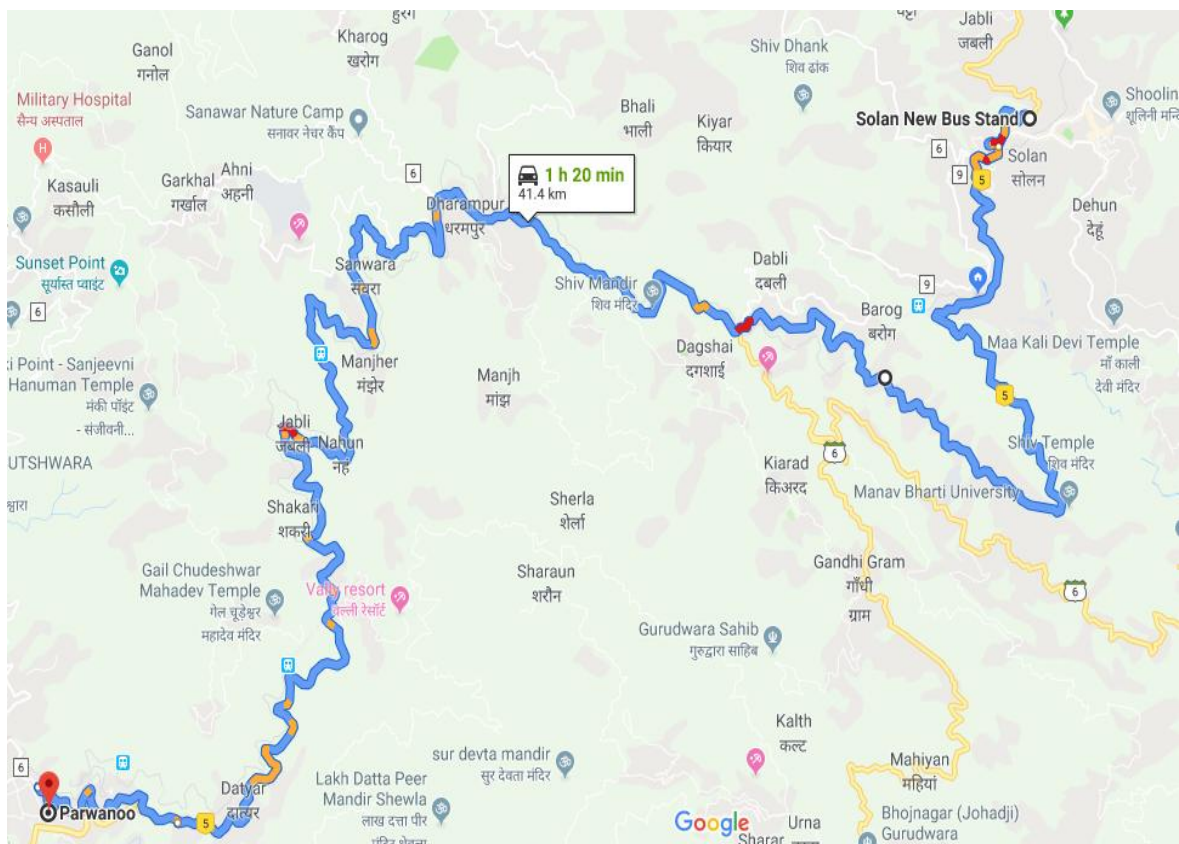


Fig.6. Map of Parwanoo to Solan four lane construction project.

Under this Parwanoo-Solan four lane project one way tunnel of length 835 metre would be made near Barog bypass, flyover at Kumarhatti and two railway over bridges at Sanawar & Barog bypass to reduce the distance by 3 km and several culverts, minor bridges, cross drainage, retaining wall, breast wall would be made. After realignment the present length of road, it is reduced about 39 km from 42 km total reduction is 7 km. While 21 km service road is also constructed at Dharampur and Solan. And is project is awarded to GR Infraproject Ltd. by EPC mode, EPC represents Engineering, Procurement and Construction is an unmistakable type of contracting understanding in the development business.

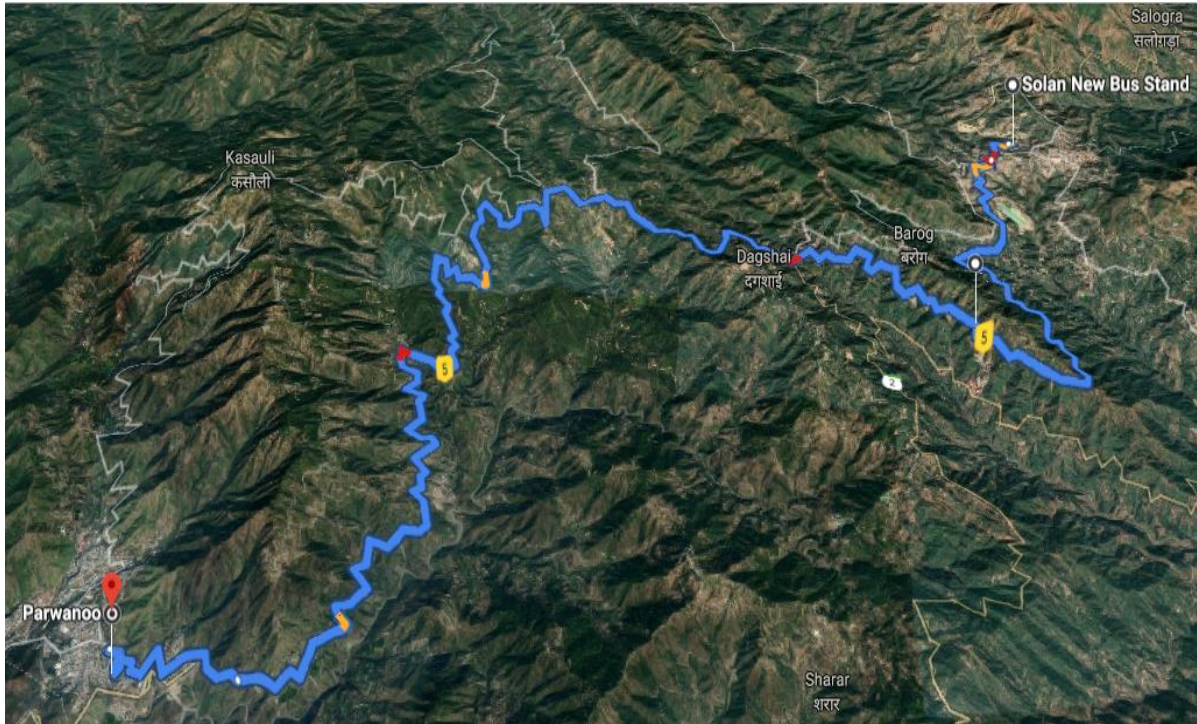


Fig.7. Satellite view of Parwanoo to solan four lane project.

The building and development contractual worker will complete the point by point building structure of the undertaking, obtain all the hardware and materials fundamental, and after that build to convey a working office or advantage for their customers. Organizations that convey EPC Projects are generally alluded to as EPC Contractors. The EPC period of the venture is otherwise called the Execution stage which ordinarily pursues what is known as a FEED (Front End Engineering Design) stage. The FEED is an essential building configuration utilized as the reason for the EPC stage. The FEED can be isolated into discrete bundles casing distinctive bits of the task. The FEED bundles are utilized as the reason for offering on when the customer offers the EPC work to the market or in other words Engineering, Procurement and Construction is one of the forms of contracting arrangement used by some of the construction industries where contractor is totally accountable for each and every activities indulge in construction work from designing part, procurement part, construction part, commissioning part and the final part is to transfer the final completed project to owner or the end-user.



Fig.8. Cutting and levelling work



Fig.9. Construction of retaining wall



Fig.10. Preparation of levelled surface



Fig.11. Installation of geo-synthetic



Fig.12. Construction of fly over



Fig.13. Construction of tunnel

INTERFERENCE

Above figures show the construction activities at Parwanoo-Solan four lane works by GR INFRAPROJECT Ltd., in which we can see the several ongoing activities like cutting and levelling of mountains for the construction of highway, construction of retaining wall to support the mountain mass, installation of geo synthetic material, construction of fly over at kumarhatti, 921-metre one-way tunnel on the Barog bypass.

3.1.1 BENEFITS OF THE PROJECT

The venture will have numerous benefits. It will decrease the travel instance significantly between Solan to Parwanoo, the two principal cities of Himachal Pradesh. The planned alignment also reduces the distance sandwiched between Solan and Parwanoo by about 7 km due to enhanced alignment. In addition the superior road will provide other benefits are as follows:

- Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost to the society.
- Service prospect to people.
- Maturity of neighbouring business, agriculture and handicrafts.
- Progress of tourism and pilgrimage.
- Transporting, dispensation and selling of agricultural products.
- Diminution in accidents.
- Diminution in pollution.
- Breach up of opportunities for new occupations.
- Better loom to remedial & Educational services and speedy hauling of consumable commodities like fruits, vegetables and dairy products etc.
- Enhanced eminence of life for people and many more.

3.2 DATA COLLECTION

Data collection is the most essential and important parameter to fulfil for the quality research. Collected data was customized according to the research ambiance. On which your work will based upon. In this study data was gathered by two different method.

3.2.1 PRIMARY DATA COLLECTION

The primary information touch the initial info collect by the analyst himself in his or her investigation. This information is formed accessible out of the blue simply by the specialist. the info may be gathered through direct near home examinations, through respondents, and summary utilizing surveys. the buildup modes may likewise be through; messages, individual meeting, phonephone meeting and self-reliant summary. the advantages of this system for operation incorporate; unwavering quality and exactitude and besides it's a superior strategy for escalated examination. Then again, the impediments are staggering expense associated an excessive quantity of your time spent, and therefore the strategy

isn't affordable for broad enquiry. As a results of the quantitative plan of our investigation, the essential infowas gathered within the review by utilizing surveys and what is more phone interviews. The polls were messaged to our objective respondents WHO were relied upon to fill the fragile duplicate of the surveys and came back them by mails or by speed post

3.2.2 SECONDARY DATA COLLECTION

The secondary data auxiliary information alludes to that data which have just been gathered, broke down, archived and distributed by some different specialists or individuals. The analyst along these lines utilizes this data to help his or her present examination or discoveries. Getting this data is quicker, more affordable, and incredible exercises, for example, studies are not required. Be that as it may, this data gathered isn't constantly accessible for nothing and will cost cash, the data are not in every case enough, some are old or terminated in the mean time some are false data. In this examination, our auxiliary information was gathered from scholastic online sites, for example, various online published articles and journals, university libraries, books etc.

3.2.3 QUESTIONNAIRE

Questionnaire was the most important and main tool to gather the information from our targeted respondents. Through this questioner survey the opinion of the different employee working in GR INFRA PRIVATE LIMITED will extract from the developed questionnaire. The questionnaire was structure into 3 sections which meets our research objectives.

Section A: about the respondent technical background or working designation.

Section B: mark the score or opinions of construction stake holders regarding causes of construction delay and any other feedback.

Section C: questions were design to identify the effects of delay.

Before the questionnaire was distributed a small study was conducted to validate the delay cause by experienced people like our university professor and A class contractors in this region. When our questionnaire meets or fulfil our research objectives then we distributed the questioner among expected participants who will respond to this survey.

Questioner consists of total 101 questions or can say factors causing delay to the road construction project. These questions were marked on the bases of Likert 5 point scale. 1 to 5 signify the effect of delay causes in Parwanoo Solan road construction project and this effect of delay was further classified into 8 groups according to their reliability.

CHAPTER 4

PROJECT METHODOLOGY

4.1 GENERAL

This section includes the technique and the structure that was utilized to lead the research objectives. It was a quantitative research in which the information was gathered utilizing questionnaire surveys. The populace was consist of contractors, consultants, supervisors, site engineers, designers and specialists who were chosen by arbitrary examining and accommodation inspecting procedure. There was accumulation of both essential and auxiliary information or it also called primary and secondary data. The essential information was gotten utilizing polls while the optional information was accumulated from the previous literature data. What's more this part additionally introduces the poll plan or questionnaire design, the distinctive segments of the surveys; the scale just as the pilot ponders that was directed to learn the unwavering quality of the poll.

The research methodology select for this study is from the thorough literature study. Questioner was prepared according to this four laning of parwanoo solan road construction project in Himachal Pradesh.

4.1.1 RESEARCH DESIGN

The exploration was intended to get assessments from consultants, contractors, designer, site engineers, and supervisors of construction companies and chiefs of development organizations and furthermore the proprietor concerning the components causing delays, impacts of postponements, too hazards related with development delays. The conceivable causes, impacts and dangers of deferrals were recognized from the writing and these elements were tried with the partners of the Himachal Pradesh development industry. An aggregate of 90 postpone components were recognized from the writing and partners of the GR INFRA PRIVATE LIMITED were approached to give their precious opinion on these causes through positioning.

Additionally 20 impacts of development ventures delay were likewise distinguished from the writing and questions were structured by these variables to get the conclusion from partners.

4.1.2 RESPONDENT AND RESPONDENT SIZE

The populace was made of consultants, contractors, owner, site engineers, supervisors, designers with over 10years of involvement in the development business and private customers or proprietors. In addition all respondents had accomplished tertiary training. This inferred the high position, extensive long periods of work involvement and instructive foundation gave our respondents enough learning of the development business with issues identifying with causes, impacts and dangers of development delay. The populace measure comprised of 101 respondents, which included 12 contractors, 5 consultants, 3 owners, 37 site engineers, 38 supervisors, 6 designers. The populace measure was restricted to this number to adequately amplify the time and cost allotted for the exploration since the surveys had numerous inquiries and will be tedious which may demoralize a few respondents from taking an interest. Additionally the wide idea of the survey may not be inside the skill of some development partners. Anyway viable choice of the objective respondents with high skill and experience demonstrated to shield these shortcomings.

4.2 SAMPLING TECHNIQUES (analysis technique)

The conducted survey was filled by 101 participants out of 154 distributed survey copy. In which major survey was filled by two designations, which was the site engineers and supervisors, rest was filled by owner, contractors, consultants and designers. They fill the survey individually with sound mind and mark the delay causing factors at the rating scale of 5 point, ranging from 1 to 5. Which was likert scale, in this 1 implies very low important, 2 implies low important, 3 implies moderate important, 4 implies high important, 5 implies extreme important and then this filled survey data was analysed by relative importance index (RII) technique [25],[32] to determine the relative importance of various cause s of defers and the same method was use in this study for each factors as follows:

$$RII = \frac{\sum W}{A * N}$$

Table: 2 Point Likert scale

Sr.no	Scale	Respondent Scores
1	Very Low Important	1
2	Low Important	2
3	Moderate Important	3
4	High Important	4
5	Extreme Important	5

Where ‘W’ is the Weightage given to each factor by the respondents participants (ranging from 1 to 5), A is the highest weight that is 5 in this case because of the chosen ranging scale (1 to 5). N is total number of respondent participants who filled the survey. The value of the RII is always lies between the ranges from 0 to 1 (0 not inclusive), higher the value of RII more important was the causes of defers and secondly the average index analysis (AI) is to be calculated on the bases of responses given by the participants. Where AI is used to appraise the perception of the respondent participants, it is calculated by using equation below:

$$AI = \frac{\text{Number of Respondents} \times \text{Number of Evaluations}}{\text{Total Respondents}}$$

The number of evaluation for each and every question is strictly based on a ranging scale of 1 to 5. Where 1 implies strongly disagree, 2 implies disagree, 3 implies moderately agree, 4 implies agree and 5 implies strongly agree. The rating of each and every delay factor is also done on the bases of AI value. The classification of the AI values would be categorised into 5 different levels of agreement that is:

Table 3: Average index value

1.00 ≤	Average Index value	< 1.50	Strongly Disagree
1.50 ≤		< 2.50	Disagree
2.50 ≤		< 3.50	Moderately Agree
3.50 ≤		< 4.50	Agree
4.50 ≤		< 5.00	Strongly Agree

4.3 ANALYSIS USED IN SPSS

4.3.1 RELIABILITY ANALYSIS IN SPSS

Unwavering quality investigation enables you to think about the properties of estimation scales and the things that make the scales, in other words it is a process to calculate the most commonly used method of scale. The Reliability Analysis methodology figures various ordinarily utilized proportions of scale unwavering quality and furthermore gives data about the connections between individual things in the scale. Interclass relationship coefficients can be utilized to register between rater unwavering quality evaluations or in other word it this analysis is used to check relationship between data and check weather our data is reliable or not. Various models use for reliability are as follows :

- **Cronbach Alpha:** This model is based on the average inter-item correlation. This model is based upon internal consistency of the data.
- **Parallel:** In this model they assume that each and every item has equivalent variances & the same error variances transversely replications
- **Guttman:** In this model SPSS compute Guttman's lower limits for true reliability.
- **Strict parallel:** This model established the assumptions of the Parallel model and as well assumes equivalent means transversely items.
- **Split-half:** In this model scale is split into two parts and examines the correlation among the two tear parts.

Considerations of data Reliability Analysis

Data: it can be exhibit in ordinal or interval form, but the data should be implied numerically form.

Assumptions. For reliability test the data should be autonomous, and errors should be uncorrelated between two different items. Each couple of matter should have a bivariate normal allocation. The nature of the Scales should be additive, so that each entry is linearly correlated to the whole or total score.

In our research we us Cronbach Alpha model for the reliability analysis. If the value of Cronbach Alpha is greater than 0.7 only then we can say our factor are reliable. If not then w cannot say the factors we choose is reliable.

4.3.2 SPEARMAN'S RANK CORRELATION

Spearman's rank correlation is also called Spearman' rho it is one of the same thing, it is a non-parametric test use to measure rank correlations and it assesses the depth of relationship

between two different variable, it can use montonic function to describe this relationship among variable, correlation coefficient is denoted by Greek letter rho (ρ) or also denoted by r_s . Formulas for computing correlation are:

$$r_s = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

Where

n = Number of observation

$d_i = rg(X_i) - rg(Y_i)$, difference among two ranks.

The value correlation is fluctuates between -1 to +1, where -ve and +ve stands for negative and positive relationship amid different variables. The values of correlation coefficient with its importance are as follows:

Table 4: value of correlation coefficient with its significance

Sign of correlation coefficient	Strong	Moderate	Weak	Very weak or none
+ev value signify Positive relationship	0.5 to 1.0	0.3 to 0.49	0.1 to 0.29	0 to 0.09
- ev value signify Negative relationship	-1.0 to -0.5	-0.49 to -0.3	-0.29 to -0.1	-0.09 to 0

4.3.3 FACTOR ANALYSIS

It is a method or model use to reduce the data or you can say that it is data reduction method. This will work on the key notion of multiple observed variable having comparable patterns of respondent scores because they are linked with latent variable. It is also use to generates hypotheses concerning underlying mechanism.

Considerations of factor analysis:

Data: The suitable data for this analysis is quantitative variables at ratio level or interval. It is not appropriate for categorical data, the most suitable data for factor analysis whose pearson correlation coefficient is calculated sensibly.

Assumptions: The value ought to have a bivariate typical or normal allocation for each pair of factors, and perceptions ought to be free. The factor investigation display indicates that factors are dictated by regular factors (the elements assessed by the model) and exceptional components (which don't cover between watched factors); the figured appraisals depend on

the presumption that every single one of a kind factor are uncorrelated with one another and with the basic elements.

4.3.4 MULTIPLE REGRESSION

It is a tool by which we can predict an outcome of the collected data, by making one or more dependent variable based ahead numerous independent variable data in chorus.

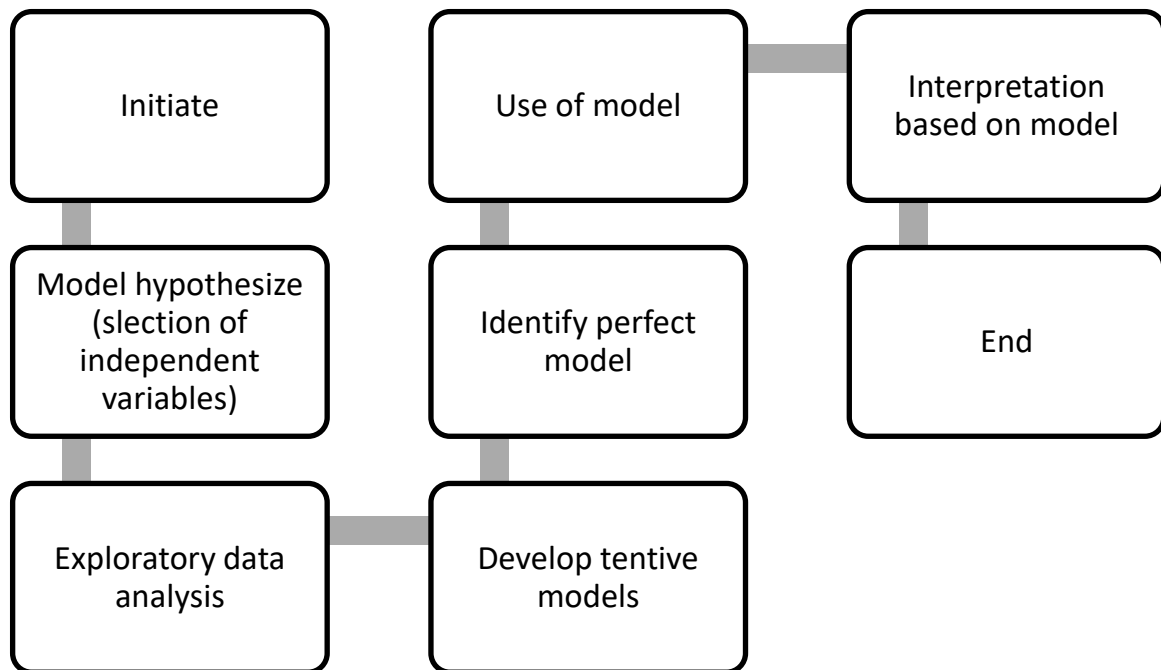


Fig.14. Steps to initiate multiple regression

There are many techniques for initiating regression analysis, in our research we use SPSS software for doing this regression. We use linear regression that is a parametric method to do this analysis in this regression function is defined in stipulations of predetermined numerical of mysterious parameter. The efficiency of regression analysis method is depending upon the data generating procedure, it is also dependent upon the extent the assumption for process is made. After all the assumptions the regression predictors equation is to be formed for the prediction of factors that affect the project in the future.

