

## RANKING OF DELAY FACTORS IN THE INDIAN BUILDING CONSTRUCTION

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### ABSTRACT

Experience and literature studies revealed that for a construction project to be considered successful, it should be completed within time and within the budget. The factors that cause time delay are then of critical importance to the profitability of most construction projects. Many researchers, in the literature, have identified the most common problems that affect and cause delays in construction projects. These affect the company's performance and also has a drastic impact on the overall economy of the country. A deeper understanding of these factors is necessary as it is critical to understand which factors are more detrimental to the project than others. To accomplish this, a survey of the industry experts was conducted and their inputs were used to rank the most common delay causing factors based on their severity. Using this one can identify which factors are more likely to cause time over runs in projects and ultimately lead to time and money losses. The most common factors that cause delays were identified from the literature and then were grouped into 7 categories. From the inputs received from the industry experts, the factors which were considered to be the most severe in each category were recognized. Also the group which was considered to be the most severe was recognized

**INTRODUCTION** In most countries, experience and the literature revealed that successful construction projects should be completed before project due dates and within budget. Therefore, causes of time delay are of critical importance to the profitability of most construction projects. Many researchers, in the literature, have identified these problems as factors that affect the delay in construction projects and will affect company's performance and overall economy of the country as well. Meanwhile, identification and evaluating factors causing delay in construction projects have been carried out in the last decade. However, a deeper study is still needed to improve the understanding of these problems. A construction project is commonly acknowledged as successful

when it is completed on time, within budget, in accordance with specifications and to stakeholder's satisfaction.

Construction projects may differ in size, duration, objectives, uncertainty, complexity, pace, and some other dimensions. Delay in the construction industry is defined as non-completion of project within the specified duration agreed upon in contract. Delays are common in various construction projects and cause considerable losses to project parties. The common results of delays are as follows:

## OBJECTIVE

- To identify the various factors that cause time and over-runs in construction projects and to see the factors which contributes significantly towards the delays for the Indian scenario using inputs from industry experts.

To identify the most critical factors which are considered detrimental to the progress and also to identify the groups which contribute the most to the delays in a project.

## LITERATURE REVIEW

### 2.1 LITERATURE STUDY

This chapter confers the review of literatures regarding the issue of delay factors of Construction industry in the past researches and studies. Delay analysis is usually ignored or done subjectively by simply adding a contingency. As a result, many major projects fail to meet schedule deadlines (O. Duran et al. 2006). There have been a lot of papers on delays in construction projects done in the recent years. The most noteworthy of them which are relevant to the current study are being reviewed.

**(1) Chidambaram Ramanathan, SP Narayanan and Arazi B Idrus, “ Construction Delays causing risks on time and cost – A critical review”, (Universiti Teknologi Petronas, Malaysia), 2009** :Chidambaram Ramanathan reviewed the studies done by previous authors and tried to evaluate their efforts (Chidambaram Ramanathan et al. 2009) .

. Most construction projects can be divided into 3 stages namely 1. Project conception , 2. Project design,3. Construction phase. Identifying common problems that occurred in the projects of

the same type in the past can also be very helpful to the planner in fixing contingencies (Chidambaram Ramanathan et al. 2009). Some authors divide the construction project phase into 2 namely the preconstruction phase ie. the phase from conception to award of contract and then the construction phase ie. from award of contract to completion of the project. Delays occur in both the phases of the project.

**(2) In the paper titled “ Delay factors in construction projects” ( RemonFayek et al. 2013),** the authors did a comprehensive questionnaire survey in Egypt and arrived at a formula to calculate the duration by which the project will be delayed with reasonable accuracy. 99 factors were identified and were divided into 9 groups. Successful projects must be completed before due dates and within budget. It is crucial for the contractors to identify the factors that affect the success of the project and estimate their impact before bidding. Several studies have been conducted by researchers in determining the delay causing factors but their methodologies of ranking these factors differ greatly.

**(3) HemantaDoloi (2013) analyse chronic problem,** the subject of poor cost performance has been widely published in the mainstream project and construction management literature. Nevertheless, the underlying responsibilities of the key stakeholders (clients, consultants, and contractors) in managing this chronic problem in the construction industry remain unclear. **Hemanta Doloi (2013)** analyses this problem in the Australian industry. Therefore, contractors’ ability in using sophisticated methods and their rationalizations at the tender development stage are considered crucial in achieving cost success in most projects.