CHAPTER 5

RESULT AND DISCUSSIONS

5.1 GENERAL

The prepared survey was filled by 101 participant in which they responds to the entire 90 question as shown in appendix-A and this was further summarized into below table number 9. for the ranking of delay factor according to their importance using RRI, AI technique. The numbers of each and every participant are shown in below pie chart.

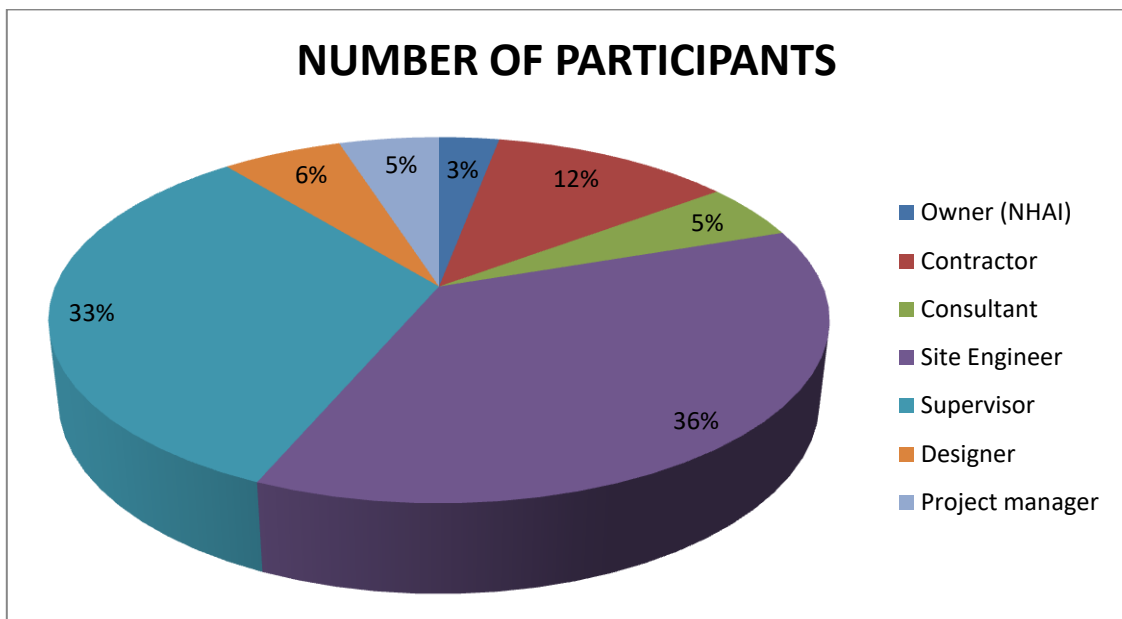


Fig.15. Total number of participants in survey

And further the reliability analysis, factor analysis, correlation and multiple regressions in SPSS was done to increase the effectiveness of the result, which are as follows.

5.2 RELIABILITY ANALYSIS

The reliability analysis for the eight different groups contributing delay is defined on the bases of Cronbach's Alpha value and analysed results by SPSS is shown in appendix-B. if the value of Cronbach's Alpha is greater than 0.7 then we said that the factors are reliable, nearer the value of Cronbach's Alpha to 1 higher the reliability of the factor. Other factor of delay has highest Cronbach's Alpha value ie. 0.99, which signify it is highly reliable among all the delay groups , 0.957 was the lowest Cronbach's Alpha value of equipments related factors among all delay groups. But all the value of alpha is in between 0.957 to 0.99, which signify the factors related to these groups are strongly reliable. Following graph show the Cronbach's Alpha value of every defer group factors.

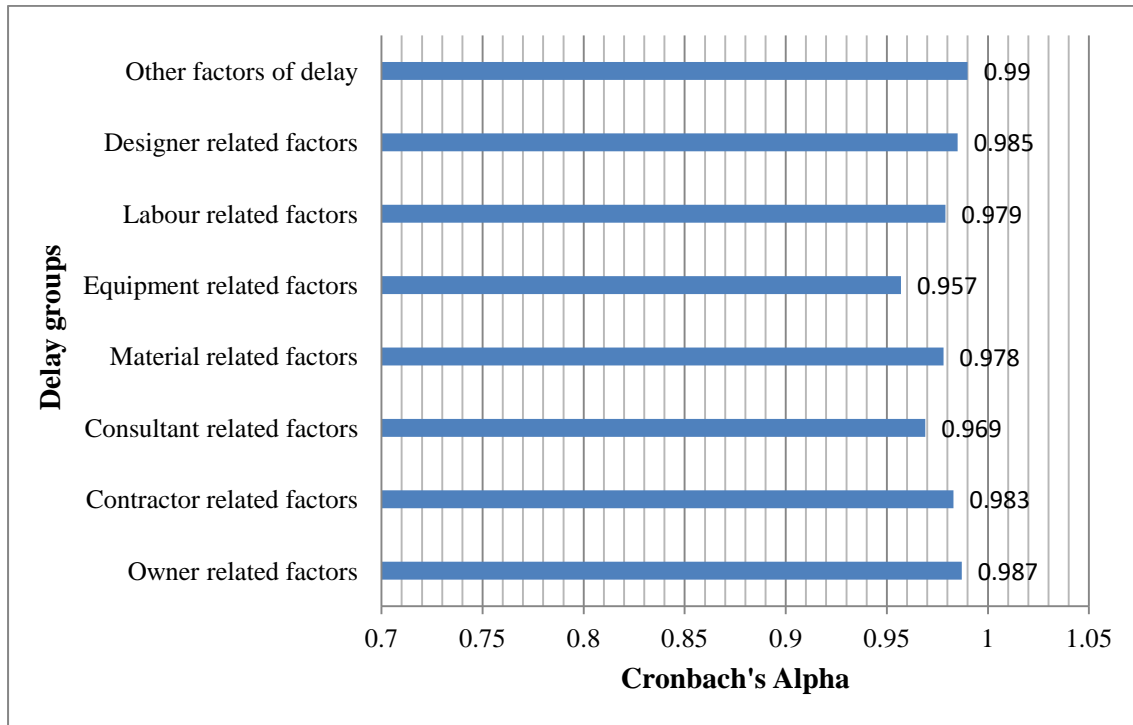


Fig.16. showing Cronbach's Alpha for delay groups

5.3 SPEARMAN'S RANK CORRELATION

The spearman's rank correlation is use to measure a association between different parties, like in this case (owner, consultant, contractor, designer, material, equipment, labour, other factor) and also strength and direction of association. In this research we utilized Spearman's rank correlation to give you an idea about the level of conformity between particular parties or delay groups and the value of correlation fluctuate between -1 to +1 where +1 shows the strongly positive correlation between parties and vice versa -1 shows the strongly negative correlation among the parties, 0 show the none or very weak correlation between different groups. In this study the value of Spearman's rank correlation coefficient is range between + 0.493 to + 0.932, which signifies the positive correlation between two different parties. The highest positive correlation coefficient value is 0.932 which implies the strong + (ev) correlation between owner related group and other factor of delay, the lowest positive correlation coefficient value is 0.493, which implies the moderate + (ev) correlation among material related group and designer related group and the correlation coefficient value of other different parties lie between the range of +0.5 to+0.1 which implies the positively strong relationship between parties the correlation coefficient value of these different groups are show in below table & for better understanding the graph is also shown as below.

Table 5: Non parametric spearman's rank correlation value of delay groups

Correlation matrix									
		Mean owner	Mean contractor	Mean consultant	Mean material	Mean equipment	Mean labour	Mean designer	Mean other
Mean owner	Correlation Coefficient	1	.915**	.807**	.675**	.776**	.648**	.562**	.932**
	Sig. (2-tailed)	.	0	0	0	0	0	0	0
Mean contractor	Correlation Coefficient	.915**	1	.854**	.681**	.773**	.733**	.656**	.864**
	Sig. (2-tailed)	0	.	0	0	0	0	0	0
Mean consultant	Correlation Coefficient	.807**	.854**	1	.873**	.874**	.717**	.592**	.834**
	Sig. (2-tailed)	0	0	.	0	0	0	0	0
Mean material	Correlation Coefficient	.675**	.681**	.873**	1	.853**	.645**	.493**	.698**
	Sig. (2-tailed)	0	0	0	.	0	0	0	0
Mean equipment	Correlation Coefficient	.776**	.773**	.874**	.853**	1	.839**	.670**	.839**
	Sig. (2-tailed)	0	0	0	0	.	0	0	0
Mean labour	Correlation Coefficient	.648**	.733**	.717**	.645**	.839**	1	.938**	.730**
	Sig. (2-tailed)	0	0	0	0	0	.	0	0
Mean designer	Correlation Coefficient	.562**	.656**	.592**	.493**	.670**	.938**	1	.648**
	Sig. (2-tailed)	0	0	0	0	0	0	.	0
Mean other	Correlation Coefficient	.932**	.864**	.834**	.698**	.839**	.730**	.648**	1
	Sig. (2-tailed)	0	0	0	0	0	0	0	.

** . Correlation is significant at the 0.01 level (2-tailed).

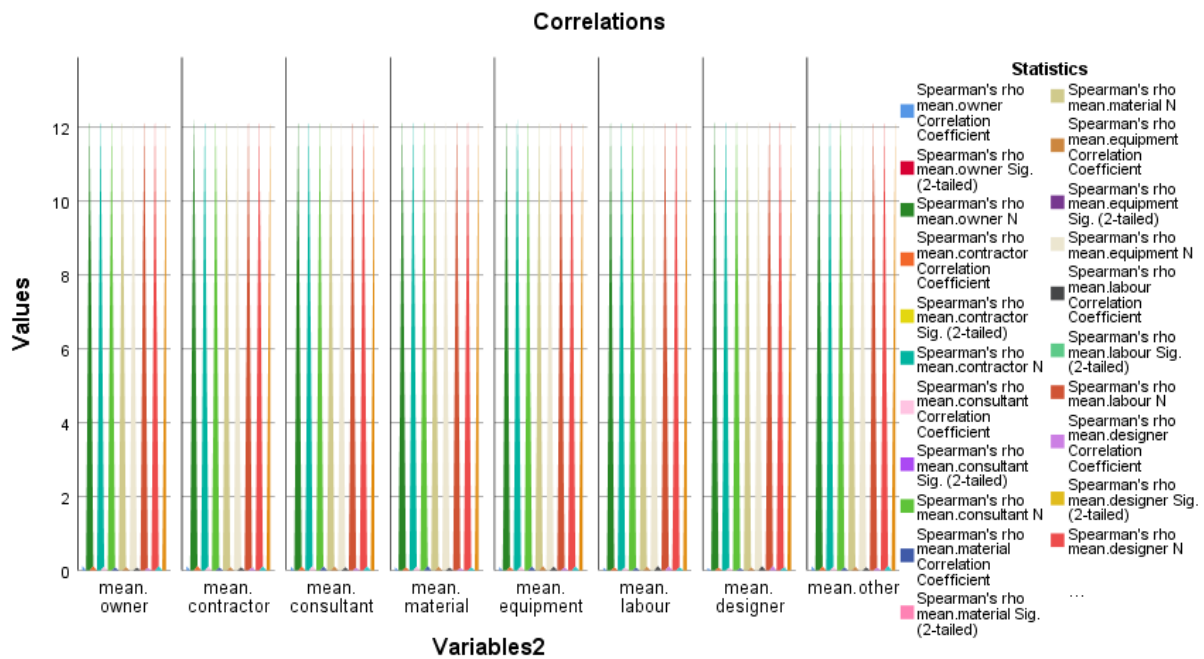


Fig.17. Spearman's rank correlation value of delay groups

5.4 FACTOR ANALYSIS

Factor analysis is generally use for reduction of large amount of questions into few variables (groups) under which these factors are sub divided. So for the first step we check the KMO (Kaiser-Meyer-Olkin) value, if the KMO value is greater than 0.5 only then we consider our sample size is good. In this case KMO value is 0.774 which is greater than 0.5 hence our sample size is ok. And the for Extraction of data we use Principal Component Analysis whose value is not less than 0.3 for result approval and the following procedure of factor analysis is shown in appendix-C.

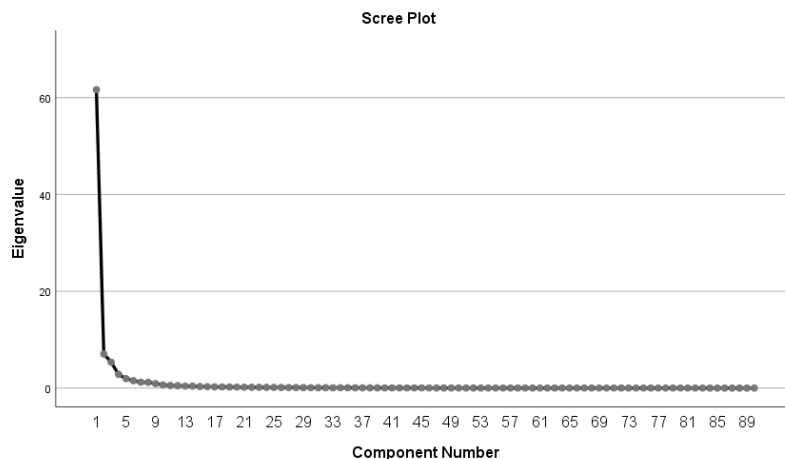


Fig.18. Scree plot

From the scree plot of Eigen value and component we got the rough idea which factor is to be retained for the confirmation we compare this data with parallel analysis and through this deduce the component under which variable categorized, reduced component or groups are As follows then we check the Cronbach's Alpha for the reliability analysis for the particular deduced group and our reduced group with their reliability analysis are shown in below table number 6, 7.

Table 6: factor analysis of variable

	Number of delay factors						
Group-1	ORLS7	ORLS8	OFLS90	OFLS80	ORLS2	ORLS6	ORLS5
	OFLS88	OFLS78	ORLS1	OFLS82	ORLS9	OFLS81	OFLS86
	ORLS3	CRLS13	OFLS77	CRLS12	OFLS89	OFLS76	ORLS11
	OFLS79	OFLS75	CRLS18	CRLS21	OFLS74	OFLS87	OFLS71
	OFLS84	OFLS85	OFLS73	CRLS14	CRLS19	OFLS72	CRLS17
	CTLS31	CRLS15	CRLS23	CRLS22	OFLS66	OFLS70	ORLS4
	OFLS83	ORLS10	CRLS16	CRLS20	-	-	-
Group-2	DRLS63	DRLS62	DRLS61	DRLS59	LRLS57	DRLS60	LRLS56
	LRLS55	LRLS53	DRLS58	LRLS48	LRLS50	LRLS51	LRLS52
	LRLS47	OFLS65	OFLS64	OFLS68	ETLS46	ETLS44	OFLS69
	OFLS67	LRLS54	LRLS49	ETLS45	-	-	-
Group-3	MLLS38	MLLS35	CTLS33	MLLS34	MLLS37	MLLS36	ETLS41
	CTLS32	MLLS39	ETLS43	MLLS40	CTLS24	CTLS27	CTLS25
	CTLS30	CTLS29	CTLS28	ETLS42	CTLS26	-	-

Table 7: Reliability analysis of factor analysis

Reliability Statistics		
Group	Cronbach's Alpha	No. of Items
1	0.994	46
2	0.989	25
3	0.985	19

5.5 MULTIPLE REGRESSION

It is used to predict the value of a variable based on the value of two or more other variable, the variable we predict is called dependent variable, the value of dependent variable derived from independent variable. In short in this model we predict the factor contributing delay in project. In this model we use stepwise method for multiple regression and through this model used in SPSS software shows 11 factors are most significant and they are called predictors, explanation of this model is shown in appendix-D. In this 11 regression model is run and these total regression analysis is explained in appendix-4, we select the 11th model because its R square value is very good and Anova for 11th model are significant hence out of 90 variable 11 are most significant by stepwise method of regression, Atmosphere in the project is the strongest predictor out of 11 it is in 1st position due to its highest beta that is 0.517, with its shared contribution of 36.8% and unique contribution is about 2.6% and followed by predictors are shown in following table 8. For this model we consider Effect of sub-surface conditions (soil, rock, water table etc.) is a dependent factor.

Table 8: list of predicted factors by SPSS

Predictor's	Factor shared		Unique shared	
	(Partial) ²	%	(Part) ²	%
Atmosphere in the project	0.607	36.8	0.162	2.6
effect of social and cultural factors	-0.334	11.1	-0.075	0.5
Delay due to sudden change in alignment	0.359	12.8	0.082	0.6
Slow mobilization of labour on site	-0.648	41.9	-0.181	3.2

Shortage of overall organizational body	0.612	37.4	0.164	2.6
Tragedy during construction	-0.559	31.2	-0.144	2
Bad terrain condition	0.225	5	0.049	0.2
Extra additional work	0.398	15.8	0.092	0.8
Late delivery of material to desired site	-0.38	14.4	-0.088	0.7
Control & restriction on traffic mobilization at job site	0.378	14.2	0.087	0.7
slow site clearances (forest department, public properties etc)	-0.224	5	-0.049	0.2
a. Dependent Variable: Effect of sub-surface conditions (soil, rock, water table etc.)				

And the regression equations (Y) for the significant predictors are.

$$Y = 0.52x_1 - 0.183x_2 + 0.269x_3 - 0.323x_4 + 0.441x_5 - 0.391x_6 + 0.159x_7 + 0.270x_8 - 0.170x_9 + 0.262x_{10} - 0.142x_{11} + \varepsilon$$

Where

x_1 = Atmosphere in the project

x_2 = Effect of social and cultural factors

x_3 = Delay due to sudden change in alignment

x_4 = Slow mobilization of labour on site

x_5 = Shortage of overall organizational body

x_6 = Tragedy during construction

x_7 = Bad terrain condition

x_8 = Extra additional work

x_9 = Late delivery of material to desired site

x_{10} = Control & restriction on traffic mobilization at job site

x_{11} = Slow site clearances (forest department, public properties etc)

ε = Error

5.6 ANALYSIS OF DATA THROUGH RII & AI MODEL

Table 9: Ranking of delay factors

DG	S.No	Causes of delay	Respondent score					RII	AI	Rank
			VLI	LI	MI	HI	EI			
A. Factors Related Owner	1	Delay in progress payments.	3	12	23	20	43	0.7743	3.8713	15
	2	Deliver the furnish site to the contractor.	2	6	9	35	49	0.8436	4.2178	3
	3	Change order by the owner in between construction.	9	24	29	32	7	0.6079	3.0396	72
	4	Slow and late decision making by the owner.	2	8	23	37	31	0.7723	3.8614	16
	5	Poor communication and lack Of coordination with other fellow parties.	2	8	25	37	29	0.7644	3.8218	20
	6	Attending irregular weekly meetings.	4	11	25	41	20	0.7228	3.6139	37
	7	Late in changing and approving designed documents by the owner.	6	8	13	25	49	0.8040	4.0198	6
	8	Unreachable to the professional construction team.	10	12	21	34	24	0.6990	3.4950	46
	9	One sided contract condition and no fairness in contract administration.	8	14	25	35	19	0.6851	3.4257	53
	10	Stopping of ongoing work by the owner.	10	24	29	31	7	0.6020	3.0099	74
	11	Unprofitable delay penalties.	2	16	31	33	19	0.7010	3.5050	45
B. Factors related to contractor	1	Frequent change in project scheduling and planning.	2	2	23	40	34	0.8020	4.0099	7
	2	Poor communication and coordination between contractors.	3	14	20	27	37	0.7604	3.8020	22
	3	Lack of supervision in site management.	2	4	25	39	31	0.7842	3.9208	10
	4	Inadequate contractor experience.	6	38	17	33	7	0.5941	2.9703	75
	5	Inappropriate construction method.	4	8	23	43	23	0.7446	3.7228	30
	6	Delay in resource allocation.	6	8	11	23	53	0.8158	4.0792	4
	7	Unreliable subcontractors.	2	16	27	35	21	0.7129	3.5644	40
	8	Frequent change of sub-contractors.	10	6	37	23	25	0.6931	3.4653	49
	9	Incompetent project team.	4	6	29	28	34	0.7624	3.8119	21
	10	Work force of different nationalities on site.	3	18	24	27	29	0.7208	3.6040	38
	11	Problem in financing project by the contractor side.	2	26	25	33	15	0.6653	3.3267	62
	12	Disputes between contractor and other parties.	10	18	29	25	19	0.6495	3.2475	68