The factors are

1. Accurate project planning and monitoring,
2. Design efficiency,
3. Effective site management,
4. Communication,
5. Contactor's efficiency,
6. Project characteristics,
7. Due diligence,
8. Market competition.

**(4) Augustine UcheElinwa and Mangvwat Joshua (2001)** does a comprehensive analysis of the factors causing time over-runs in the Nigerian construction industry. Delays are very serious in the Nigerian Construction Industry as the fluctuating oil prices result in drastic revenue changes and consequently a lower level of spending from the government and slower economic growth.

**(5) Abhishek Bhargava et al. (2010) reported that a comprehensive three stage least squares analysis of time and cost over-runs in projects.**

Broadly speaking, the problems during the building process have been considered in relation to:

1. Separation of design from construction
2. Lack of integration
3. Lack of effective communication
4. Uncertainty
5. Changing environment, and
6. Increasing project complexity.

**(6) Shamil G. Naoum et al. (1994)** does a critical analysis of time and cost management in traditional contracts . Broadly speaking, the

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**(7) Peter E.D. Love (2013)** analysed the statistical characteristics of cost overruns experienced from contracts awarded in 276 Australian projects (Peter E.D. Love et al. 2013). It is always critical to the project delivery that accurate cost predictions be made in the first place. Despite the application of techniques devised by researchers as well as the adoption of new and more innovative organizational and management practices, cost overruns are still a very common problem in construction projects.

**(8) N. Hamzaha, M.A. Khoirya** classified the delays in construction projects into 2 types namely excusable and non-excusable delays (**N. Hamzaha et al. 2011**). In construction projects if the delay is between 10-30 % it is considered manageable and above 30% it is considered very difficult. Although the parties involved in the contract agree upon the extra time and cost associated with delay, in many cases there were problems as to whether the contractor was entitled to the extra cost. Non excusable delays are the delays caused by the contractor and his subcontractors.

## METHODOLOGY

### METHODOLOGY ADOPTED FOR THE STUDY

Literature study and the study of delay factors were done in order to get the details related to ranking of delay factors in the construction industry. This study aims to find out the factors that cause the time and cost over-runs in projects. A detailed literature review gave the most common categories of factors causing delays in projects. By combining the inputs from professionals in the construction industry, these factors can then further be reduced to the ones most prominent in the Indian scenario. With those factors a predictive model suitable for the Indian scenario can be developed. This model can then be validated using case studies. The flow chart below represents the methodology adopted for the study.

### **3.2 WORKING METHODOLOGY CHART**

Predictive models can be developed using statistical analysis of the data collected. From this predictive model it is expected to be able to predict the time and cost over-runs that a project might undergo. This can be accomplished by knowing which factors are more predominant in the case study taken.

A detailed questionnaire survey was prepared. The factors that cause delays in projects as obtained from the literature reviews were divided into categories. The participants in the survey were asked to rate the severity of these factors. From their inputs the factors were then sorted out based on their relative importance index. From this index we get a fair idea of the factors which tend to cause the most delays in projects. A total of 83 delay factors were selected from the literature review.

These factors were then divided into 7 categories which are ,

1. Consultant related factors
2. Contractor related factors

3. Equipment related factors
4. External factors
5. Labour related factors
6. Materials related factors
7. Owner related factors

General types of construction delays should be clearly examined before schedule delay analysis begins. Schedule construction delays are categorized in many ways. According to Trauner et al. (2009),

The participants were asked to rate the factors from a scale of 1 to 5 based on what they think will be the impact of the factor on the delays occurring in a project with 1 being very less effect to 5 being severe effect.

The Relative Importance Index of these factors are then calculated using the weighted average method. This helps to rate which factor is considered the most severe in the group and on the whole list of factors. From these survey results we will get a greater understanding of factors which we are supposed to avoid from a project management perspective in order to avoid time over-runs in the project.