DG	S.No	Causes of delay	Respondent score					RII	AI	Rank
			VLI	LI	MI	HI	EI			
C. Factors related to consultant	1	Conflicts between consultant and designer.	2	9	33	24	33	0.7525	3.7624	26
	2	Delay in performing inspection and testing.	32	26	27	13	3	0.4594	2.2970	84
	3	Appreciative chief change in the scope of exertion.	4	8	25	33	31	0.7564	3.7822	24
	4	Inaccurate site investigation.	2	25	25	32	17	0.6733	3.3663	58
	5	Late reviewing and approving design documents.	6	12	25	33	25	0.7168	3.5842	39
	6	Poor communication and coordination with other parties.	8	15	35	25	18	0.6594	3.2970	64
	7	Lack of skill of mentor in road construction development.	4	11	39	23	24	0.7030	3.5149	44
	8	Incompetence to contractor's technical enquiries.	6	13	8	39	35	0.7663	3.8317	19
	9	Poor quality control by consultant side.	6	12	10	37	36	0.7683	3.8416	18
	10	Inadequate project management.	10	6	39	22	24	0.6871	3.4356	52
D. Factor related to material	1	Change in material type and specification in between construction.	2	16	31	29	23	0.7089	3.5446	41
	2	Lack of construction materials in market.	6	18	21	33	23	0.6970	3.4851	47
	3	Late delivery of material to desired site.	2	6	23	39	31	0.7802	3.9010	12
	4	Fluctuation in material price.	4	4	26	33	34	0.7762	3.8812	14
	5	Poor procurement strategies of construction materials.	4	12	23	35	27	0.7366	3.6832	33
	6	Issues arise in while transportation of material.	34	26	25	13	3	0.4515	2.2574	86
	7	Deterioration of material when they are needed.	32	28	25	13	3	0.4554	2.2772	85
E. Factors related equipment	1	Less efficiency of equipments.	2	17	33	36	13	0.6812	3.4059	55
	2	Shortage of advance hi-tech equipments.	6	20	23	33	19	0.6772	3.3861	57
	3	Failure of equipment due to frequent breakdown.	10	10	29	29	23	0.6891	3.4455	51
	4	Slow mobilization of equipment.	2	17	29	31	22	0.7069	3.5347	42
	5	Equipment allocation problem.	2	25	24	35	15	0.6713	3.3564	59
	6	Poor level of skilled operators.	6	20	31	25	19	0.6614	3.3069	63
	1	Lack of labour.	4	8	23	40	26	0.7505	3.7525	27
	2	Low productivity of labour.	6	10	39	22	24	0.6950	3.4752	48

DG	S.No	Causes of delay	Respondent score					RII	AI	Rank
			VLI	LI	MI	HI	EI			
F. Factors related to labour	3	Conflicts among labour.	16	28	31	23	3	0.5386	2.6931	80
	4	Slow mobilization of labour on site.	14	22	29	29	7	0.5861	2.9307	76
	5	Unqualified & inadequate experienced labour.	2	9	27	33	30	0.7584	3.7921	23
	6	Shortage of skilled labour.	2	6	19	31	43	0.8119	4.0594	5
	7	Problem due to different culture.	2	26	22	37	14	0.6693	3.3465	60
	8	Lack of motivation among labour.	10	18	31	23	19	0.6455	3.2277	69
	9	Wrong selection of labour.	8	16	36	23	18	0.6535	3.2673	67
	10	Incorrect amount of labours use to do particular work.	2	14	19	36	30	0.7545	3.7723	25
	11	Labour strikes.	2	4	21	41	33	0.7960	3.9802	8
G. Factors related to designer	1	Design disputes / errors.	2	6	11	29	53	0.8475	4.2376	2
	2	Insufficient & inappropriate data collection.	6	12	21	28	34	0.7426	3.7129	31
	3	Use of preliminary engineering design software.	8	16	35	23	19	0.6574	3.2871	66
	4	Insufficient & unclear detail in drawing.	4	16	21	28	32	0.7347	3.6733	34
	5	Delay in design work.	2	14	29	27	29	0.7327	3.6634	35
	6	Lack of communication by designer side after designing.	6	10	39	24	22	0.6911	3.4554	50
H. Other factor of delay	1	Delay due to sudden change in alignment.	2	10	21	27	41	0.7881	3.9406	9
	2	Bad terrain condition.	4	9	21	42	25	0.7485	3.7426	28
	3	Control & restriction on traffic mobilization at job site.	28	14	31	25	3	0.5228	2.6139	82
	4	Slow site clearances (forest department, public properties etc).	2	5	23	41	30	0.7822	3.9109	11
	5	Unfavorable weather condition & natural disasters.	10	20	32	17	22	0.6416	3.2079	71
	6	Delay in obtaining permits from the authorities.	4	8	25	41	23	0.7406	3.7030	32
	7	Accidents during construction & safety aspects.	12	40	13	21	15	0.5743	2.8713	79
	8	Restrictions by government agency.	10	24	27	33	7	0.6059	3.0297	73
	9	Price fluctuations.	8	42	17	21	13	0.5782	2.8911	77
	10	Problem with other agency.	22	26	21	27	5	0.5347	2.6733	81
	11	Tragedy during construction.	7	15	37	25	17	0.6594	3.2970	65

DG	S.No	Causes of delay	Respondent score					RII	AI	Rank
			VLI	LI	MI	HI	EI			
H. Other factor of delay	12	Extra additional work.	3	5	31	23	39	0.7782	3.8911	13
	13	Location of the project.	28	14	32	24	3	0.5208	2.6040	83
	14	Lack of government judicial system for construction conflict settlement.	2	9	21	39	30	0.7703	3.8515	17
	15	Desired quality of construction.	6	12	32	38	13	0.6792	3.3960	56
	16	Public strikes & riots.	8	43	15	23	12	0.5762	2.8812	78
	17	Atmosphere in the project.	4	8	25	38	26	0.7465	3.7327	29
	18	Shortage of overall organizational body.	8	15	23	37	18	0.6832	3.4158	54
	19	Economic crisis.	10	19	29	25	18	0.6436	3.2178	70
	20	Effect of sub-surface condition (soil, rock, water table etc.)	2	10	3	21	65	0.8713	4.3564	1
	21	Inadequate project document	38	30	23	5	5	0.4198	2.0990	89
	22	Effect of social and cultural factors.	40	32	19	7	3	0.4040	2.0198	90
	23	Type of project offer and award.	6	12	33	23	27	0.7050	3.5248	43
	24	Interference of local public live in nearby of construction site.	36	30	21	11	3	0.4317	2.1584	88
	25	Delay in inspection and certification by third party.	4	10	27	39	21	0.7248	3.6238	36
	26	Changes in policy for loan by bankers.	34	28	27	9	3	0.4396	2.1980	87
27	Delay due to rework of unaccepted quality of work.	6	18	25	40	12	0.6673	3.3366	61	

The aim of the research is to investigate the most crucial and least crucial factors causing defer in the four laning of parwanoo-solan highway. From enormously study of previous literature the questionnaire is prepared, which consist of 90 critical factors influencing delay in road construction project in Himachal Pradesh region. These factors were further subdivided into 8 different groups. This questionnaire were distributed among 145 peoples out of which 101 people respond back, respondent score of top 15 major causes of delay are as follows:

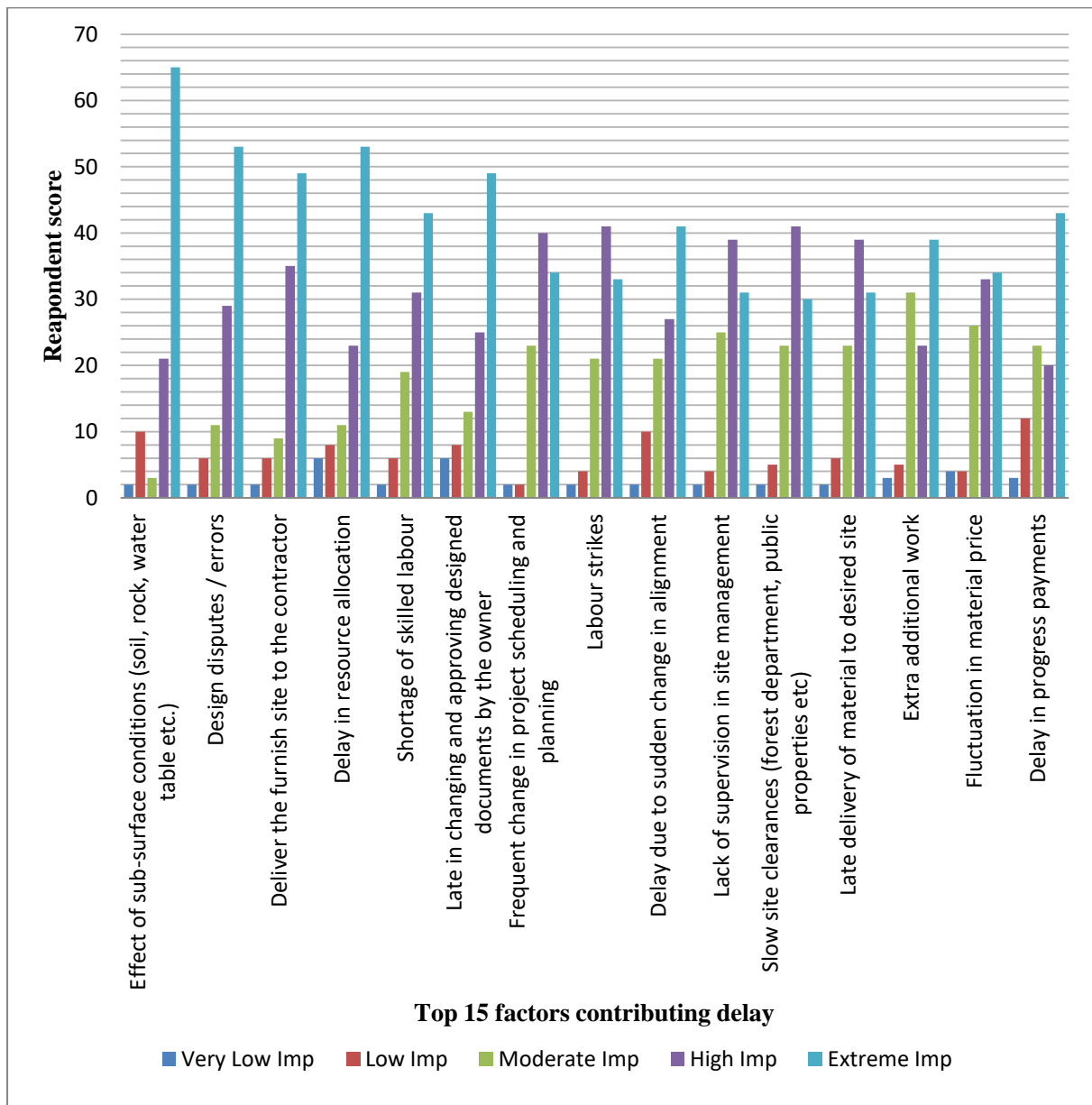


Fig.19. Respondent scores of top 15 delay causes

This respondent score was analysed by RII & AI method at a rating of 5 point Likert rating scale and these results were also tested by SPSS software. Through this analysis Effect of sub-surface conditions (soil, rock, water table etc.) have a highest AI value of 4.3564 also a highest RII value of 0.8713 hence have a rank 1 that implies this is the extreme crucial factor causing delay in parwanoo road construction project. Followed by this design disputes / error rank 2nd highest factor with RII of 0.8475, AI of 4.2376, Deliver the furnish site to the contractor rank 3rd highest factor with RII of 0.8436, AI of 4.2178 and continued. This top 15 most crucial factor causing delay with their relative importance index, average index, delay group by which the particular factor belongs and with their respective ranks are shown by the following graphs and table:

Table 10 -Top 15 major causes of delay in parwanoo solar road construction

S.No.	Causes of Delay	RII	AI	Rank	Delay Groups
1	Effect of sub-surface conditions (soil, rock, water table etc.)	0.8713	4.3564	1	Other factor of delay
2	Design disputes / errors.	0.8475	4.2376	2	Designer related
3	Deliver the furnish site to the contractor.	0.8436	4.2178	3	Owner related
4	Delay in resource allocation.	0.8158	4.0792	4	Contractor related
5	Shortage of skilled labour.	0.8119	4.0594	5	Labour related
6	Late in changing and approving designed document by the owner.	0.8040	4.0198	6	Owner related
7	Frequent change in project scheduling and planning.	0.8020	4.0099	7	Contractor related
8	Labour strikes.	0.7960	3.9802	8	Labour related
9	Delay due to sudden change in alignment.	0.7881	3.9406	9	Other factor of delay
10	Lack of supervision in site management.	0.7842	3.9208	10	Contractor related
11	Slow site clearances (forest department, public properties etc.).	0.7822	3.9109	11	Other factor of delay
12	Late delivery of material to desired site.	0.7802	3.9010	12	Material related
13	Extra additional work.	0.7782	3.8911	13	Other factor of delay
15	Fluctuation in material price.	0.7762	3.8812	14	Material related
15	Delay in progress payments.	0.7743	3.8713	15	Owner related

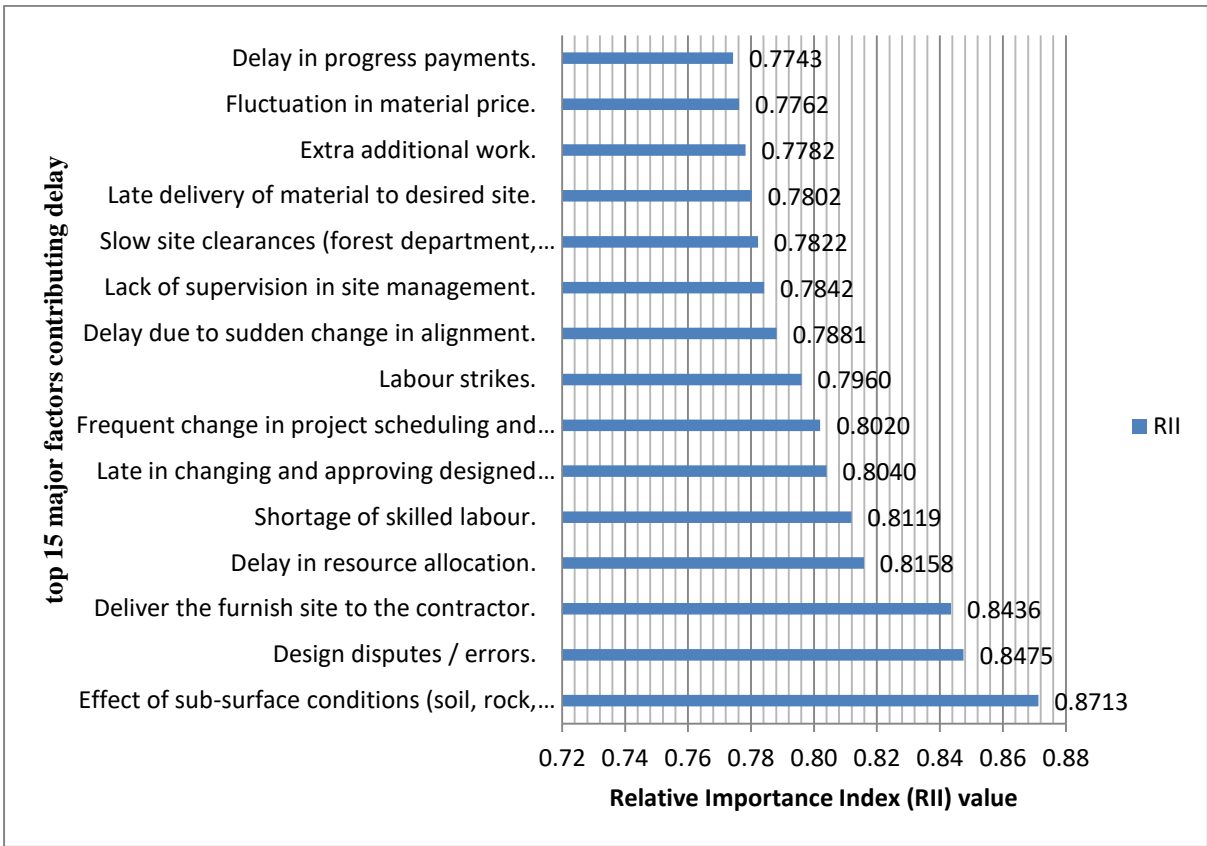


Fig.20. Relative importance index of top 15 major factor causing delay

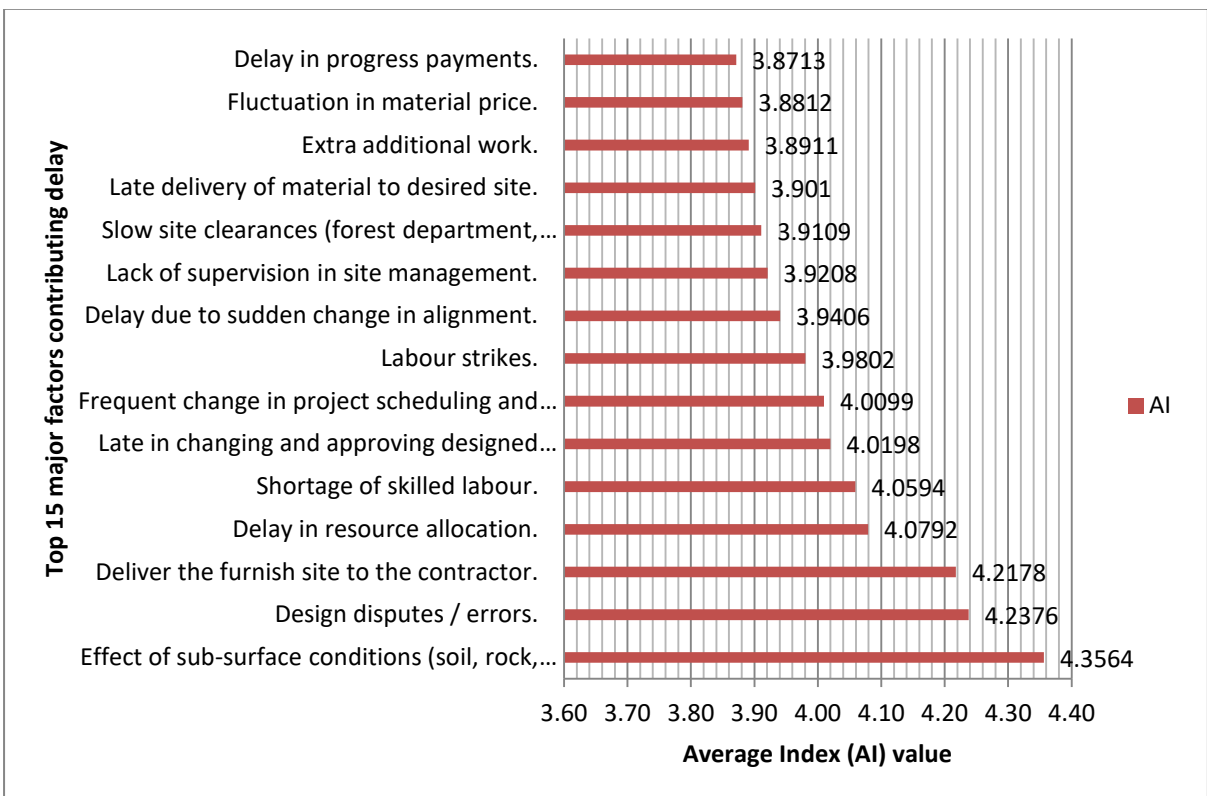


Fig.21. Average index of top 15 major factor causing delay

The respondent score of the least critical factor causing defer in road construction are in fig.22. Effect of the social and cultural factors score is very less influencing factor causing defer with very high rating point of 1 by 40 people, which implies very low important with very low rating point of 5 by 3 people, which implies extreme important just like that people who respond for the survey fill the survey according to their individual perception. Through this the respondent score of base 15 minor defer causes are as follows:

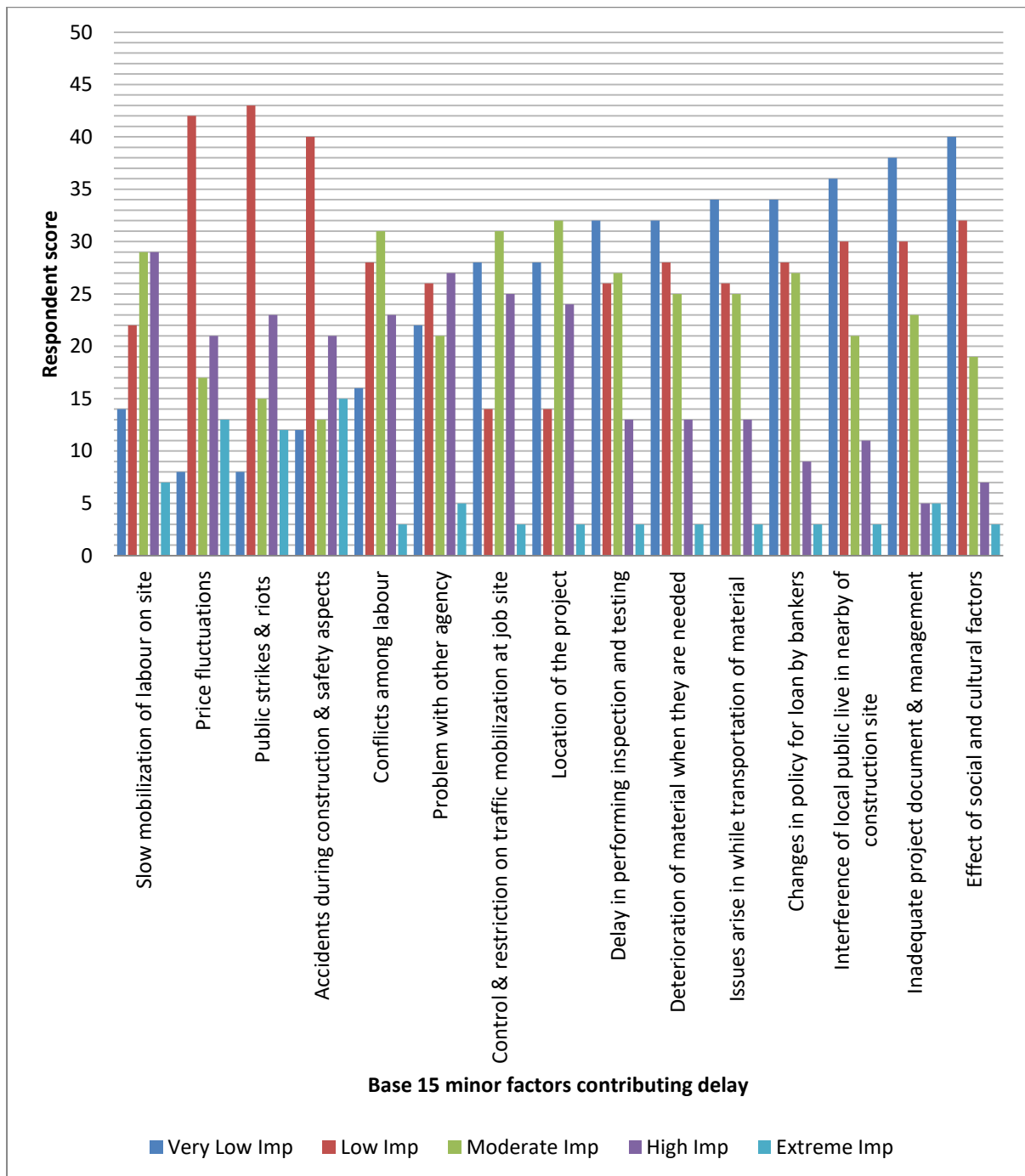


Fig.22. Respondent scores of base 15 delay causes

Through analyses the value of relative important index (RII) and average index (AI) of least critical factor, effect of social and cultural factors is 0.4040 and 2.0198, due to is smallest RII value its overall rank in the survey is 90 and most of the respondent disagree that this factor is causing a delay likewise the rank, average index, relative importance index, with their respective delay groups of bottom 15 minor defer causing delay in solan parwanoo are shown in the below table 11 and fig.23, 24.