The Relative Importance Index of each of the factors are calculated using the following formula

$(n1) \times (n2) \times (n3) \times (n4) \times (n5) / \text{total number of respondents}$

n1: Number of respondents who checked “Very little effect”

n2: Number of respondents who checked “ Little effect”

n3: Number of respondents who checked “Average effect”

n4: Number of respondents who checked “High effect”

n5: Number of respondents who checked “Very high effect”

## **DATA ANALYSIS**

### **3.4.1 CONSULTANT RELATED FACTORS**

The consultant related factors are the ones that are directly related to the consultants in the projects. The consultants play an important role in any project as they are the ones who need to approve before any work to be carried out by the contractor. They also have to check the quality of the work completed by the contractor ie. they must ascertain that the work has been completed as per the requirements in the contract so that the payment can be made to the contractor.

The factors considered were

1. Inadequate project management assistance
2. Delay in reviewing and approving documents
3. Poor communication and coordination between owner and contractor
4. Inaccurate site investigation
5. Delay in performing inspection and testing
6. Delay in approving major changes in scope of work by the consultant
7. Conflicts between consultant and design engineer
8. Lack of consultant experience in construction projects.

Then ranked on RII comes 2 factors

- Poor communication and coordination between owner and contractor

- Inaccurate site investigation

Poor communication and coordination between the owner and contractor are a result of the consultant and project management teams. If the owners requirements are not effectively conveyed to the contractor by the consultants and project management teams, several revisions will have to be done till both the owner and contractor actually understand each other. This can be avoided if the consultants and project management teams handle the situation with finesse.

Inaccurate site investigation is one of the most important factors when we consider the Indian scenario. We seldom see proper site investigations being carried out and this results in disastrous results. Proper site investigation must be done by the consultants rather than use data from old projects. Also it should be noted that too much money must not be invested into this.

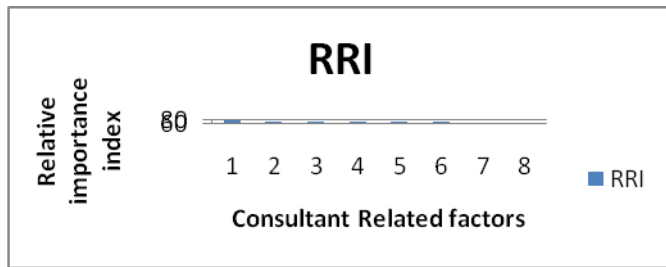
The factors which were considered the least severe in the consultant category were

- Delay in reviewing and approving documents
- Conflicts between consultant and design engineer
- Inadequate project management assistance
- Delay in performing inspection and testing

Finally the factor which was rated the least among the consultant category was the delay in performing inspections and testing. The work done by the contractor must be inspected and tested by the consultants before the go is given to proceed to the next stage. Generally site engineers from the consultant side do this. Conflicts are bound to arise



between the contractor side and consultant side engineers as it is a play of opposing forces.

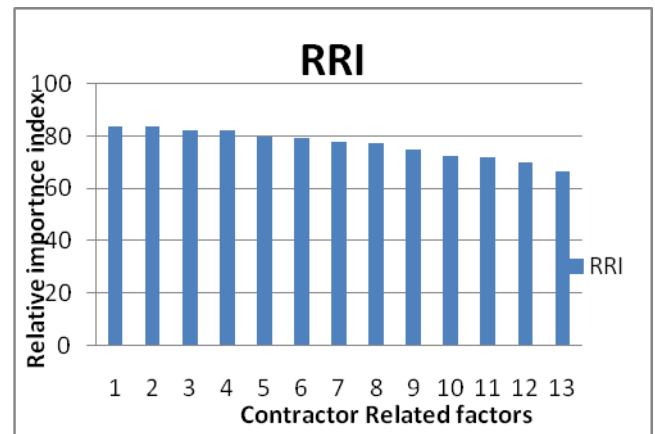


*Fig 3.2 Relative Importance Index - Consultant Related factors*

### 3.4.2 CONTRACTOR RELATED FACTORS

The contractor related factors are the ones that are a result of the direct action of the contractor and can have an adverse effect on the project. As expected the factors in this category had a very high Relative Importance Index compared with the factors from the other groups. The factors from the Contractor group were.