Table 11: Base 15 ranked delay in parwanoo solan road construction project.

S.No.	Causes of Delay	RII	AI	Rank	Delay Groups
1	Effect of social and cultural factors.	0.4040	2.0198	90	Other factor of delay
2	Inadequate project document.	0.4198	2.0990	89	Other factor of delay
3	Interference of local public live in nearby of construction site.	0.4317	2.1584	88	Other factor of delay
4	Changes in policy for loan by bankers.	0.4396	2.1980	87	Other factor of delay
5	Issues arise in while transportation of material.	0.4515	2.2574	86	Material related
6	Deterioration of material when they are needed.	0.4554	2.2772	85	Material related
7	Delay in performing inspection and testing.	0.4594	2.2970	84	Consultant related
8	Location of the project.	0.5208	2.6040	83	Other factor of delay
9	Control & restriction on traffic mobilization at job site.	0.5228	2.6139	82	Other factor of delay
10	Problem with other agency.	0.5347	2.6733	81	Other factor of delay
11	Conflicts among labour.	0.5386	2.6931	80	Labour related
12	Accidents during construction & safety aspects.	0.5743	2.8713	79	Other factor of delay
13	Public strikes & riots.	0.5762	2.8812	78	Other factor of delay
14	Price fluctuations.	0.5782	2.8911	77	Other factor of delay
15	Slow mobilization of labour on site.	0.5861	2.9307	76	Labour related

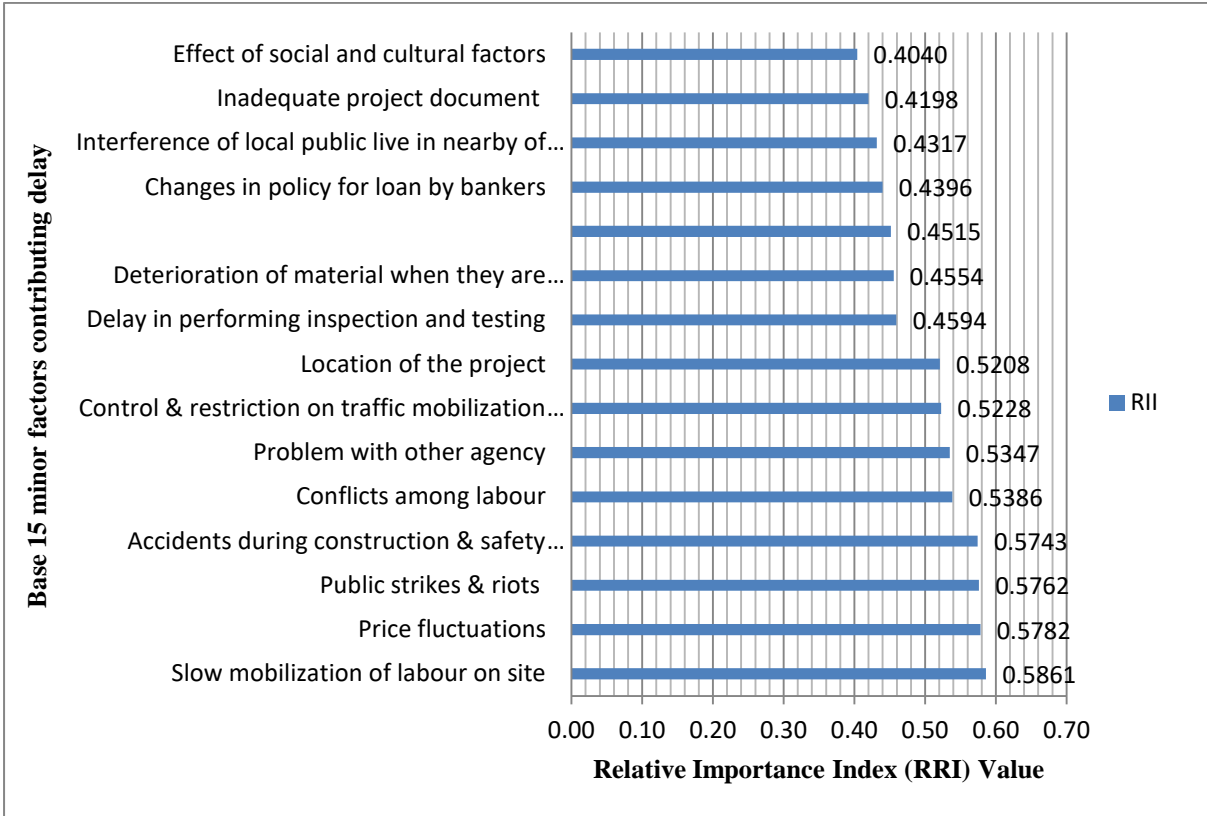


Fig.23. Relative importance index of base 15 minor factor causing delay

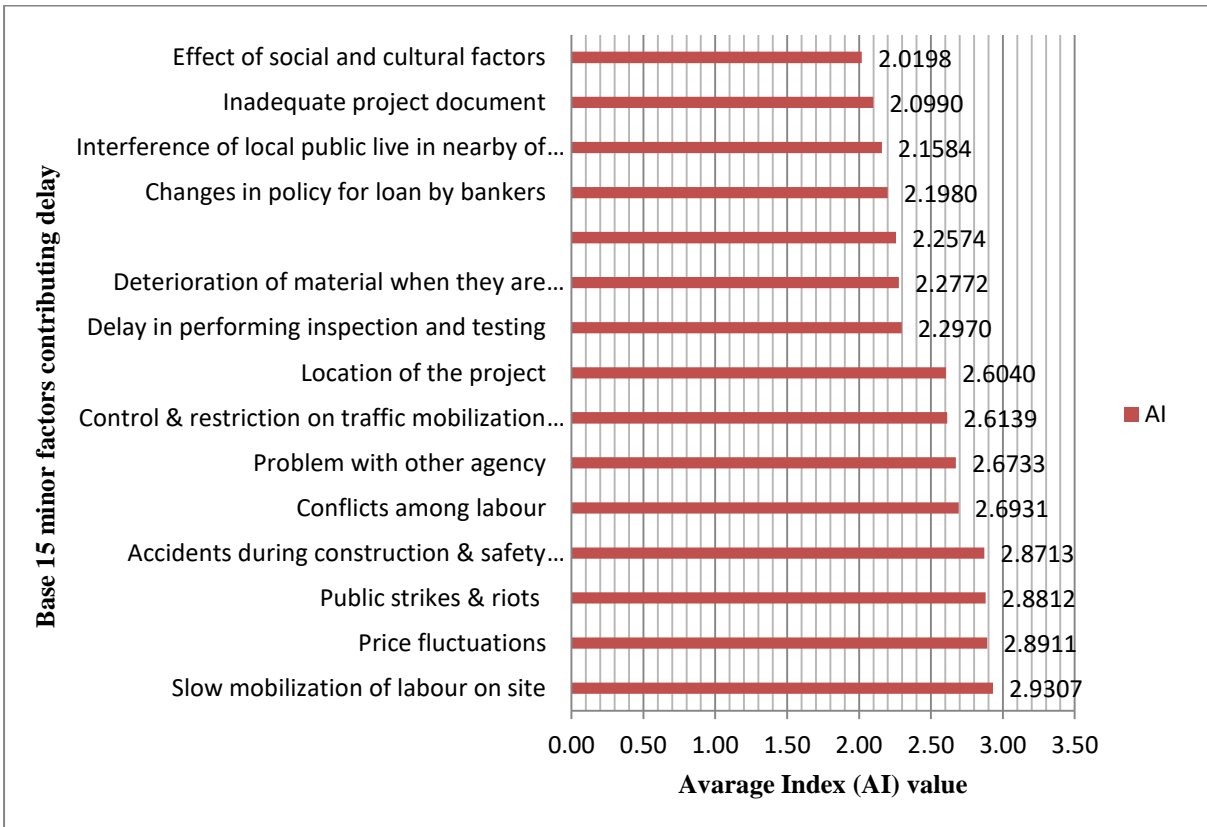


Fig.24. Average index of base 15 minor factor causing delay

INFERENCE

Average index value of top 15 major factor causing delay in road construction project is lie between 4.3564 to 3.8713 which implies they are strongly agree and agree that these top 15 delay factors are most critical and hence they were causing huge delay as compare to the other factor of defer imparting delay. Effect of sub-surface conditions (soil, rock, water table etc.) have a very high RII value 0.8713 which implies 1st rank with very high AI value of 4.3564 it means most of the people will agree that this factor was very crucial likewise design disputes / errors secure 2nd rank with RII value 0.8475, AI value 4.2376 i.e. agree, deliver the furnish site to the contractor secure 3rd rank with RII value 0.8436, AI value 4.2178 i.e. agree, delay in resource allocation secure 4th rank with RII value 0.8158, AI value 4.0792 i.e. agree, shortage of skilled labour secure 5th rank with RII value 0.8119, AI value 4.0594 i.e. agree, late in changing and approving designed document by the owner secure 6th rank with RII value 0.8040, AI value 4.0198 i.e. agree, frequent change in project scheduling and planning secure 7th rank with RII value 0.8020, AI value 4.0099 i.e. agree, labour strikes secure 8th rank with RII value 0.7960, AI value 3.9802 i.e. agree, delay due to sudden change in alignment secure 9th rank with RII value 0.7881, AI value 3.9406 i.e. agree, lack of supervision in site management secure 10th rank with RII value 0.7842, AI value 3.9208 i.e. agree, slow site clearances (forest department, public properties etc) secure 11th rank with RII value 0.7822, AI value 3.9109 i.e. agree, late delivery of material to desired site secure 12th rank with RII value 0.7802, AI value 3.9010 i.e. agree, extra additional work secure 13th rank with RII value 0.7782, AI value 3.8911 i.e. agree, fluctuation in material price secure 14th rank with RII value 0.7762, AI value 3.8812 i.e. agree, delay in progress payments secure 15th rank with RII value 0.7743, AI value 3.8713 i.e. agree. In such a way the value of base 15 minor factors influencing defers is to analyzed through RII and AI method. Effect of social and cultural factors hold a lowest rank delay factor among 90 causes of delay which is 90th rank with the RII & AI value of 0.4040 & 2.0198, inadequate project document hold the 89th rank with the RII & AI value of 0.4198 & 2.0990, interference of local public live in nearby of construction site hold the 88th rank with the RII & AI value of 0.4317 & 2.1584, Changes in policy for loan by bankers hold the 87th rank with the RII & AI value of 0.4396 & 2.1980, Issues arise in while transportation of material hold the 86th rank with the RII & AI value of 0.4515 & 2.2574, deterioration of material when they are needed hold the 85th rank with the RII & AI value of 0.4554 & 2.2772, delay in performing inspection and testing hold the 84th rank with the RII & AI value of 0.4594 & 2.2970, location of the project hold the 83th

rank with the RII & AI value of 0.5208 & 2.6040, control & restriction on traffic mobilization at job site hold the 82th rank with the RII & AI value of 0.5228 & 2.6139, problem with other agency hold the 81th rank with the RII & AI value of 0.5347 & 2.6733, conflicts among labour hold the 80th rank with the RII & AI value of 0.5386 & 2.6931, accidents during construction & safety aspects hold the 79th rank with the RII & AI value of 0.5743 & 2.8713, public strikes & riots hold the 78th rank with the RII & AI value of 0.5762 & 2.8812, price fluctuations hold the 77th rank with the RII & AI value of 0.5782 & 2.8911, slow mobilization of labour on site hold the 76th rank with the RII & AI value of 0.5861 & 2.9307. The value of average index of base 15 minor factors contributing defers in road construction project is lie between 2.0198 to 2.9307 which implies the respondent is moderately agree and disagree that this base 15 factors imparting crucial delay to the parwanoo solan road construction project.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

The objective of this research was to identify the major and minor factors that contributing defer to Parwanoo-Solan four laning of road construction project implemented by G R INFRAPROJECT PRIVATE LIMITED in Himachal Pradesh. From thorough literature review 90 causes of delay that affects the delay in such type of hilly terrain were extracted.

Then these 90 causes were further subdivided into 8 different groups. The major 15 and minor 15 causes of delay were identified by owner, contractor, consultant, designer, site engineer, supervisors and project manager point of view. Effect of sub-surface conditions (soil, rock, water table etc.) is a major factor, followed by other factors and Effect of social and cultural factors is a minor factor contributed defer in this road construction project with highest & lowest RRI of 0.8713 & 0.4040. The result of reliability analysis is in between 0.957 to 0.99, which mean the factors under 8 groups are highly reliable. The Spearman's rank correlation coefficient among all the respondent point of view is lies between +0.562 to +0.932 which shows the positive correlation among their point of view. From factor analysis in SPSS they categorized the 90 factors into 3 groups only with 1st group has 46 factors, 2nd groups has 25 factors, 3rd group has 19 factors with very good Cronbach' alpha value lies between 0.994 to 0.989. from the result of linear regression they predict top 11 factors that contribute defer in this road construction in future and the top most factor predict by the SPSS software is atmosphere in the road construction project.

RECOMMENDATION

The main reason behind defer in any construction project is the indolent attitude of management either it belongs to owner side, consultant side, contractor side etc. towards their duty & responsibility, So the most essential and common recommendation to all is to avoid such type of indolent attitude for the sake of project.

Owner is the backbone of any construction project, the effective involvement of owner in the project is mandatory for the completion of project within decided project duration. Some of the important key points for the owner to shun the delay are:

- To pay consideration or attention while the planning, scheduling, designing stage of the construction project is to be made, in sake of avoiding the future plan of the project. Due to Inadequate attention at that stage results the deviation in the project duration.
- It is essential to make correct and fast decision making progression by owner side organisation without wasting of too much time.
- Owner should encompass familiar about the proceedings in the construction to enhance the speed of approvals process.
- Time to time motivation for other related parties is required for the productive progress of the project.
- Owner should nominate the contractor and consultant not only based on lowest bid, nominate them on the bases of the previous projects and their strong technical expertise.
- It's a primary responsibility of the owner to provide a sufficient construction land to initiate the road construction, any difficulty in land acquisition should sort out first. Timely cash flow is to be released by owner side or avoid the delay in progress payments.

Same as contractor and consultant their indulgement as well as coordination with the management and other party in the project is very essential to reduce defer in construction project.

- Contractor should bid for the project if they are confident about their financial support as well as their technical expertise with such project and have confidence to complete the project in targeted time duration within budget.
- Contractor should make the infrastructure according to the guidelines, without

changing its desired specification and shun the rework owing to poor quality of work.

- Proper resource allocation is to be planned before initiating the activities. Proper utilization of labour and equipment is to be planned.
- Proper planning and scheduling of activities is to be made without any collapse of two different activities.
- Adequate site investigation of site is to be made by contractor and consultant side to check any type of misconduct by management team, site engineer and any project associate.
- Consultant should rectify any type of wrong method and process followed by the field associates that causes the delay in project duration.
- Consultant should distribute the site work according to the associate capabilities.

SUGGESTIONS

- Use of advance construction technique are implementing on the construction site.
- Use of advance and high-tech equipments in the construction is required to minimise the duration of particular activity.
- Flexibility should give to the contractor if they require any design improvement at any working stage due to topographic conditions.
- Avoid any type misleading situation where the chance of strike (labour, local people, employee) take place, results the wastage of time.
- Time to time surprise site inspection by higher authority should conduct to increase the productivity of the project.
- Use of advance civil software in the project is essential to simulate the problem occur in between the project and then rectify the problem before their occurrence.
- Correct material forecasting by the site engineer is required for smooth conduction of construction activities.
- Avoid the frequent change of associate who is directly linked with the project.

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APPENDIX

APPENDIX-A

ID code	Number of participants	ORLS1	ORLS2	ORLS3	ORLS4	ORLS5	ORLS6	ORLS7	ORLS8	ORLS9	ORLS10	ORLS11	CRLS12	CRLS13
001	Owner 1	3	3	2	3	3	3	3	2	2	2	2	3	2
002	Owner 2	3	3	2	3	3	3	3	2	2	2	2	3	2
003	Owner 3	3	4	2	3	3	3	3	2	2	2	2	3	3
004	Contractor 1	2	2	1	2	2	1	1	1	1	1	2	2	2
005	Contractor 2	2	2	1	2	2	2	1	1	1	1	2	3	2
006	Contractor 3	2	2	1	2	2	2	1	1	1	1	2	3	2
007	Contractor 4	2	2	1	2	2	2	2	1	1	1	2	3	2
008	Contractor 5	2	2	1	2	2	2	2	1	1	1	2	3	2
009	Contractor 6	2	3	1	2	2	2	2	1	2	1	2	3	2
010	Contractor 7	2	3	2	2	2	2	2	1	2	1	2	3	2
011	Contractor 8	2	3	2	3	3	2	2	2	2	2	2	3	2
012	Contractor 9	2	3	2	3	3	2	2	2	2	2	2	3	2
013	Contractor 10	2	3	2	3	3	2	2	2	2	2	2	3	2
014	Contractor 11	2	3	2	3	3	2	2	2	2	2	2	3	2
015	Contractor 12	2	3	2	3	3	2	3	2	2	2	2	3	2
016	Consultant 1	1	1	1	1	1	1	1	1	1	1	1	1	1
017	Consultant 2	1	1	1	1	1	1	1	1	1	1	1	1	1
018	Consultant 3	1	2	1	2	2	1	1	1	1	1	2	2	1
019	Consultant 4	3	4	2	3	3	3	3	2	2	2	3	3	3
020	Consultant 5	3	4	2	3	3	3	3	2	2	2	3	3	3
021	Site Engineer 1	3	4	2	3	3	3	3	2	2	2	3	3	3
022	Site Engineer 2	3	4	2	3	3	3	3	2	2	2	3	3	3
023	Site Engineer 3	3	4	2	3	3	4	4	3	3	3	3	4	4
024	Site Engineer 4	3	4	2	3	3	4	4	3	3	3	3	4	4
025	Site Engineer 5	3	4	2	3	3	3	3	3	3	2	3	3	3
026	Site Engineer 6	3	4	2	3	3	3	3	3	3	2	3	3	3
027	Site Engineer 7	3	4	2	3	3	3	3	3	3	2	3	3	3
028	Site Engineer 8	3	4	2	3	3	3	3	3	3	2	3	3	3
029	Site Engineer 9	3	4	2	3	3	3	3	3	3	2	3	3	3
030	Site Engineer 10	3	4	2	3	3	3	4	3	3	2	3	4	3
031	Site Engineer 11	3	4	2	3	3	3	4	3	3	2	3	4	3
032	Site Engineer 12	3	4	2	3	3	3	4	3	3	2	3	4	3
033	Site Engineer 13	3	4	2	3	3	3	4	3	3	2	3	4	3
034	Site Engineer 14	3	4	3	4	3	3	4	3	3	2	3	4	3
035	Site Engineer 15	3	4	3	4	3	3	4	3	3	2	3	4	3
036	Site Engineer 16	3	5	3	4	4	4	5	4	4	3	4	4	4
037	Site Engineer 17	3	5	3	4	4	4	5	4	4	3	4	4	4
038	Site Engineer 18	3	5	3	4	4	4	5	4	4	3	4	4	4
039	Site Engineer 19	4	5	3	4	4	4	5	4	4	3	4	4	4
040	Site Engineer 20	4	4	3	4	4	3	4	3	3	2	3	4	3
041	Site Engineer 21	4	4	3	4	4	3	4	3	3	2	3	4	3
042	Site Engineer 22	4	4	3	4	4	3	4	3	3	2	3	4	3
043	Site Engineer 23	4	4	3	4	4	3	4	3	4	3	4	4	4
044	Site Engineer 24	4	4	3	4	4	3	4	3	4	3	4	4	4
045	Site Engineer 25	4	4	3	4	4	3	4	3	4	3	4	4	4
046	Site Engineer 26	4	4	3	4	4	3	4	3	4	3	4	4	4
047	Site Engineer 27	4	4	3	4	4	4	4	3	4	3	4	4	4
048	Site Engineer 28	4	4	3	4	4	4	4	4	4	3	4	4	4
049	Site Engineer 29	4	4	3	4	4	4	4	4	4	3	4	4	4

050	Site Engineer 30	4	4	3	4	4	4	4	4	4	3	4	4	4
051	Site Engineer 31	4	4	3	4	4	4	4	4	4	3	4	4	4
052	Site Engineer 32	4	4	3	4	4	4	4	4	4	4	4	4	4
053	Site Engineer 33	4	4	3	4	4	4	4	4	4	4	4	4	5
054	Site Engineer 34	4	4	3	4	4	4	4	4	4	4	4	4	5
055	Site Engineer 35	4	4	3	4	4	4	4	4	4	4	4	4	5
056	Site Engineer 36	4	4	3	4	4	4	4	4	4	4	4	5	5
057	Site Engineer 37	4	5	3	4	4	4	5	4	4	4	4	5	5
058	Supervisor 1	5	5	3	4	4	4	5	4	4	4	4	5	5
059	Supervisor 2	5	5	3	4	4	4	5	4	4	4	4	5	5
060	Supervisor 3	5	5	3	4	4	4	5	4	4	4	4	5	5
061	Supervisor 4	5	5	3	4	4	4	5	4	4	4	4	5	5
062	Supervisor 5	5	5	4	4	4	4	5	4	4	4	4	5	5
063	Supervisor 6	5	5	4	4	4	4	5	4	4	4	4	5	5
064	Supervisor 7	5	5	4	4	4	4	5	4	4	4	4	5	5
065	Supervisor 8	5	5	4	4	4	4	5	4	4	4	4	5	5
066	Supervisor 9	5	5	4	4	4	4	5	4	4	4	4	5	5
067	Supervisor 10	5	5	4	4	4	4	5	4	4	4	4	5	5
068	Supervisor 11	5	5	4	4	4	4	5	4	4	4	4	5	5
069	Supervisor 12	5	5	4	4	4	4	5	4	4	4	4	5	5
070	Supervisor 13	5	5	4	5	4	4	5	4	4	4	4	5	5
071	Supervisor 14	5	5	4	5	4	4	5	4	3	3	3	4	3
072	Supervisor 15	5	5	4	5	5	4	5	4	3	3	3	4	4
073	Supervisor 16	5	5	4	5	5	4	5	4	3	3	3	4	4
074	Supervisor 17	5	5	4	5	5	4	5	4	3	3	3	4	4
075	Supervisor 18	5	5	4	5	5	4	5	4	3	3	3	4	4
076	Supervisor 19	5	5	4	5	5	4	5	4	3	3	3	4	4
077	Supervisor 20	5	5	4	5	5	4	5	5	3	3	3	4	4
078	Supervisor 21	5	5	4	5	5	4	5	5	3	3	3	4	4
079	Supervisor 22	5	5	4	5	5	4	5	5	3	3	3	4	4
080	Supervisor 23	5	5	4	5	5	4	5	5	4	3	3	4	4
081	Supervisor 24	5	5	4	5	5	5	5	5	4	3	3	4	4
082	Supervisor 25	5	5	4	5	5	5	5	5	5	4	5	5	5
083	Supervisor 26	5	5	4	5	5	5	5	5	5	4	5	5	5
084	Supervisor 27	5	5	4	5	5	5	5	5	5	4	5	5	5
085	Supervisor 28	5	5	4	5	5	5	5	5	5	4	5	5	5
086	Supervisor 29	5	5	4	5	5	5	5	5	5	4	5	5	5
087	Supervisor 30	5	5	4	5	5	5	5	5	5	4	5	5	5
088	Supervisor 31	5	5	4	5	5	5	5	5	5	4	5	5	5
089	Supervisor 32	5	5	4	5	5	5	5	5	5	4	5	5	5
090	Supervisor 33	5	5	4	5	5	5	5	5	5	4	5	5	5
091	Supervisor 34	5	5	4	5	5	5	5	5	5	4	5	5	5
092	Supervisor 35	5	5	4	5	5	5	5	5	5	4	5	5	5
093	Supervisor 36	5	5	4	5	5	5	5	5	5	4	5	5	5
094	Supervisor 37	5	5	5	5	5	5	5	5	5	5	5	5	5
095	Supervisor 38	5	5	5	5	5	5	5	5	5	5	5	5	5
096	Designer 1	5	5	5	5	5	5	5	5	5	5	5	5	5
097	Designer 2	5	5	5	5	5	5	5	5	5	5	5	5	5
098	Designer 3	5	5	5	5	5	5	5	5	5	5	5	5	5
099	Designer 4	5	5	5	5	5	5	5	5	5	5	5	5	5
100	Designer 5	5	5	5	5	5	5	5	5	5	5	5	5	5
101	Designer 6	4	5	3	4	4	4	5	4	4	3	4	4	4

ID code	Number of Participants	CRLS14	CRLS15	CRLS16	CRLS17	CRLS18	CRLS19	CRLS20	CRLS21	CRLS22	CRLS23	CTLS24	CTLS25	CTLS26
001	Owner 1	3	2	2	2	2	1	2	2	2	1	3	3	2
002	Owner 2	3	2	2	2	2	1	2	2	2	1	3	3	3
003	Owner 3	3	2	2	2	2	1	2	2	2	1	3	3	3
004	Contractor 1	3	2	2	2	2	1	2	2	2	1	3	3	3
005	Contractor 2	3	2	2	2	2	2	3	2	2	2	3	3	3
006	Contractor 3	3	2	2	2	2	2	3	2	2	2	3	3	3
007	Contractor 4	3	2	3	2	2	2	3	2	2	2	3	3	3
008	Contractor 5	3	2	3	2	2	2	3	2	2	2	3	3	3
009	Contractor 6	3	2	3	3	2	2	3	2	2	2	3	3	3
010	Contractor 7	3	2	3	3	2	2	3	2	2	2	3	3	3
011	Contractor 8	3	2	3	3	2	3	3	2	2	2	3	3	3
012	Contractor 9	3	2	3	3	2	3	3	2	2	2	3	3	3
013	Contractor 10	3	2	3	3	3	3	3	2	2	2	3	3	3
014	Contractor 11	3	2	3	3	3	3	3	2	2	2	3	3	3
015	Contractor 12	3	2	3	3	3	3	3	2	2	2	3	3	3
016	Consultant 1	3	2	3	3	3	3	3	3	2	2	3	2	2
017	Consultant 2	3	2	3	3	3	3	3	3	2	2	3	2	2
018	Consultant 3	3	2	3	3	3	3	3	3	2	2	3	3	3
019	Consultant 4	3	2	3	3	3	3	3	3	2	2	3	3	3
020	Consultant 5	3	2	3	4	3	3	3	3	2	2	3	4	3
021	Site Engineer 1	2	1	1	1	2	1	1	1	2	1	3	4	3
022	Site Engineer 2	2	1	1	1	2	1	1	2	2	1	3	4	3
023	Site Engineer 3	4	2	4	4	3	3	4	3	3	3	2	2	2
024	Site Engineer 4	4	2	4	4	3	3	4	3	3	3	2	3	2
025	Site Engineer 5	2	1	2	1	2	1	2	2	2	1	2	3	2
026	Site Engineer 6	2	1	2	1	2	1	2	2	2	1	2	3	2
027	Site Engineer 7	1	1	1	1	1	1	1	1	1	1	2	3	2
028	Site Engineer 8	1	1	1	1	1	1	1	1	1	1	2	2	1
029	Site Engineer 9	3	2	3	4	3	3	3	3	2	2	2	2	1
030	Site Engineer 10	3	2	3	4	3	3	3	3	2	2	2	1	1
031	Site Engineer 11	3	2	3	4	3	3	3	3	3	3	2	1	1
032	Site Engineer 12	3	2	3	4	3	3	3	3	3	3	1	3	3
033	Site Engineer 13	3	2	3	4	3	3	3	3	3	3	1	3	3
034	Site Engineer 14	4	2	3	4	3	3	3	3	3	3	3	4	3
035	Site Engineer 15	4	2	3	4	3	3	3	3	3	3	3	4	3
036	Site Engineer 16	4	3	4	5	4	3	4	4	3	3	3	4	3
037	Site Engineer 17	4	3	4	5	4	4	4	4	3	3	3	4	3
038	Site Engineer 18	4	3	4	5	4	4	4	4	3	3	3	4	4
039	Site Engineer 19	4	3	4	5	4	4	4	4	3	3	3	4	4
040	Site Engineer 20	4	2	3	4	3	3	3	3	3	3	3	4	4
041	Site Engineer 21	4	2	3	4	3	3	3	3	3	3	3	4	4
042	Site Engineer 22	4	2	4	4	3	3	3	3	3	3	3	4	4
043	Site Engineer 23	4	3	4	5	4	3	4	4	3	3	4	4	4
044	Site Engineer 24	4	3	4	5	4	3	4	4	3	3	4	4	4
045	Site Engineer 25	4	3	4	5	4	3	4	4	3	3	4	4	4
046	Site Engineer 26	4	3	4	5	4	3	4	4	4	3	4	4	4
047	Site Engineer 27	4	3	4	5	4	4	4	4	4	3	4	4	4
048	Site Engineer 28	4	3	4	5	4	4	4	4	5	5	5	5	5
049	Site Engineer 29	4	3	4	5	4	4	4	4	5	5	5	5	5

050	Site Engineer 30	4	4	4	5	4	4	4	4	4	4	4	4	4
051	Site Engineer 31	4	4	4	5	4	4	4	4	4	4	4	4	4
052	Site Engineer 32	4	4	4	5	4	4	4	4	4	4	4	4	4
053	Site Engineer 33	4	4	4	5	4	4	4	4	4	4	4	4	4
054	Site Engineer 34	4	4	4	5	4	4	5	4	4	4	4	4	4
055	Site Engineer 35	4	4	4	5	4	4	5	4	4	4	4	4	4
056	Site Engineer 36	4	4	4	5	4	4	5	4	4	4	4	4	4
057	Site Engineer 37	4	4	4	5	4	4	5	4	4	4	5	4	4
058	Supervisor 1	4	4	4	5	4	4	5	5	4	4	5	4	4
059	Supervisor 2	5	4	4	5	4	4	5	5	4	4	5	4	5
060	Supervisor 3	5	4	4	5	4	3	4	4	4	4	5	5	5
061	Supervisor 4	5	4	4	5	4	3	4	4	4	4	5	5	5
062	Supervisor 5	5	4	4	5	4	3	4	4	4	3	4	4	4
063	Supervisor 6	5	4	4	5	4	4	5	5	4	3	4	4	4
064	Supervisor 7	5	4	4	5	4	4	5	5	4	4	5	5	5
065	Supervisor 8	5	4	4	5	4	5	5	5	4	4	5	5	5
066	Supervisor 9	5	4	4	5	4	5	5	5	4	4	5	5	5
067	Supervisor 10	5	4	5	5	4	5	5	5	4	4	5	5	5
068	Supervisor 11	5	4	5	5	4	5	5	5	4	4	5	5	5
069	Supervisor 12	5	4	5	5	5	5	5	5	4	4	5	5	5
070	Supervisor 13	5	4	5	5	5	5	5	5	4	4	5	5	5
071	Supervisor 14	4	2	4	4	3	3	3	3	4	4	5	5	5
072	Supervisor 15	4	2	4	4	3	3	3	3	4	4	4	4	4
073	Supervisor 16	4	2	4	4	3	3	3	3	4	4	4	4	4
074	Supervisor 17	4	2	4	4	3	3	4	3	4	4	4	4	4
075	Supervisor 18	4	2	4	4	3	3	4	3	4	4	4	4	4
076	Supervisor 19	4	2	4	4	3	3	4	3	4	4	5	5	5
077	Supervisor 20	4	3	4	4	3	4	4	4	4	4	5	5	5
078	Supervisor 21	4	3	4	4	4	4	4	4	4	4	5	5	5
079	Supervisor 22	4	3	4	4	4	4	4	4	4	4	5	5	5
080	Supervisor 23	4	3	4	4	4	4	5	4	3	3	4	4	4
081	Supervisor 24	4	3	4	5	4	3	4	3	3	3	3	4	4
082	Supervisor 25	5	4	5	5	5	5	5	5	3	3	3	4	4
083	Supervisor 26	5	4	5	5	5	5	5	5	3	3	4	4	4
084	Supervisor 27	5	4	5	5	5	5	5	5	3	3	4	4	4
085	Supervisor 28	5	4	5	5	5	5	5	5	3	3	4	4	4
086	Supervisor 29	5	4	5	5	5	5	5	5	3	3	4	4	4
087	Supervisor 30	5	4	5	5	5	5	5	5	3	3	4	4	4
088	Supervisor 31	5	4	5	5	5	5	5	5	5	5	5	5	5
089	Supervisor 32	5	4	5	5	5	5	5	5	5	5	5	5	5
090	Supervisor 33	5	4	5	5	5	5	5	5	5	5	5	5	5
091	Supervisor 34	5	4	5	5	5	5	5	5	5	5	5	5	5
092	Supervisor 35	5	4	5	5	5	5	5	5	5	5	5	5	5
093	Supervisor 36	5	4	5	5	5	5	5	5	5	5	5	5	5
094	Supervisor 37	5	5	5	5	5	5	5	5	5	5	5	5	5
095	Supervisor 38	5	5	5	5	5	5	5	5	5	5	5	5	5
096	Designer 1	5	5	5	5	5	5	5	5	5	5	5	5	5
097	Designer 2	5	5	5	5	5	5	5	5	5	5	5	5	5
098	Designer 3	5	5	5	5	5	5	5	5	5	5	5	5	5
099	Designer 4	5	5	5	5	5	5	5	5	5	5	5	5	5
100	Designer 5	5	5	5	5	5	5	5	5	5	5	5	5	5
101	Designer 6	4	3	4	5	4	4	4	4	4	4	5	5	5

ID code	Number of participants	CTLS27	CTLS28	CTLS29	CTLS30	CTLS31	CTLS32	CTLS33	MLLS34	MLLS35	MLLS36	MLLS37	MLLS38	MLLS39
001	Owner 1	2	2	2	2	1	4	3	3	4	4	4	4	2
002	Owner 2	2	2	2	2	2	4	4	4	4	4	5	5	3
003	Owner 3	2	2	2	2	2	4	4	4	4	4	5	5	3
004	Contractor 1	2	2	2	2	2	4	3	3	4	4	4	4	2
005	Contractor 2	2	2	2	2	2	4	3	3	4	4	4	4	2
006	Contractor 3	2	2	2	2	2	3	3	3	2	3	3	3	1
007	Contractor 4	2	2	2	2	2	3	3	3	2	3	3	3	1
008	Contractor 5	2	3	2	2	2	3	3	3	2	3	3	3	1
009	Contractor 6	2	3	2	2	2	3	3	3	2	3	3	3	1
010	Contractor 7	2	3	2	2	2	2	1	2	2	2	2	2	1
011	Contractor 8	2	3	2	3	2	2	1	2	2	2	2	2	1
012	Contractor 9	2	3	2	3	2	2	1	2	2	3	3	2	1
013	Contractor 10	2	3	3	3	2	2	1	2	2	3	3	2	1
014	Contractor 11	2	3	3	3	2	2	2	2	2	3	3	2	1
015	Contractor 12	2	3	3	3	3	2	2	2	2	3	3	2	1
016	Consultant 1	2	4	4	4	4	2	2	2	2	3	3	2	1
017	Consultant 2	2	4	4	4	4	2	2	2	2	3	3	2	1
018	Consultant 3	3	1	1	3	3	1	1	2	1	2	2	2	1
019	Consultant 4	3	1	1	3	3	3	3	3	2	3	3	3	1
020	Consultant 5	3	1	1	3	3	3	3	3	2	3	3	3	1
021	Site Engineer 1	3	1	1	3	3	3	3	3	3	3	3	3	1
022	Site Engineer 2	3	1	1	3	3	3	3	3	3	3	3	3	1
023	Site Engineer 3	2	2	1	1	1	1	1	1	1	1	1	1	1
024	Site Engineer 4	2	2	1	1	1	1	1	1	1	1	1	1	1
025	Site Engineer 5	2	2	2	1	1	1	1	2	1	2	1	1	1
026	Site Engineer 6	2	2	2	1	1	5	4	4	4	4	5	5	3
027	Site Engineer 7	2	2	2	2	1	5	4	4	4	4	5	5	3
028	Site Engineer 8	2	1	1	3	3	2	2	2	2	3	3	2	1
029	Site Engineer 9	2	4	3	3	4	2	2	2	2	3	3	2	1
030	Site Engineer 10	1	4	4	4	4	2	3	2	2	3	3	3	1
031	Site Engineer 11	1	4	4	4	5	2	3	2	2	3	3	3	1
032	Site Engineer 12	2	4	3	3	4	1	1	2	1	2	1	1	1
033	Site Engineer 13	3	4	3	3	4	1	1	2	1	2	2	2	1
034	Site Engineer 14	3	3	3	3	3	3	3	3	3	3	3	3	1
035	Site Engineer 15	3	3	3	3	4	3	3	3	3	3	3	3	1
036	Site Engineer 16	3	3	3	3	4	4	3	3	3	3	3	3	1
037	Site Engineer 17	3	3	3	3	4	4	3	3	3	3	3	3	1
038	Site Engineer 18	3	3	3	3	4	4	3	3	3	3	3	3	1
039	Site Engineer 19	3	3	3	3	4	4	3	3	3	4	3	3	1
040	Site Engineer 20	3	3	3	3	4	4	3	3	3	4	3	3	1
041	Site Engineer 21	3	3	3	3	4	4	3	3	3	4	3	3	1
042	Site Engineer 22	3	3	3	3	4	4	3	3	3	4	4	3	2
043	Site Engineer 23	3	4	3	3	4	4	3	4	4	4	4	4	2
044	Site Engineer 24	3	4	3	3	4	4	3	4	4	4	4	4	2
045	Site Engineer 25	3	4	3	3	4	4	3	4	4	4	4	4	2
046	Site Engineer 26	4	4	3	4	4	4	4	4	4	4	4	4	2
047	Site Engineer 27	4	4	3	4	4	4	4	4	4	4	4	4	2
048	Site Engineer 28	5	5	5	5	5	5	5	5	5	5	5	5	4
049	Site Engineer 29	5	5	5	5	5	5	5	5	5	5	5	5	4