1. Poor financial control on site
  2. Inappropriate contractor’s policies
  3. Unreliable Sub-contractors
  4. Rework due to errors
  5. Poor site management and supervision
  6. Obsolete technology
  7. Ineffective project planning and scheduling
  8. Incompetent project team
  9. Inappropriate construction methods
  10. Inadequate contractor experience
  11. Frequent change of sub-contractors
- a) Ineffective project planning and scheduling (RII: 83.8%)
  - b) Poor site management and supervision (RII: 83.6 %)
  - c) Rework due to errors (RII: 82.4 %)



*Fig 3.3 Relative Importance Index - Contractor Related factors*

Good site management and supervision from the contractor side is expected both from the consultants and owner side. If these are not upto the mark, the project will suffer. Many of these difficulties can be alleviated if the consultants have good experience in the type of project undertaken. A properly written contract where even the small things are explicitly mentioned can make the contractor aware of the results of improper site management and supervision.

The next 6 factors ranked by the RII were:

1. Poor financial control on site
2. Incompetent project team
3. Inadequate contractor experience
4. Inappropriate construction methods
5. Unreliable sub-contractors
6. Frequent change of sub-contractor

The last 2 factors as ranked by the Relative Importance Index in the Contractors group were

1. Inappropriate contractor’s policies
2. Obsolete technology

The contractor’s policies of acquiring materials and manpower and other site policies can cause a

lot of tension between the contractor and consultant side. The consultant side must make sure that the contractor's policies are acceptable to them before awarding them the contract in the first place. Obsolete technology used in construction by the contractor in result in more time taken to complete activities and can result in time over-runs.

### **DESIGN RELATED FACTORS**

These factors relate to the design and design revision aspects in the project. It is usual as a project progresses to get changes in design due to a several reasons. From the literature surveys, the factors that relate to the design aspect of a project which can cause delays in the project were

1. Defective design made by designers
2. Incomplete project design
3. Unclear and inadequate details in drawings
4. Poor use of advanced engineering design software
5. Misunderstanding of owners requirement by design engineers
6. Mistakes and delays in producing design documents
7. Lack of design team experience in construction projects
8. Insufficient data collection and survey before design
9. Design errors and omissions made by designers
10. Design changes by owner or his agent during construction
11. Complexity of project design

Design changes by the owner or his agent during construction is another factor which can cause time over-runs in projects. The owner must also be very clear about what his needs exactly are.

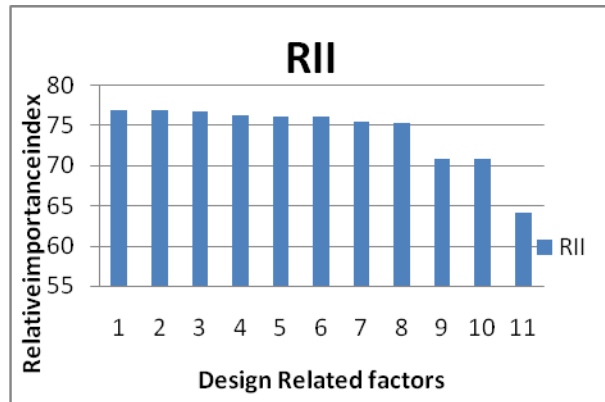
The project management team must ensure that the owners totally understand the pros and cons of their intended use for the land parcel. Otherwise this will result in the project being delayed and will cost the owner more money. Most project management consultancies have a fixed fee for a project and they do not tend to lose much if the project goes haywire. However in the best interests of all parties involved, it is imperative that the owners must understand all the required aspects of the project so that they can be sure that this is the best use for their land parcel.

The last 3 factors in the design related group were

- a) Unclear and inadequate details in drawings
- b) Complexity of project design
- c) Poor use of advanced engineering design software

Unclear and inadequate details in drawings will result in time lost when the contractor side sends the documents back for review to the design team. This can be avoided by the design team in the first place and must be ensured by the project management team.

Complexity of project design can be a difficult issue. If the project is complex in nature it must be made sure that the designers selected for it are adequate for it. Also the designers must ensure that they have not bit into something which is more than what they can chew. The project management team and the owners must make sure that design contracts are awarded to design firms who are capable of completing the design of the project on their own. Experience in similar projects helps in this regard.



*Fig 3.4 Relative Importance Index - Design Related factors*

### 3.4.4 EQUIPMENT RELATED FACTORS

The factors in this category are directly related to the equipment mobilization and availability and the delays that can occur in a project because of them. Most of the equipment mobilization is to be done by the contractor side and the factors in this category are to be taken by the contractor side.

The factors considered in the survey under this category were

1. Slow mobilization of equipment
2. Shortage of equipment
3. Low efficiency of equipment
4. Inadequate modern equipment
5. Improper equipment
6. Frequent equipment breakdowns
7. Equipment allocation problem

Of all these factors the top 3 factors with the highest Relative Importance Index were

- Shortage of equipment
- Frequent equipment breakdowns
- Equipment allocation problem

Shortage of equipment is a serious problem and many a times cause problems between the contractor and project management teams. This can be caused due to variety of reasons and it is not always possible to foresee the reasons for these. However contingency measures can be developed by the contractor team for such a case. If they are short of equipment, the contractor should have means of getting them from somewhere else and the project management team must ensure that this is the case.

Frequent equipment breakdowns are another delay causing factor in projects. Heavy machinery like bulldozers, cranes etc. have a very high chance of breaking down specially after years in service. If the project relies heavily on such heavy machinery, it will be good to ensure that the contractor does not have very old equipment. Also if the contractor has means to repair these said equipment quickly and effectively, it will be good. If however the machinery turns out to be unreliable even after several repairs, it has to be replaced.

Equipment allocation problem becomes critical when the contractor has several simultaneous projects. This will create a serious logistics problem for the contractor team. Most contractors are not so enthusiastic about getting new equipment, but somehow managing with the equipment that they have. The project management team must ensure that if the contractor has several running projects, then this equipment allocation problem will not come into play. This will also depend on the progress of the other projects. If the other projects are delayed and somehow the dates when the equipments are required overlap, it will cause delays.

The other factors in the Equipment related category ranked according to their Relative Importance Index are

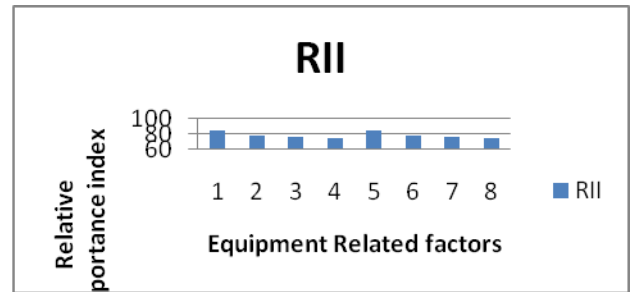


- Low efficiency of equipment
- Slow mobilization of equipment
- Improper equipment
- Inadequate modern equipment

Low efficiency of equipment is a serious problem in big projects. If the equipment brought in by the contractor cannot complete the work at the required speed, more equipment must be mobilized. If this is not done quickly, it will result in a large amount of money in the end to complete the package on time. The project management team must ensure that the equipments with the contractor are enough to complete the job on time.

Slow mobilization of equipment is another problem. This particularly affects heavy machinery. Some complex projects require heavy machinery and this is usually to be mobilized by the contractor. However if the mobilization is slow and the equipment doesn't reach on time, the work cannot be started and all the activities that are to be done after this will be affected. It is always advised to have the equipment mobilized and ready before it is actually required on site. This way even if the mobilization process hits a delay, the equipment can still be hoped to reach on time for use in the project.

The last factor in the equipment related category is the Inadequate modern equipments. If the contractor side does not have inadequate modern equipment to complete the job, it may become a problem. It must always be ensured that the equipment used by the contractor are the most modern available in the field. This becomes more important when the projects is really complex as old technologies are slower and can cause problems.



**Fig 3.5 Relative Importance Index – Equipment Related factors**

### 3.4.5 LABOUR RELATED FACTORS

These factors relate to the labour availability at site and the factors that can cause delay in this respect. A total of 8 factors were selected from the literature review for this. The selected factors under the labour related group were

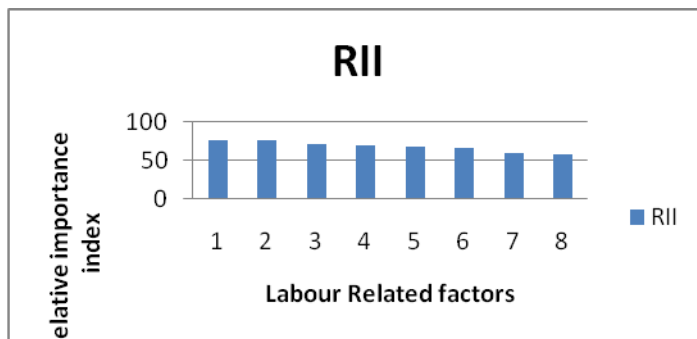
1. Labour injuries
2. Labour strikes
3. Slow mobilization of labour
4. Shortage of labour
5. Personal conflicts among labour
6. Low productivity of labour
7. Low motivation morale of labour
8. Absenteeism