050	Site Engineer 30	4	4	3	4	4	4	4	4	4	4	5	4	3
051	Site Engineer 31	4	4	4	4	4	4	4	4	4	4	5	4	3
052	Site Engineer 32	4	4	4	4	4	4	4	4	4	4	5	4	3
053	Site Engineer 33	4	4	4	4	4	4	4	4	4	4	5	4	3
054	Site Engineer 34	4	4	4	4	4	4	4	4	4	4	5	4	3
055	Site Engineer 35	4	4	4	4	4	4	4	4	4	4	5	5	3
056	Site Engineer 36	4	4	4	4	5	5	4	4	4	4	4	4	2
057	Site Engineer 37	4	4	4	4	5	5	4	4	4	4	4	4	2
058	Supervisor 1	4	4	4	4	5	5	4	4	4	4	4	4	2
059	Supervisor 2	4	4	4	4	5	5	4	4	4	5	4	4	3
060	Supervisor 3	4	4	4	4	5	5	4	4	4	5	4	4	3
061	Supervisor 4	4	4	4	4	5	5	4	4	4	5	4	4	3
062	Supervisor 5	4	4	3	3	4	4	3	4	4	4	4	4	2
063	Supervisor 6	4	4	3	4	4	4	3	4	4	4	4	4	2
064	Supervisor 7	4	4	4	4	5	5	4	4	4	5	4	4	3
065	Supervisor 8	4	4	4	4	5	5	4	4	4	5	4	4	3
066	Supervisor 9	4	4	4	4	5	5	4	4	4	5	4	4	3
067	Supervisor 10	4	5	4	4	5	5	4	4	4	5	4	4	3
068	Supervisor 11	4	5	4	5	5	5	5	4	4	5	5	4	3
069	Supervisor 12	4	5	4	5	5	5	5	5	5	5	5	4	3
070	Supervisor 13	4	5	4	5	5	5	5	5	5	5	5	5	3
071	Supervisor 14	4	5	4	5	5	5	5	5	5	5	5	5	3
072	Supervisor 15	4	3	3	3	4	4	3	3	3	4	4	4	2
073	Supervisor 16	4	3	3	3	4	4	3	3	3	4	4	4	2
074	Supervisor 17	4	4	3	3	4	4	3	3	3	4	4	4	2
075	Supervisor 18	4	4	3	3	4	4	3	3	3	4	4	4	2
076	Supervisor 19	4	5	4	5	5	5	5	5	5	5	5	5	3
077	Supervisor 20	4	5	4	5	5	5	5	5	5	5	5	5	3
078	Supervisor 21	4	5	5	5	5	5	5	5	5	5	5	5	3
079	Supervisor 22	5	5	5	5	5	5	5	5	5	5	5	5	3
080	Supervisor 23	4	4	3	3	4	4	3	4	4	4	4	4	2
081	Supervisor 24	3	3	3	3	4	4	3	3	3	4	4	3	2
082	Supervisor 25	3	3	3	3	4	4	3	3	3	4	4	3	2
083	Supervisor 26	3	3	3	3	4	4	3	3	3	4	4	3	2
084	Supervisor 27	3	3	3	3	4	4	3	3	3	4	4	3	2
085	Supervisor 28	3	3	3	3	4	4	3	3	3	4	4	4	2
086	Supervisor 29	3	3	3	3	4	4	3	3	3	4	4	4	2
087	Supervisor 30	3	4	3	3	4	4	3	3	4	4	4	4	2
088	Supervisor 31	5	5	5	5	5	5	5	5	5	5	5	5	4
089	Supervisor 32	5	5	5	5	5	5	5	5	5	5	5	5	4
090	Supervisor 33	5	5	5	5	5	5	5	5	5	5	5	5	4
091	Supervisor 34	5	5	5	5	5	5	5	5	5	5	5	5	4
092	Supervisor 35	5	5	5	5	5	5	5	5	5	5	5	5	4
093	Supervisor 36	5	5	5	5	5	5	5	5	5	5	5	5	4
094	Supervisor 37	5	5	5	5	5	5	5	5	5	5	5	5	4
095	Supervisor 38	5	5	5	5	5	5	5	5	5	5	5	5	4
096	Designer 1	5	5	5	5	5	5	5	5	5	5	5	5	4
097	Designer 2	5	5	5	5	5	5	5	5	5	5	5	5	4
098	Designer 3	5	5	5	5	5	5	5	5	5	5	5	5	4
099	Designer 4	5	5	5	5	5	5	5	5	5	5	5	5	5
100	Designer 5	5	5	5	5	5	5	5	5	5	5	5	5	5
101	Designer 6	5	5	5	5	5	5	5	5	5	5	5	5	5

ID code	Number of participants	MLLS40	ETLS41	ETLS42	ETLS43	ETLS44	ETLS45	ETLS46	LRLS47	LRLS48	LRLS49	LRLS50	LRLS51	LRLS52
001	Owner 1	2	3	3	3	1	1	1	1	1	1	1	1	1
002	Owner 2	3	4	4	4	1	1	1	1	1	1	1	1	1
003	Owner 3	3	4	4	4	2	2	1	1	1	1	1	2	2
004	Contractor 1	2	3	3	3	4	4	4	5	5	4	4	5	5
005	Contractor 2	2	3	3	3	4	4	4	5	5	4	4	5	5
006	Contractor 3	1	2	2	2	3	3	3	4	4	3	4	4	5
007	Contractor 4	1	3	2	2	4	4	4	5	4	4	4	4	5
008	Contractor 5	1	3	2	3	4	4	4	5	4	4	4	5	5
009	Contractor 6	1	3	2	3	3	3	3	4	4	3	3	4	4
010	Contractor 7	1	2	2	1	3	3	3	4	4	3	3	4	4
011	Contractor 8	1	2	2	1	2	2	2	3	3	2	2	3	3
012	Contractor 9	1	2	2	1	3	2	2	3	3	2	2	3	3
013	Contractor 10	1	2	2	1	3	2	2	3	3	2	2	3	3
014	Contractor 11	1	2	2	2	3	2	2	3	3	2	2	3	3
015	Contractor 12	1	2	2	2	2	2	2	2	2	1	1	2	2
016	Consultant 1	1	2	2	2	2	2	2	2	2	1	1	2	2
017	Consultant 2	1	2	2	2	2	2	2	2	2	1	1	2	3
018	Consultant 3	1	2	1	1	2	2	2	2	2	1	1	2	3
019	Consultant 4	1	3	2	3	2	2	2	2	2	1	1	2	3
020	Consultant 5	1	3	2	3	2	2	2	2	2	1	1	3	3
021	Site Engineer 1	1	3	2	3	2	2	2	3	2	1	1	3	3
022	Site Engineer 2	1	3	2	3	2	2	2	3	2	1	1	3	3
023	Site Engineer 3	1	1	1	1	2	2	2	3	2	1	2	3	3
024	Site Engineer 4	1	1	1	1	2	2	2	3	2	1	2	3	3
025	Site Engineer 5	1	2	1	1	2	2	2	3	3	2	2	3	3
026	Site Engineer 6	3	4	4	4	2	2	2	3	3	2	2	3	3
027	Site Engineer 7	3	4	4	5	2	2	1	1	1	1	1	2	2
028	Site Engineer 8	1	2	2	2	2	2	1	2	1	1	1	2	2
029	Site Engineer 9	1	2	2	2	2	2	1	2	1	1	1	2	2
030	Site Engineer 10	1	2	2	2	3	2	2	3	3	2	2	3	3
031	Site Engineer 11	1	2	2	2	3	2	2	3	3	2	2	3	3
032	Site Engineer 12	1	2	1	1	3	2	2	3	3	2	2	3	3
033	Site Engineer 13	1	2	1	1	3	2	2	3	3	2	2	3	3
034	Site Engineer 14	1	3	3	3	3	2	3	3	3	2	2	3	3
035	Site Engineer 15	1	3	3	3	3	3	3	3	3	2	2	3	4
036	Site Engineer 16	3	4	4	4	4	4	4	4	5	4	4	5	5
037	Site Engineer 17	3	4	4	4	4	4	4	4	3	3	3	4	4
038	Site Engineer 18	2	3	3	3	3	3	3	3	3	2	2	3	4
039	Site Engineer 19	2	3	4	3	3	3	3	4	3	2	2	3	4
040	Site Engineer 20	2	3	4	3	3	3	3	4	3	2	3	3	4
041	Site Engineer 21	2	3	4	3	3	3	3	4	3	2	3	3	4
042	Site Engineer 22	2	4	4	3	3	3	3	4	3	2	3	4	4
043	Site Engineer 23	2	4	4	3	3	3	3	4	3	2	3	4	4
044	Site Engineer 24	3	4	4	3	3	3	3	4	3	2	3	4	4
045	Site Engineer 25	3	4	4	3	3	3	3	4	3	3	3	4	4
046	Site Engineer 26	3	4	4	3	3	3	3	4	4	3	4	5	5
047	Site Engineer 27	3	4	4	3	3	3	3	4	4	3	4	5	5
048	Site Engineer 28	4	4	5	5	5	4	5	5	5	4	4	5	5
049	Site Engineer 29	4	4	5	5	5	5	5	5	5	4	4	5	5

050	Site Engineer 30	3	4	4	3	3	3	3	4	4	3	3	4	4
051	Site Engineer 31	2	4	4	4	4	4	4	4	4	3	4	4	5
052	Site Engineer 32	3	4	4	4	4	4	4	4	4	3	4	4	5
053	Site Engineer 33	3	4	4	4	4	4	4	4	5	4	4	5	5
054	Site Engineer 34	3	4	4	4	4	4	4	4	5	4	4	5	5
055	Site Engineer 35	3	4	4	4	4	4	4	4	5	4	4	5	5
056	Site Engineer 36	3	4	4	4	4	4	4	4	5	4	4	5	5
057	Site Engineer 37	1	3	3	3	3	3	3	3	3	2	2	3	4
058	Supervisor 1	1	3	3	3	3	3	3	3	3	2	2	3	4
059	Supervisor 2	1	3	3	3	3	3	3	3	3	2	2	3	4
060	Supervisor 3	1	3	3	3	3	3	3	3	3	2	2	3	4
061	Supervisor 4	2	3	3	3	3	3	3	3	3	2	2	3	4
062	Supervisor 5	3	4	4	3	4	3	3	4	4	3	3	4	5
063	Supervisor 6	2	4	4	4	4	3	3	4	4	3	3	4	5
064	Supervisor 7	2	4	4	4	4	3	3	4	3	2	3	4	5
065	Supervisor 8	2	4	4	4	4	4	3	4	3	2	3	4	5
066	Supervisor 9	3	4	4	4	4	4	3	4	3	2	3	4	5
067	Supervisor 10	3	4	4	4	4	4	3	4	4	3	3	4	5
068	Supervisor 11	3	4	4	4	4	4	4	4	4	3	3	4	5
069	Supervisor 12	2	4	4	4	4	4	4	4	4	3	4	4	5
070	Supervisor 13	2	4	4	4	4	4	4	4	4	3	4	4	5
071	Supervisor 14	3	4	4	4	4	4	4	4	3	3	3	4	4
072	Supervisor 15	2	3	3	4	4	4	4	4	4	3	3	4	4
073	Supervisor 16	2	3	3	4	4	4	4	4	4	3	3	4	4
074	Supervisor 17	2	3	3	4	4	4	4	4	3	3	3	4	4
075	Supervisor 18	2	3	3	5	5	4	4	5	3	3	3	4	4
076	Supervisor 19	3	4	4	5	5	4	4	5	3	3	3	4	4
077	Supervisor 20	3	4	5	5	5	4	5	5	3	3	3	4	4
078	Supervisor 21	3	4	5	5	5	4	5	5	3	3	3	4	4
079	Supervisor 22	3	4	5	5	5	4	5	5	5	4	4	5	5
080	Supervisor 23	2	3	3	3	3	3	3	3	3	2	2	3	4
081	Supervisor 24	2	3	3	4	4	4	3	4	3	3	3	4	4
082	Supervisor 25	2	3	3	4	4	4	3	4	3	3	4	5	5
083	Supervisor 26	2	3	3	4	4	4	3	4	4	3	4	5	5
084	Supervisor 27	2	3	3	4	4	4	4	4	4	3	4	5	5
085	Supervisor 28	2	3	3	4	4	4	4	4	4	3	3	4	4
086	Supervisor 29	2	3	3	4	4	4	4	4	4	3	3	4	4
087	Supervisor 30	2	3	3	5	5	4	4	5	3	3	3	4	4
088	Supervisor 31	4	4	5	5	5	5	5	5	5	4	4	5	5
089	Supervisor 32	4	5	5	5	5	5	5	5	5	4	4	5	5
090	Supervisor 33	4	5	5	5	5	5	5	5	5	4	4	5	5
091	Supervisor 34	4	5	5	5	5	5	5	5	5	4	4	5	5
092	Supervisor 35	4	5	5	5	5	5	5	5	5	4	4	5	5
093	Supervisor 36	4	5	5	5	5	5	5	5	5	4	4	5	5
094	Supervisor 37	4	5	5	5	5	5	5	5	5	4	4	5	5
095	Supervisor 38	4	5	5	5	5	5	5	5	5	4	5	5	5
096	Designer 1	4	5	5	5	5	5	5	5	5	4	5	5	5
097	Designer 2	4	5	5	5	5	5	5	5	5	4	5	5	5
098	Designer 3	4	5	5	5	5	5	5	5	5	4	5	5	5
099	Designer 4	5	5	5	5	5	5	5	5	5	5	5	5	5
100	Designer 5	5	5	5	5	5	5	5	5	5	5	5	5	5
101	Designer 6	5	5	5	5	5	5	5	5	5	5	5	5	5

ID code	Number of participants	LRLS53	LRLS54	LRLS55	LRLS56	LRLS57	DRLS58	DRLS59	DRLS60	DRLS61	DRLS62	DRLS63	OFLS64	OFLS65
001	Owner 1	1	1	1	1	1	1	1	1	1	1	1	1	1
002	Owner 2	1	1	1	1	1	1	1	1	1	1	1	1	1
003	Owner 3	2	1	1	2	2	2	1	1	1	2	1	2	1
004	Contractor 1	2	1	1	2	3	2	2	1	2	2	2	2	2
005	Contractor 2	2	1	1	2	3	2	2	1	2	2	2	2	2
006	Contractor 3	4	5	4	5	5	5	5	5	5	5	5	3	3
007	Contractor 4	4	5	5	5	5	5	5	5	5	5	5	3	3
008	Contractor 5	2	1	1	2	2	2	1	1	2	2	1	2	2
009	Contractor 6	4	3	3	4	4	5	4	3	4	4	4	3	3
010	Contractor 7	4	3	3	4	4	5	4	3	4	4	4	3	3
011	Contractor 8	4	4	4	5	5	5	5	4	5	5	5	3	3
012	Contractor 9	4	4	4	5	5	5	5	4	5	5	5	3	3
013	Contractor 10	4	4	4	5	5	5	5	4	5	5	5	3	3
014	Contractor 11	2	2	2	3	3	4	3	2	3	3	3	3	3
015	Contractor 12	2	1	2	2	3	3	2	2	2	2	2	2	2
016	Consultant 1	2	2	2	2	3	3	2	2	2	2	2	2	2
017	Consultant 2	2	2	2	2	3	3	2	2	2	2	2	2	2
018	Consultant 3	2	2	2	2	3	3	2	2	2	2	2	3	2
019	Consultant 4	2	2	2	2	3	3	2	2	2	2	2	3	3
020	Consultant 5	2	2	2	2	3	3	2	2	2	2	2	3	3
021	Site Engineer 1	2	2	2	2	3	3	2	2	2	2	2	3	3
022	Site Engineer 2	2	2	2	3	3	3	2	2	2	3	3	3	3
023	Site Engineer 3	2	2	2	3	3	3	2	2	2	3	3	3	3
024	Site Engineer 4	2	2	2	3	3	3	3	2	2	3	3	3	3
025	Site Engineer 5	2	2	2	3	3	4	3	2	2	3	3	3	3
026	Site Engineer 6	2	2	2	3	3	4	3	2	3	3	3	3	3
027	Site Engineer 7	2	1	1	2	2	2	1	1	1	2	1	2	1
028	Site Engineer 8	2	1	1	2	2	2	1	1	2	2	1	2	2
029	Site Engineer 9	2	1	2	2	3	3	2	2	2	2	2	2	2
030	Site Engineer 10	2	2	2	3	3	4	3	2	3	3	3	3	3
031	Site Engineer 11	2	2	2	3	3	4	3	2	3	3	3	3	3
032	Site Engineer 12	2	2	3	3	3	4	3	3	3	3	3	3	3
033	Site Engineer 13	2	2	3	3	3	4	3	3	3	3	3	3	3
034	Site Engineer 14	2	2	3	3	3	4	3	3	3	3	3	4	3
035	Site Engineer 15	2	2	3	3	4	4	3	3	3	3	3	4	4
036	Site Engineer 16	5	5	5	5	5	5	5	5	5	5	5	5	5
037	Site Engineer 17	4	3	3	4	4	5	4	3	4	4	3	4	4
038	Site Engineer 18	3	3	3	3	4	4	3	3	3	3	3	4	4
039	Site Engineer 19	3	3	3	4	4	4	3	3	3	3	3	4	4
040	Site Engineer 20	3	3	3	4	4	4	3	3	3	3	3	4	4
041	Site Engineer 21	3	3	3	4	4	4	3	3	3	3	3	4	4
042	Site Engineer 22	3	3	3	4	4	4	3	3	3	3	3	4	4
043	Site Engineer 23	3	3	3	4	4	4	4	3	3	3	3	4	4
044	Site Engineer 24	3	3	3	4	4	4	4	3	3	3	3	4	4
045	Site Engineer 25	4	3	3	4	4	5	4	3	4	4	3	4	4
046	Site Engineer 26	5	5	5	5	5	5	5	5	5	5	5	5	4
047	Site Engineer 27	5	5	5	5	5	5	5	5	5	5	5	5	4
048	Site Engineer 28	4	4	4	4	5	5	5	4	5	4	4	5	5
049	Site Engineer 29	4	4	4	4	5	5	5	4	5	4	4	5	5

050	Site Engineer 30	4	3	3	4	4	5	4	3	4	4	4	5	4
051	Site Engineer 31	4	4	4	4	4	5	5	4	4	4	4	5	5
052	Site Engineer 32	4	4	4	4	5	5	5	4	4	4	4	5	5
053	Site Engineer 33	5	5	5	5	5	5	5	5	5	5	5	5	5
054	Site Engineer 34	5	5	5	5	5	5	5	5	5	5	5	5	5
055	Site Engineer 35	5	5	5	5	5	5	5	5	5	5	5	5	5
056	Site Engineer 36	5	5	5	5	5	5	5	5	5	5	5	5	5
057	Site Engineer 37	3	3	3	3	4	4	3	3	3	3	3	4	4
058	Supervisor 1	3	3	3	3	4	4	3	3	3	3	3	4	4
059	Supervisor 2	3	3	3	3	4	4	3	3	3	3	3	4	4
060	Supervisor 3	3	3	3	3	4	4	3	3	3	3	3	4	4
061	Supervisor 4	3	3	3	3	4	4	3	3	3	3	3	4	4
062	Supervisor 5	4	3	3	4	4	5	4	3	4	4	4	5	4
063	Supervisor 6	4	4	3	4	4	5	4	4	4	4	4	5	4
064	Supervisor 7	4	4	4	4	4	5	4	4	4	4	4	5	4
065	Supervisor 8	4	4	4	4	4	5	4	4	4	4	4	5	4
066	Supervisor 9	4	4	4	4	4	5	4	4	4	4	4	5	4
067	Supervisor 10	4	4	4	4	4	5	4	4	4	4	4	5	4
068	Supervisor 11	4	4	4	4	4	5	4	4	4	4	4	5	4
069	Supervisor 12	4	4	4	4	4	5	4	4	4	4	4	5	4
070	Supervisor 13	4	4	4	4	4	5	4	4	4	4	4	5	5
071	Supervisor 14	4	3	3	4	4	5	4	3	4	4	3	5	4
072	Supervisor 15	3	3	3	4	4	4	4	3	4	3	3	4	4
073	Supervisor 16	3	3	3	4	4	4	4	3	4	3	3	4	4
074	Supervisor 17	3	3	3	4	4	4	4	3	4	4	3	4	4
075	Supervisor 18	3	3	3	4	4	4	4	3	4	4	3	4	4
076	Supervisor 19	3	3	3	4	4	5	4	3	4	4	3	4	4
077	Supervisor 20	3	3	3	4	4	5	4	3	4	4	3	4	4
078	Supervisor 21	4	3	3	4	4	5	4	3	4	4	3	4	4
079	Supervisor 22	5	5	5	5	5	5	5	5	5	5	5	5	5
080	Supervisor 23	3	3	3	3	4	4	3	3	3	3	3	4	4
081	Supervisor 24	4	3	3	4	4	5	4	3	4	4	3	5	4
082	Supervisor 25	4	5	5	5	5	5	5	5	5	5	5	5	4
083	Supervisor 26	4	5	5	5	5	5	5	5	5	5	5	5	4
084	Supervisor 27	4	5	5	5	5	5	5	5	5	5	5	5	4
085	Supervisor 28	3	3	3	4	4	4	4	3	4	3	3	4	4
086	Supervisor 29	3	3	3	4	4	4	4	3	4	3	3	4	4
087	Supervisor 30	3	3	3	4	4	4	4	3	4	4	3	4	4
088	Supervisor 31	4	4	4	5	5	5	5	4	5	4	4	5	5
089	Supervisor 32	4	4	4	5	5	5	5	4	5	5	4	5	5
090	Supervisor 33	4	4	4	5	5	5	5	4	5	5	4	5	5
091	Supervisor 34	4	4	4	5	5	5	5	4	5	5	4	5	5
092	Supervisor 35	4	4	4	5	5	5	5	4	5	5	4	5	5
093	Supervisor 36	4	4	4	5	5	5	5	4	5	5	4	5	5
094	Supervisor 37	4	4	4	5	5	5	5	4	5	5	4	5	5
095	Supervisor 38	4	4	4	5	5	5	5	4	5	5	4	5	5
096	Designer 1	5	5	5	5	5	5	5	5	5	5	5	5	5
097	Designer 2	5	5	5	5	5	5	5	5	5	5	5	5	5
098	Designer 3	5	5	5	5	5	5	5	5	5	5	5	5	5
099	Designer 4	5	5	5	5	5	5	5	5	5	5	5	5	5
100	Designer 5	5	5	5	5	5	5	5	5	5	5	5	5	5
101	Designer 6	5	5	5	5	5	5	5	5	5	5	5	5	5