The next 5 factors in this category ranked by their severity are

- Labour strikes
- Absenteeism
- Low motivation and morale of labour
- Personal conflicts among labour
- Labour injuries

Low motivation and morale of labour is usually not a big issue in India. The labours have to be paid on time and the contractor must make sure of this. Or else labour shortages or labour

strikes can occur which can complicate things further.



**Fig 3.6 Relative Importance Index – Labour Related factors**

### 3.4.6 MATERIALS RELATED FACTORS

In the materials group, the factors which directly relate to the supply and acquisition of material are discussed. Material acquisition is an important process of any construction project. The materials cannot be all stored on site and will have to be brought in as required. This logistics problem can cause delays in the availability of material on site and in turn can cause delays in the activities in the site. The factors that were considered were

1. Unreliable suppliers
  2. Shortage of construction materials
  3. Poor quality of construction materials
  4. Poor procurement of construction materials
  5. Late delivery of materials
  6. Escalation of material prices
  7. Damage of sorted materials during construction
  8. Changes in material type and specifications
- The most important among these as shown by the survey were

1. Shortage of construction materials
2. Late delivery of materials
3. Unreliable suppliers

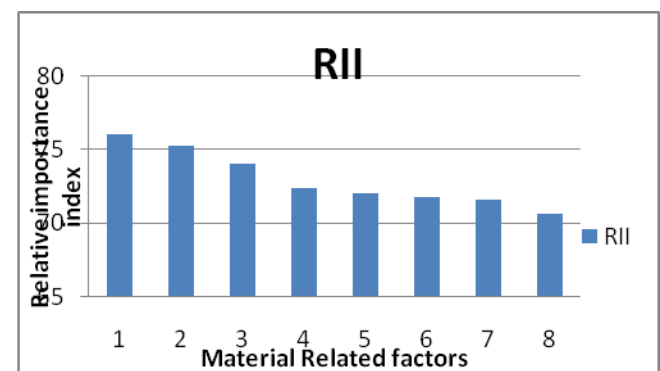
### 4. Damage of sorted materials during construction

Damage and wastage of materials during construction can be a big issue. Wastages will mean that the contractor will have to order more materials, or he might even complete the work with the damaged materials. Work should never be completed using materials which are below the acceptable standards. The project management team must note this. The site engineers of the contractor must also ensure that their labourers do not waste or damage materials on site. These kind of practices from the contractor side will create tensions between them and the project management team and the owners.

The other 4 factors in the group as ranked by their severity were

- Poor procurement of construction materials
- Poor quality of construction materials
- Changes in material type and specifications
- Escalation of material prices

Poor procurement of construction materials are a direct result of poor planning on the contractor side. If their planning team is not efficient, then these kind of problems will appear. When procurement is done factors like storage, wastage, time required to get the materials to the site etc. must be considered.



**Fig 3.7 Relative Importance Index - Materials  
Related factors**

## CONCLUSION

1. From the survey of the experts in the industry, the factors that were considered to be the most severe in causing time over runs in construction projects were identified. The most important of these factors were

- Delay in payments
- Shortage of equipment
- Ineffective planning and scheduling

2. The project management teams should note that the contractors hired for the job have adequate experience in the type of construction project entrusted to them and also enough manpower and equipment to complete the job on time

3. The project management team must be careful to avoid reworks due to errors as it is also considered one of the crucial factors which can delay the project remarkably.

4. The owners must ensure that the mode of financing for the project will not affect their ability to pay the contractor for the completed works on time.

5. The factors directly related to the contractor group ranked highest in the severity of groups. It must be ensured that the contractors follow proper construction practices and also have a very good track record.

6. Proper practices by the contractor can save a lot of money and time.

7. The project management team must be aware of the other projects which the contractor has simultaneously undertaken. This is so that they can

foresee when the contractor will be forced to divide his resources among the projects.

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