ID code	Number of participants	OFLS66	OFLS67	OFLS68	OFLS69	OFLS70	OFLS71	OFLS72	OFLS73	OFLS74	OFLS75	OFLS76	OFLS77	OFLS78
001	Owner 1	1	1	1	2	1	1	2	1	2	3	1	2	2
002	Owner 2	1	1	1	2	1	1	2	1	2	3	1	2	2
003	Owner 3	1	1	2	2	1	2	2	1	2	3	1	2	2
004	Contractor 1	1	1	1	2	1	1	1	1	1	2	1	3	2
005	Contractor 2	1	1	1	2	1	1	1	1	1	2	1	3	2
006	Contractor 3	1	1	2	3	2	2	2	2	3	3	1	3	2
007	Contractor 4	1	1	2	3	2	2	2	2	3	3	1	3	2
008	Contractor 5	1	1	2	3	2	2	2	2	3	3	1	1	1
009	Contractor 6	1	1	1	2	1	1	1	1	2	2	1	1	1
010	Contractor 7	1	1	2	3	2	2	2	2	3	3	1	2	1
011	Contractor 8	1	1	2	3	2	2	2	1	2	3	2	4	3
012	Contractor 9	1	1	2	3	2	2	2	1	2	3	1	2	1
013	Contractor 10	1	1	2	3	2	2	2	2	3	3	1	2	1
014	Contractor 11	2	1	2	3	2	2	2	2	3	3	1	3	2
015	Contractor 12	1	1	2	3	2	2	2	1	2	3	1	3	2
016	Consultant 1	1	1	1	1	1	1	1	1	1	1	1	3	2
017	Consultant 2	1	1	1	1	1	1	1	1	1	1	1	3	3
018	Consultant 3	1	1	1	1	1	1	1	1	1	1	1	3	3
019	Consultant 4	1	1	3	3	2	3	2	2	3	3	1	3	3
020	Consultant 5	1	1	1	1	1	1	1	1	1	2	1	3	3
021	Site Engineer 1	1	1	1	2	1	1	1	1	1	2	1	3	3
022	Site Engineer 2	1	1	2	3	2	2	2	1	2	3	1	3	3
023	Site Engineer 3	1	1	2	3	2	2	2	1	2	3	1	3	3
024	Site Engineer 4	1	1	2	3	2	2	2	1	2	3	1	3	3
025	Site Engineer 5	1	1	2	3	2	2	2	1	2	3	1	2	1
026	Site Engineer 6	1	1	2	3	2	2	2	1	2	3	1	2	2
027	Site Engineer 7	1	1	2	2	1	2	2	1	2	3	1	2	2
028	Site Engineer 8	1	1	2	3	2	2	2	1	2	3	1	3	3
029	Site Engineer 9	1	1	2	3	2	2	2	1	2	3	1	3	3
030	Site Engineer 10	2	1	2	3	2	2	2	2	3	3	2	3	3
031	Site Engineer 11	2	1	2	3	2	2	2	2	3	3	2	3	3
032	Site Engineer 12	2	1	3	3	2	2	2	2	3	3	2	3	3
033	Site Engineer 13	2	2	3	3	2	2	2	2	3	3	2	3	3
034	Site Engineer 14	2	2	3	3	2	2	2	2	3	3	2	4	3
035	Site Engineer 15	2	2	3	3	2	2	2	2	3	3	2	4	3
036	Site Engineer 16	4	3	5	5	4	4	4	2	3	3	2	4	3
037	Site Engineer 17	3	3	3	4	3	4	4	2	3	3	2	4	3
038	Site Engineer 18	3	2	3	4	2	3	3	2	3	3	2	4	3
039	Site Engineer 19	3	2	3	4	3	3	3	2	3	3	2	4	3
040	Site Engineer 20	3	2	3	4	3	3	3	2	3	4	2	4	3
041	Site Engineer 21	3	2	3	4	3	3	3	2	3	4	2	4	3
042	Site Engineer 22	3	2	3	4	3	3	3	3	3	4	3	4	4
043	Site Engineer 23	3	2	3	4	3	3	3	3	3	4	3	4	4
044	Site Engineer 24	3	2	3	4	3	3	3	3	3	4	3	4	4
045	Site Engineer 25	3	3	3	4	3	3	3	3	3	4	3	4	4
046	Site Engineer 26	3	3	4	4	4	3	3	3	3	4	3	4	4
047	Site Engineer 27	3	3	4	4	4	3	3	3	3	4	3	4	4
048	Site Engineer 28	4	4	5	5	4	4	3	3	3	4	3	4	4
049	Site Engineer 29	4	4	5	5	4	3	3	3	3	4	3	4	4

050	Site Engineer 30	3	3	4	4	4	4	3	3	4	4	3	4	4
051	Site Engineer 31	4	3	4	4	4	4	3	3	4	4	3	4	4
052	Site Engineer 32	4	3	4	5	4	4	3	3	4	4	3	4	4
053	Site Engineer 33	4	3	5	5	4	4	3	2	3	4	2	4	3
054	Site Engineer 34	4	3	5	5	4	4	3	2	3	4	3	4	3
055	Site Engineer 35	4	3	5	5	2	3	2	2	3	4	3	4	3
056	Site Engineer 36	4	3	5	5	2	3	2	2	3	4	3	4	3
057	Site Engineer 37	2	2	3	3	2	3	2	2	3	4	3	4	3
058	Supervisor 1	2	2	3	3	2	3	2	2	3	4	3	4	3
059	Supervisor 2	2	2	3	4	2	3	2	2	3	4	3	4	3
060	Supervisor 3	2	2	3	4	2	3	2	3	3	4	3	4	3
061	Supervisor 4	2	2	3	4	4	3	2	3	3	4	3	4	3
062	Supervisor 5	3	3	4	4	4	3	2	3	3	4	3	4	4
063	Supervisor 6	3	3	4	4	4	3	2	3	4	5	3	4	4
064	Supervisor 7	3	3	4	4	4	3	2	3	4	5	3	4	4
065	Supervisor 8	3	3	4	4	4	3	2	3	4	5	3	4	4
066	Supervisor 9	3	3	4	4	4	3	2	3	4	5	3	4	4
067	Supervisor 10	4	3	4	4	4	3	2	3	4	5	3	4	4
068	Supervisor 11	4	3	4	4	4	3	2	3	4	5	3	4	4
069	Supervisor 12	4	3	4	4	4	3	2	3	4	5	3	4	4
070	Supervisor 13	4	3	4	4	3	4	4	4	4	5	3	4	4
071	Supervisor 14	3	3	3	4	3	4	4	4	4	5	3	4	4
072	Supervisor 15	3	2	3	4	3	4	4	4	4	5	3	5	4
073	Supervisor 16	3	2	3	4	3	4	4	4	4	5	3	5	4
074	Supervisor 17	3	2	3	4	3	4	4	4	4	5	3	5	4
075	Supervisor 18	3	2	3	4	2	4	4	4	4	5	4	5	4
076	Supervisor 19	3	2	3	4	2	4	4	4	4	5	4	5	4
077	Supervisor 20	3	2	3	4	2	4	4	4	4	5	4	5	4
078	Supervisor 21	3	2	3	4	2	4	4	4	4	5	4	5	4
079	Supervisor 22	4	3	5	5	2	4	4	4	4	5	4	5	4
080	Supervisor 23	2	2	3	4	2	4	4	4	4	5	4	5	4
081	Supervisor 24	3	3	3	4	2	4	4	4	4	5	4	5	4
082	Supervisor 25	3	3	4	4	2	4	5	4	5	5	4	5	5
083	Supervisor 26	3	3	4	4	2	4	5	4	5	5	4	5	5
084	Supervisor 27	3	3	4	4	2	4	5	4	5	5	4	5	5
085	Supervisor 28	2	2	3	4	4	4	5	4	5	5	4	5	5
086	Supervisor 29	3	2	3	4	4	4	5	4	5	5	4	5	5
087	Supervisor 30	3	2	3	4	5	5	5	4	5	5	4	5	5
088	Supervisor 31	4	4	5	5	5	5	5	4	5	5	4	5	5
089	Supervisor 32	4	4	5	5	5	5	5	5	5	5	4	5	5
090	Supervisor 33	4	4	5	5	5	5	5	5	5	5	4	5	5
091	Supervisor 34	4	4	5	5	5	5	5	5	5	5	5	5	5
092	Supervisor 35	4	4	5	5	5	5	5	5	5	5	5	5	5
093	Supervisor 36	4	4	5	5	5	5	5	5	5	5	5	5	5
094	Supervisor 37	4	4	5	5	5	4	4	4	5	5	4	5	4
095	Supervisor 38	4	4	5	5	5	4	4	4	5	5	4	5	4
096	Designer 1	5	5	5	5	5	4	4	4	5	5	4	5	4
097	Designer 2	5	5	5	5	5	4	4	4	5	5	4	5	4
098	Designer 3	5	5	5	5	5	4	5	4	5	5	4	5	4
099	Designer 4	4	4	5	5	5	4	4	4	4	5	4	5	4
100	Designer 5	4	4	5	5	5	4	4	4	4	5	4	5	4
101	Designer 6	4	4	5	5	5	4	4	4	4	5	4	5	5

ID code	Number of participants	OFLS79	OFLS80	OFLS81	OFLS82	OFLS83	OFLS84	OFLS85	OFLS86	OFLS87	OFLS88	OFLS89	OFLS90
001	Owner 1	2	2	1	1	2	1	1	1	1	2	1	2
002	Owner 2	2	2	1	1	2	1	1	2	1	2	1	2
003	Owner 3	2	2	1	1	2	1	1	2	1	2	1	2
004	Contractor 1	2	2	2	1	2	1	1	2	1	2	1	2
005	Contractor 2	2	2	2	1	2	1	1	2	1	2	1	2
006	Contractor 3	2	2	2	2	2	1	1	2	1	2	1	2
007	Contractor 4	2	2	2	2	2	1	1	2	1	2	1	2
008	Contractor 5	1	1	1	1	1	1	1	1	1	1	1	1
009	Contractor 6	1	1	1	1	1	1	1	1	1	1	1	1
010	Contractor 7	1	1	1	1	2	1	1	1	1	1	1	1
011	Contractor 8	2	3	3	3	5	1	1	3	2	1	1	1
012	Contractor 9	1	1	1	1	2	1	1	1	1	2	1	1
013	Contractor 10	1	2	1	1	2	1	1	1	1	2	1	1
014	Contractor 11	2	3	2	2	3	1	1	2	1	2	1	2
015	Contractor 12	2	3	2	2	3	1	1	2	1	3	1	2
016	Consultant 1	2	3	2	2	3	1	1	2	1	3	1	2
017	Consultant 2	2	3	2	2	4	1	1	2	1	3	1	2
018	Consultant 3	2	3	2	2	4	1	1	2	1	3	1	2
019	Consultant 4	2	3	2	2	4	1	1	2	1	3	1	2
020	Consultant 5	2	3	2	2	4	1	1	3	1	3	1	2
021	Site Engineer 1	2	3	2	2	4	1	1	3	1	3	1	2
022	Site Engineer 2	2	3	2	2	4	1	1	3	1	3	1	2
023	Site Engineer 3	2	3	2	2	4	1	1	3	1	3	1	2
024	Site Engineer 4	2	3	2	2	4	1	1	3	1	3	1	2
025	Site Engineer 5	1	3	3	2	4	1	1	3	1	3	1	3
026	Site Engineer 6	1	3	3	2	4	1	1	3	1	3	1	3
027	Site Engineer 7	1	3	3	2	4	1	1	3	1	3	1	3
028	Site Engineer 8	2	3	3	2	4	1	1	3	1	3	1	3
029	Site Engineer 9	2	3	3	2	4	1	1	3	1	3	1	3
030	Site Engineer 10	2	3	3	2	4	1	1	3	1	3	1	3
031	Site Engineer 11	2	3	3	3	4	1	1	3	1	3	1	3
032	Site Engineer 12	2	3	3	3	4	1	1	3	1	3	1	3
033	Site Engineer 13	2	3	3	3	4	1	1	3	1	3	1	3
034	Site Engineer 14	2	3	3	3	4	1	1	3	1	3	1	3
035	Site Engineer 15	2	3	3	3	4	1	1	3	1	3	2	3
036	Site Engineer 16	2	3	3	3	4	1	1	3	1	3	2	3
037	Site Engineer 17	2	3	3	3	4	1	1	3	1	3	2	3
038	Site Engineer 18	2	4	3	3	5	1	1	3	2	3	2	3
039	Site Engineer 19	2	4	3	3	5	2	1	3	2	3	2	3
040	Site Engineer 20	2	4	3	3	5	2	1	3	2	3	2	3
041	Site Engineer 21	2	4	3	3	5	2	2	3	2	3	2	3
042	Site Engineer 22	3	4	4	3	5	2	2	4	2	4	2	3
043	Site Engineer 23	3	4	4	3	5	2	2	4	2	4	2	3
044	Site Engineer 24	3	4	4	3	5	2	2	4	2	4	2	3
045	Site Engineer 25	3	4	4	3	5	2	2	4	2	4	2	3
046	Site Engineer 26	3	4	4	3	5	2	2	4	2	4	2	3
047	Site Engineer 27	3	4	4	3	5	2	2	4	2	4	2	3
048	Site Engineer 28	3	4	4	3	5	2	2	4	2	4	2	3
049	Site Engineer 29	3	4	4	4	5	2	2	4	2	4	2	3

050	Site Engineer 30	3	4	4	4	5	2	2	4	2	4	2	4
051	Site Engineer 31	3	4	4	4	5	2	2	4	2	4	2	4
052	Site Engineer 32	3	4	4	4	5	2	2	4	2	4	2	4
053	Site Engineer 33	2	4	3	3	5	2	2	3	2	4	2	4
054	Site Engineer 34	2	4	3	3	5	2	2	3	2	4	2	4
055	Site Engineer 35	2	4	3	3	5	2	2	3	2	4	2	4
056	Site Engineer 36	2	4	3	3	5	2	2	3	2	4	2	4
057	Site Engineer 37	2	4	3	3	5	2	2	3	2	4	2	4
058	Supervisor 1	2	4	4	3	5	2	2	3	2	4	2	4
059	Supervisor 2	2	4	4	3	5	2	2	3	2	4	2	4
060	Supervisor 3	2	4	4	3	5	2	2	3	2	4	2	4
061	Supervisor 4	2	4	4	3	5	2	2	3	2	4	2	4
062	Supervisor 5	2	4	4	3	5	2	2	3	2	4	2	4
063	Supervisor 6	3	4	4	4	5	2	2	4	2	4	3	4
064	Supervisor 7	3	4	4	4	5	2	2	4	2	4	3	4
065	Supervisor 8	3	4	4	4	5	2	2	4	2	4	3	4
066	Supervisor 9	3	4	4	4	5	2	2	4	2	4	3	4
067	Supervisor 10	4	4	4	4	5	2	2	4	3	4	3	4
068	Supervisor 11	4	4	4	4	5	2	2	4	3	4	3	4
069	Supervisor 12	4	4	4	4	5	3	2	4	3	4	3	4
070	Supervisor 13	4	4	4	4	5	3	2	4	3	4	3	4
071	Supervisor 14	4	4	4	4	5	3	2	4	3	4	3	4
072	Supervisor 15	4	4	4	4	5	3	2	4	3	4	3	4
073	Supervisor 16	4	4	4	4	5	3	3	4	3	4	3	4
074	Supervisor 17	4	4	4	4	5	3	3	4	3	4	3	4
075	Supervisor 18	4	4	4	4	5	3	3	5	3	4	3	4
076	Supervisor 19	4	5	4	4	5	3	3	5	3	4	3	4
077	Supervisor 20	4	5	4	4	5	3	3	5	3	4	3	4
078	Supervisor 21	4	5	4	4	5	3	3	5	3	4	3	4
079	Supervisor 22	4	5	4	4	5	3	3	5	3	4	3	4
080	Supervisor 23	4	5	4	4	5	3	3	5	3	4	3	4
081	Supervisor 24	4	5	4	4	5	3	3	5	3	5	3	4
082	Supervisor 25	5	5	5	5	5	3	3	5	4	5	4	5
083	Supervisor 26	5	5	5	5	5	3	3	5	4	5	4	5
084	Supervisor 27	5	5	5	5	5	4	4	5	4	5	4	5
085	Supervisor 28	5	5	5	5	5	4	4	5	4	5	4	5
086	Supervisor 29	5	5	5	5	5	4	4	5	4	5	4	5
087	Supervisor 30	5	5	5	5	5	4	4	5	4	5	4	5
088	Supervisor 31	5	5	5	5	5	4	4	5	4	5	4	5
089	Supervisor 32	5	5	5	5	5	5	4	5	4	5	4	5
090	Supervisor 33	5	5	5	5	5	5	4	5	4	5	4	5
091	Supervisor 34	5	5	5	5	5	5	5	5	5	5	5	5
092	Supervisor 35	5	5	5	5	5	5	5	5	5	5	5	5
093	Supervisor 36	5	5	5	5	5	5	5	5	5	5	5	5
094	Supervisor 37	4	5	4	4	5	3	3	5	3	5	3	4
095	Supervisor 38	4	5	4	4	5	3	3	5	3	5	3	4
096	Designer 1	4	5	5	5	5	3	3	5	3	5	3	4
097	Designer 2	4	5	5	5	5	3	3	5	3	5	3	4
098	Designer 3	4	5	5	5	5	3	3	5	3	5	3	4
099	Designer 4	4	5	5	5	5	3	3	5	3	5	3	4
100	Designer 5	4	5	5	5	5	3	3	5	4	5	3	4
101	Designer 6	4	5	5	5	5	3	3	5	4	5	3	4

APPENDIX-B

RELIABILITY ANALYSIS OF FACTORS GROUPS CAUSING DELAY IN ROAD CONSTRUCTION

Case Processing Summary			
		N	%
Cases	Valid	101	100.0
	Excluded ^a	0	.0
	Total	101	100.0

a. List wise deletion based on all variables in the procedure.

Table 1: Reliability analysis of owner related factors.

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Delay in progress payments	35.990099	106.470	.934	.985
Deliver the furnish site to the contractor	35.643564	110.852	.916	.986
Change order by the owner in between construction	36.821782	108.148	.934	.985
Slow and late decision making by the owner	36.000000	109.700	.940	.985
Poor communication and lack of coordination with other fellow parties	36.039604	109.758	.944	.985
Attending irregular weekly meetings	36.247525	108.648	.955	.985
Late in changing and approving designed documents by the owner	35.841584	105.735	.936	.985
Unreachable to the professional construction team	36.366337	104.314	.966	.985
One sided contract condition and no fairness in contract administration	36.435644	106.788	.922	.986
Stopping of ongoing work by the owner	36.871287	108.233	.909	.986

Unprofitable delay penalties	36.356436	110.372	.881	.987
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Reliability Statistics	
Cronbach's Alpha	N of Items
.987	11

Table 2: Reliability analysis of contractor related factors.

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Frequent change in project scheduling and planning	39.514851	130.272	.859	.983
Poor communication and coordination between contractors	39.722772	125.022	.866	.983
Lack of supervision in site management	39.603960	128.122	.933	.982
Inadequate contractor experience	40.554455	125.190	.909	.982
Inappropriate construction method	39.801980	126.160	.939	.981
Delay in resource allocation	39.445545	122.950	.905	.982
Unreliable subcontractors	39.960396	125.658	.941	.981
Frequent change of sub-contractors	40.059406	122.756	.921	.982
Incompetent project team	39.712871	124.807	.941	.981
Work force of different nationalities on site	39.920792	122.854	.957	.981
Problem in financing project by the contractor side	40.198020	126.780	.866	.983
Disputes between contractor and other parties	40.277228	123.842	.858	.983

Reliability Statistics	
Cronbach's Alpha	N of Items
.983	12

Table 3: Reliability analysis of consultant related factors.

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Conflicts between consultant and designer	32.564356	80.328	.907	.963
Delay in performing inspection and testing	32.415842	83.165	.854	.966
Approving major changes in the scope of work	32.544554	80.330	.886	.964
Inaccurate site investigation	32.960396	80.058	.900	.964
Late reviewing and approving design documents	32.742574	80.593	.813	.967
Poor communication and coordination with other parties	33.029703	79.749	.856	.965
Lack of experience of consultant in road construction project	32.811881	80.654	.868	.965
Incompetence to contractors technical enquiries	32.495050	79.412	.835	.966
Poor quality control by consultant side	32.485149	79.972	.808	.967
Inadequate project management	32.891089	79.318	.844	.966

Reliability Statistics	
Cronbach's Alpha	N of Items
.969	10

Table 4: Reliability analysis of material related factors.

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Change in material type and specification in between construction	19.485149	38.532	.950	.972
Lack of construction materials in market	19.544554	36.930	.960	.971
Late delivery of material to desired site	19.128713	40.153	.909	.975
Fluctuation in material price	19.148515	39.048	.926	.974
Poor procurement strategies of construction materials	19.346535	38.129	.943	.972
Issues arise in while transportation of material	20.772277	38.138	.910	.975
Deterioration of material when they are needed	20.752475	39.188	.836	.980

Reliability Statistics	
Cronbach's Alpha	N of Items
.978	7

Table 5: Reliability analysis of equipment related factors.

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Less efficiency of equipments	17.029703	27.409	.842	.951
Shortage of advance hi-tech equipments	17.049505	25.548	.851	.950
Failure of equipment due to frequent breakdown	16.990099	24.910	.865	.949
Slow mobilization of equipment	16.900990	26.330	.867	.948

Equipment allocation problem	17.079208	26.034	.899	.945
Poor level of skilled operators	17.128713	25.393	.876	.947

Reliability Statistics	
Cronbach's Alpha	N of Items
.957	6

Table 6: Reliability analysis of labour related factors.

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Lack of labour	34.544554	100.010	.838	.978
Low productivity of labour	34.821782	97.488	.891	.976
Conflicts among labour	35.603960	98.662	.879	.977
Slow mobilization of labour on site	35.366337	96.394	.923	.976
Unqualified & inadequate experienced labour	34.504950	98.872	.917	.976
Shortage of skilled labour	34.237624	99.503	.898	.976
Problem due to different culture	34.950495	98.508	.898	.976
Lack of motivation among labour	35.069307	95.905	.885	.977
Wrong selection of labour	35.029703	97.449	.868	.977
Incorrect amount of labours use to do particular work	34.524752	98.252	.899	.976
Labour strikes	34.316832	100.999	.896	.977

Reliability Statistics	
Cronbach's Alpha	N of Items
.979	11

Table 7: Reliability analysis of designer related factors.

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Design disputes / errors	17.792079	31.866	.913	.985
Insufficient & inappropriate data collection	18.316832	28.979	.969	.980
Use of preliminary engineering design software	18.742574	29.733	.940	.982
Insufficient & unclear detail in drawing	18.356436	29.292	.966	.980
Delay in design work	18.366337	30.354	.961	.980
Lack of communication by designer side after designing	18.574257	30.287	.947	.982

Reliability Statistics	
Cronbach's Alpha	N of Items
.985	6

Table 8: Reliability analysis of other factors of delay

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Delay due to sudden change in alignment	80.633663	700.254	.854	.990
Bad terrain condition	80.831683	702.681	.842	.990
Control & restriction on traffic mobilization at job site	81.960396	693.878	.867	.990
slow site clearances (forest department, public properties etc)	82.277228	698.262	.855	.990
Unfavourable weather condition & natural disasters	81.366337	692.954	.844	.990
Delay in obtaining permits from the authorities	80.871287	703.273	.848	.990
Accidents during construction & safety aspects	81.702970	695.971	.780	.991
Restriction by government agency	81.544554	694.770	.931	.990
Price fluctuations	81.683168	695.579	.845	.990
problem with other agency	81.900990	689.650	.928	.990
Tragedy during construction	81.277228	696.202	.898	.990
Extra additional work	80.683168	698.879	.894	.990
Location of the project	81.970297	688.629	.958	.990
Lack of government judicial system for construction conflict settlement	80.722772	701.022	.910	.990
Desired quality of construction	81.178218	700.048	.896	.990
Public strikes & riots	81.693069	693.655	.881	.990
Atmosphere in the project	80.841584	698.375	.920	.990

Shortage of overall organizational body	81.158416	691.695	.934	.990
Economic crisis	81.356436	687.532	.959	.990
Effect of sub-surface conditions (soil, rock, water table etc.)	80.217822	705.732	.779	.990
Inadequate project document & management	82.475248	696.672	.897	.990
effect of social and cultural factors	82.554455	699.470	.890	.990
Type of project offer and award	81.049505	692.448	.919	.990
Interference of local public live in nearby of construction site	82.415842	695.905	.909	.990
delay in inspection and certification by third party	80.950495	699.168	.914	.990
changes in policy for loan by bankers	82.376238	696.217	.925	.990
Delay due to rework of unaccepted quality of work	81.237624	698.023	.898	.990

Reliability Statistics	
Cronbach's Alpha	N of Items
.990	27

APPENDIX-C

FACTOR ANALYSIS OF FACTORS CAUSING DELAY IN ROAD CONSTRUCTION

Table 1: KMO & Bartlett's test for sample size

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.774
Bartlett's Test of Sphericity	Approx. Chi-Square	22938.064
	df	4005
	Sig.	.000

Kmo= 0.774 which is greater than 0.5, so the same size is ok.

Communalities					
Code	Initial	Extraction	Code	Initial	Extraction
ORLS1	1	0.957	CRLS23	1	0.919
ORLS2	1	0.934	CTLS24	1	0.924
ORLS3	1	0.903	CTLS25	1	0.853
ORLS4	1	0.948	CTLS26	1	0.905
ORLS5	1	0.946	CTLS27	1	0.874
ORLS6	1	0.936	CTLS28	1	0.816
ORLS7	1	0.944	CTLS29	1	0.871
ORLS8	1	0.943	CTLS30	1	0.904
ORLS9	1	0.96	CTLS31	1	0.898
ORLS10	1	0.932	CTLS32	1	0.928
ORLS11	1	0.929	CTLS33	1	0.918
CRLS12	1	0.916	MLLS34	1	0.951
CRLS13	1	0.948	MLLS35	1	0.947
CRLS14	1	0.926	MLLS36	1	0.929
CRLS15	1	0.946	MLLS37	1	0.907
CRLS16	1	0.925	MLLS38	1	0.933
CRLS17	1	0.887	MLLS39	1	0.876
CRLS18	1	0.943	MLLS40	1	0.899
CRLS19	1	0.924	ETLS41	1	0.91
CRLS20	1	0.938	ETLS42	1	0.913
CRLS21	1	0.956	ETLS43	1	0.893
CRLS22	1	0.907	ETLS44	1	0.928

Communalities					
Code	Initial	Extraction	Code	Initial	Extraction
ETLS45	1	0.94	OFLS68	1	0.932
ETLS46	1	0.949	OFLS69	1	0.902
LRLS47	1	0.935	OFLS70	1	0.761
LRLS48	1	0.913	OFLS71	1	0.894
LRLS49	1	0.941	OFLS72	1	0.893
LRLS50	1	0.935	OFLS73	1	0.935
LRLS51	1	0.918	OFLS74	1	0.866
LRLS52	1	0.89	OFLS75	1	0.904
LRLS53	1	0.928	OFLS76	1	0.947
LRLS54	1	0.957	OFLS77	1	0.888
LRLS55	1	0.95	OFLS78	1	0.864
LRLS56	1	0.96	OFLS79	1	0.942
LRLS57	1	0.923	OFLS80	1	0.92
DRLS58	1	0.896	OFLS81	1	0.894
DRLS59	1	0.954	OFLS82	1	0.941
DRLS60	1	0.954	OFLS83	1	0.873
DRLS61	1	0.96	OFLS84	1	0.931
DRLS62	1	0.945	OFLS85	1	0.928
DRLS63	1	0.962	OFLS86	1	0.914
OFLS64	1	0.927	OFLS87	1	0.943
OFLS65	1	0.93	OFLS88	1	0.903
OFLS66	1	0.913	OFLS89	1	0.948
OFLS67	1	0.923	OFLS90	1	0.875

Extraction Method: Principal Component Analysis.

Table 2: Value of total variance explained

Total Variance Explained						
Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	61.646	68.496	68.496	61.646	68.496	68.496
2	7.048	7.831	76.327	7.048	7.831	76.327
3	5.339	5.933	82.260	5.339	5.933	82.260
4	2.824	3.138	85.398	2.824	3.138	85.398
5	1.949	2.165	87.563	1.949	2.165	87.563
6	1.525	1.695	89.257	1.525	1.695	89.257
7	1.216	1.351	90.608	1.216	1.351	90.608
8	1.196	1.329	91.938	1.196	1.329	91.938
9	.925	1.028	92.965	-	-	-
10	.649	.721	93.686	-	-	-
11	.537	.597	94.282	-	-	-
12	.490	.545	94.827	-	-	-
13	.408	.454	95.281	-	-	-
14	.395	.439	95.720	-	-	-
15	.313	.348	96.068	-	-	-
16	.279	.310	96.378	-	-	-
17	.246	.273	96.651	-	-	-
18	.233	.259	96.910	-	-	-
19	.216	.241	97.150	-	-	-
20	.210	.233	97.384	-	-	-
21	.188	.209	97.593	-	-	-
22	.172	.191	97.784	-	-	-
23	.154	.171	97.954	-	-	-
24	.145	.161	98.115	-	-	-
25	.138	.153	98.268	-	-	-
26	.116	.129	98.398	-	-	-
27	.111	.123	98.521	-	-	-
28	.103	.114	98.635	-	-	-
29	.096	.106	98.741	-	-	-
30	.081	.090	98.831	-	-	-
31	.073	.082	98.913	-	-	-
32	.067	.075	98.988	-	-	-
33	.064	.071	99.058	-	-	-
34	.063	.070	99.129	-	-	-
35	.060	.066	99.195	-	-	-
36	.053	.059	99.254	-	-	-
37	.048	.053	99.307	-	-	-

38	.043	.048	99.355	-	-	-
39	.043	.048	99.403	-	-	-
40	.040	.044	99.447	-	-	-
41	.039	.043	99.490	-	-	-
42	.036	.039	99.529	-	-	-
43	.033	.036	99.566	-	-	-
44	.030	.033	99.599	-	-	-
45	.029	.032	99.630	-	-	-
46	.028	.031	99.661	-	-	-
47	.023	.025	99.686	-	-	-
48	.022	.024	99.710	-	-	-
49	.021	.023	99.733	-	-	-
50	.021	.023	99.756	-	-	-
51	.019	.022	99.778	-	-	-
52	.018	.020	99.797	-	-	-
53	.015	.017	99.815	-	-	-
54	.015	.016	99.831	-	-	-
55	.013	.015	99.846	-	-	-
56	.013	.014	99.860	-	-	-
57	.012	.013	99.873	-	-	-
58	.011	.013	99.886	-	-	-
59	.010	.011	99.897	-	-	-
60	.010	.011	99.908	-	-	-
61	.008	.009	99.917	-	-	-
62	.008	.009	99.926	-	-	-
63	.007	.008	99.934	-	-	-
64	.007	.007	99.941	-	-	-
65	.006	.007	99.948	-	-	-
66	.006	.007	99.955	-	-	-
67	.005	.006	99.960	-	-	-
68	.005	.005	99.966	-	-	-
69	.004	.004	99.970	-	-	-
70	.004	.004	99.974	-	-	-
71	.004	.004	99.978	-	-	-
72	.003	.003	99.982	-	-	-
73	.003	.003	99.985	-	-	-
74	.002	.002	99.987	-	-	-
75	.002	.002	99.990	-	-	-
76	.002	.002	99.991	-	-	-
77	.002	.002	99.993	-	-	-
78	.001	.002	99.995	-	-	-

79	.001	.001	99.996	-	-	-
80	.001	.001	99.997	-	-	-
81	.001	.001	99.998	-	-	-
82	.001	.001	99.998	-	-	-
83	.000	.001	99.999	-	-	-
84	.000	.000	99.999	-	-	-
85	.000	.000	99.999	-	-	-
86	.000	.000	100.000	-	-	-
87	.000	.000	100.000	-	-	-
88	8.865E-5	9.850E-5	100.000	-	-	-
89	5.074E-5	5.638E-5	100.000	-	-	-
90	1.444E-5	1.604E-5	100.000	-	-	-
Extraction Method: Principal Component Analysis.						

Table 3: Parallel analysis

Component or Factor	Mean Eigenvalue	Percentile Eigenvalue
1	3.613114	3.868836
2	3.368370	3.534428
3	3.198753	3.332101
4	3.065110	3.209806
5	2.944590	3.063714
6	2.818856	2.922810
7	2.721436	2.831240
8	2.630192	2.743904
9	2.528690	2.633628
10	2.445085	2.528349
11	2.367039	2.454527
12	2.287715	2.369276
13	2.210167	2.290864

Table 4: total variance explained

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	61.646	68.496	68.496
2	7.048	7.831	76.327
3	5.339	5.933	82.260
4	2.824	3.138	85.398
5	1.949	2.165	87.563
6	1.525	1.695	89.257
7	1.216	1.351	90.608
8	1.196	1.329	91.938
9	.925	1.028	92.965
10	.649	.721	93.686
11	.537	.597	94.282

Table 5: Retained factor

Factor 1	3.613 < 61.646	Retained factor
Factor 2	3.368 < 70.048	Retained factor
Factor 3	3.198 < 5.339	Retained factor
Factor 4	3.065 > 2.824	Do not Retained factor
Factor 5	2.944 > 1.949	Do not Retained factor
Factor 6	2.818 > 1.525	Do not Retained factor
Factor 7	2.721 > 1.216	Do not Retained factor
Factor 8	2.630 > 1.196	Do not Retained factor

From the above comparison of two tables of parallel analysis & total variance explained we conclude a component or factor retained for further analysis. Factor retained is determined on the bases of Eigen value.

Component Correlation Matrix			
Component	1	2	3
1	1.000	.587	.631
2	.587	1.000	.464
3	.631	.464	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Highly correlated because it is greater than 0.5 hence it is Oblimin.

Rotated Component Matrix							
Code	Component			Code	Component		
	1	2	3		1	2	3
ORLS7	0.871	-	-	OFLS76	0.777	-	0.415
ORLS8	0.865	-	-	ORLS11	0.76	-	-
OFLS90	0.846	-	-	ORLS10	0.76	-	-
OFLS80	0.844	-	-	OFLS79	0.753	-	-
ORLS2	0.841	-	-	OFLS75	0.752	-	-
ORLS6	0.837	-	-	CRLS18	0.749	0.454	-
ORLS5	0.833	-	-	CRLS21	0.743	0.418	-
ORLS4	0.831	-	-	OFLS74	0.742	0.421	-
OFLS88	0.831	-	-	OFLS87	0.741	-	-
OFLS78	0.828	-	-	OFLS71	0.733	0.419	-
ORLS1	0.828	-	0.417	CRLS16	0.726	0.518	-
OFLS82	0.824	-	-	OFLS84	0.724	-	0.411
ORLS9	0.817	-	-	OFLS85	0.718	-	-
OFLS81	0.816	--	-	OFLS73	0.715	-	0.41
OFLS86	0.808	-	-	CRLS14	0.708	0.436	-
OFLS83	0.806	-	-	CRLS19	0.704	0.514	-
ORLS3	0.797	-	-	OFLS72	0.699	-	-
CRLS13	0.791	-	-	CRLS17	0.696	0.482	-
OFLS77	0.789	-	-	CRLS20	0.666	0.534	-
CRLS12	0.783	-	-	CTLS31	0.631	-	0.402
OFLS89	0.779	-	-	CRLS15	0.589	0.488	-

Rotated Component Matrix							
Code	Component			Code	Component		
	1	2	3		1	2	3
CRLS23	0.586	0.505	0.461	ETLS46	-	0.609	0.56
CRLS22	0.584	0.479	0.514	ETLS44	0.422	0.602	0.506
OFLS66	0.566	0.553	0.48	OFLS69	0.569	0.595	-
OFLS70	0.523	0.51	-	ETLS45	0.415	0.594	0.548
DRLS63	-	0.925	-	OFLS67	0.532	0.558	0.522
DRLS62	-	0.885	-	MLLS38	-	-	0.903
DRLS61	-	0.883	-	MLLS35	-	-	0.878
DRLS59	-	0.883	-	CTLS33	-	-	0.871
LRLS57	-	0.875	-	MLLS34	-	-	0.869
DRLS60	-	0.872	-	MLLS37	-	-	0.863
LRLS56	-	0.87	-	MLLS36	0.418	-	0.825
LRLS54	-	0.863	-	ETLS41	-	-	0.818
LRLS55	-	0.863	-	ETLS42	-	-	0.815
LRLS53	-	0.852	-	CTLS32	-	-	0.813
DRLS58	-	0.825	-	MLLS39	-	-	0.796
LRLS48	-	0.794	-	ETLS43	0.456	-	0.786
LRLS50	-	0.772	0.439	MLLS40	-	-	0.739
LRLS51	-	0.764	-	CTLS24	0.453	-	0.665
LRLS52	-	0.76	-	CTLS27	0.539	0.411	0.609
LRLS49	-	0.729	0.503	CTLS25	0.511	-	0.606
LRLS47	-	0.682	0.404	CTLS26	0.506	0.427	0.584
OFLS65	0.567	0.674	-	CTLS30	0.425	-	0.558
OFLS64	0.607	0.648	-	CTLS29	0.442	0.434	0.555
OFLS68	0.547	0.617	0.416	CTLS28	0.451	0.452	0.475
Extraction Method: Principal Component Analysis.							
Rotation Method: Varimax with Kaiser Normalization.							
a. Rotation converged in 6 iterations.							

APPENDIX-D

Variables Entered/Removed ^a			
Model	Variables Entered	Variables Removed	Method
1	Atmosphere in the project	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	effect of social and cultural factors	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Delay due to sudden change in alignment	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Slow mobilization of labour on site	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	Shortage of overall organizational body	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	Tragedy during construction	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
7	Bad terrain condition	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
8	Extra additional work	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
9	Late delivery of material to desired site	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
10	Control & restriction on traffic mobilization at job site	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
11	slow site clearances (forest department, public properties etc)	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
a. Dependent Variable: Effect of sub-surface conditions (soil, rock, water table etc.)			

These 11 factors shows by Spss software are most significant and they are pridictors.

Model Summary ¹					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.886 ^a	0.785	0.782	0.4962538	-
2	.920 ^b	0.847	0.843	0.4210139	-
3	.932 ^c	0.869	0.865	0.3911936	-
4	.950 ^d	0.902	0.898	0.3393595	-
5	.959 ^e	0.919	0.915	0.3104035	-
6	.963 ^f	0.928	0.924	0.2937887	-
7	.967 ^g	0.935	0.93	0.281344	-
8	.970 ^h	0.94	0.935	0.2706077	-
9	.973 ⁱ	0.947	0.942	0.25627	-
10	.976 ^j	0.952	0.947	0.2447644	-
11	.977 ^k	0.955	0.949	0.2398744	1.361
a. Predictors: (Constant), Atmosphere in the project					
b. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors					
c. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment					
d. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site					
e. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body					
f. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction					
g. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition					
h. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work					
i. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work, Late delivery of material to desired site					

j. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work, Late delivery of material to desired site, Control & restriction on traffic mobilization at job site
k. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work, Late delivery of material to desired site, Control & restriction on traffic mobilization at job site, slow site clearances (forest department, public properties etc)
l. Dependent Variable: Effect of sub-surface conditions (soil, rock, water table etc.)

R square value is very good and these highlighted are predictors out of 90 variable only highlighted value are predictors

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	88.788	1	88.788	360.534	.000 ^b
	Residual	24.381	99	0.246		
	Total	113.168	100			
2	Regression	95.798	2	47.899	270.229	.000 ^c
	Residual	17.371	98	0.177		
	Total	113.168	100			
3	Regression	98.324	3	32.775	214.169	.000 ^d
	Residual	14.844	97	0.153		
	Total	113.168	100			
4	Regression	102.112	4	25.528	221.666	.000 ^e
	Residual	11.056	96	0.115		
	Total	113.168	100			
5	Regression	104.015	5	20.803	215.91	.000 ^f
	Residual	9.153	95	0.096		
	Total	113.168	100			
6	Regression	105.055	6	17.509	202.86	.000 ^g
	Residual	8.113	94	0.086		
	Total	113.168	100			
7	Regression	105.807	7	15.115	190.959	.000 ^h
	Residual	7.361	93	0.079		
	Total	113.168	100			
8	Regression	106.431	8	13.304	181.677	.000 ⁱ
	Residual	6.737	92	0.073		

	Total	113.168	100			
9	Regression	107.192	9	11.91	181.353	.000 ^j
	Residual	5.976	91	0.066		
	Total	113.168	100			
10	Regression	107.776	10	10.778	179.898	.000 ^k
	Residual	5.392	90	0.06		
	Total	113.168	100			
11	Regression	108.047	11	9.822	170.708	.000 ^l
	Residual	5.121	89	0.058		
	Total	113.168	100			
a. Dependent Variable: Effect of sub-surface conditions (soil, rock, water table etc.)						
b. Predictors: (Constant), Atmosphere in the project						
c. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors						
d. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment						
e. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site						
f. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body						
g. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction						
h. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition						
i. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work						
j. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work, Late delivery of material to desired site						
k. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work, Late delivery of material to desired site, Control & restriction on traffic mobilization at job site						
l. Predictors: (Constant), Atmosphere in the project, effect of social and cultural factors, Delay due to sudden change in alignment, Slow mobilization of labour on site, Shortage of overall organizational body, Tragedy during construction, Bad terrain condition , Extra additional work, Late delivery of material to desired site, Control & restriction on traffic mobilization at job site, slow site clearances (forest department, public properties etc)						

Hence the anova for all the predictors are significant

Coefficients ^a										
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	1.113	0.183		6.072	0					
Atmosphere in the project	0.52	0.072	0.517	7.203	0	0.886	0.607	0.162	0.099	10.14
Effect of social and cultural factors	-0.183	0.055	-0.184	-3.347	0.001	0.584	-0.334	-0.075	0.169	5.923
Delay due to sudden change in alignment	0.269	0.074	0.276	3.623	0	0.766	0.359	0.082	0.087	11.45
Slow mobilization of labour on site	-0.323	0.04	-0.352	-8.029	0	0.328	-0.648	-0.181	0.264	3.788
Shortage of overall organizational body	0.441	0.06	0.488	7.294	0	0.839	0.612	0.164	0.114	8.791
Tragedy during construction	-0.391	0.061	-0.414	-6.364	0	0.578	-0.559	-0.144	0.12	8.324
Bad terrain condition	0.159	0.073	0.158	2.175	0.032	0.733	0.225	0.049	0.096	10.37
Extra additional work	0.27	0.066	0.274	4.097	0	0.681	0.398	0.092	0.114	8.772
Late delivery of material to desired site	-0.17	0.044	-0.156	-3.881	0	0.507	-0.38	-0.088	0.315	3.172
Control & restriction on traffic mobilization at job site	0.262	0.068	0.299	3.848	0	0.71	0.378	0.087	0.084	11.88
Slow site clearances (forest department, public properties etc)	-0.142	0.066	-0.152	-2.17	0.033	0.64	-0.224	-0.049	0.103	9.667

a. Dependent Variable: Effect of sub-surface conditions (soil, rock, water table etc.)