



EVALUATION OF COST AND TIME OVERRUN IN GOVERNMENT CONSTRUCTION PROJECTS - A CASE STUDY

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ABSTRACT

The construction industry is regarded as one of the fast growing industry in India. In the modern years, due to substantial increase in the amount of construction companies and change in government administrations in Kerala state, the construction projects are exposed to cost and time overrun or sometimes both, and has an impact on progress of the works associated with the construction industry. This study attempts to determine the factors contributing to cost and time overrun on construction projects in Kerala. Questionnaire survey was conducted among owners, clients and contractors of the projects. Data was analyzed for various indices analysis and correlation analysis, and the major delay causing attributes in the construction projects were ranked. The results showed that “payment delay by the client” was the most critical factor that contributed towards the project delay followed by “clients’ financial availability to pass the running bill” and “delay in payment to the contractor”. These three major delay causing factors were supported by all three parties of construction. The study also recommended owners, contractor and clients to take responsibilities to avoid or reduce time and cost overrun of projects which can be achieved by good management of construction projects and also introducing new methods in storing materials from the initial phase of the project to avoid unnecessary delays in construction.

Key words: Civil; Construction; Government; Time overrun, Cost overrun, Mega projects, delays, Factors.

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1. INTRODUCTION

The construction industry is considered as one of the vital industry in the developing economy. The industry does not confine itself to builders, but also to those who design, develop and maintain structures and other resources such as capital, labour and material. The construction industry in India provides service to workforce to nearly 32 million and its market size is about Rs 248000 Crores as per the Construction Industry Development Council. The GSDP (Gross State Domestic Product) in Kerala construction sector in the year 2015-2016 was Rs 63831 Cr compared to Rs 59965 Cr in 2014-15 as per the Department of Economics and Statistics, Kerala State Planning Board. As the infrastructure complexity of projects increases it puts a greater need on the project manager to complete and deliver the project within the speculated time and planned budget along with a greater quality of work. There are diverse categories of construction such as heavy construction which includes projects such as sewer systems and infrastructures, dams; commercial building which includes offices, apartments, school and public buildings and residential buildings. The construction industry in India is considered as an important parameter for the development of the country as it creates lot of opportunities such as investments across and various other sectors. One major indicator is the intrusive pace of construction activities happening in the country. The economist and development analysts of the country believe that if the current national level strategies or initiatives are consistently supported with other initiatives in the areas of health, labour and education, this country will grow in its infrastructural development in par with Brazil, China and Russia towards developing nation by 2050. However, the construction industry in Kerala has been suffering from many complications which affects cost, quality of work, time and major factor being political situations and techniques that has been followed in the mode of construction. Poor time and cost performance are critical issues the construction industry is facing right now, and as a result construction companies fail to achieve project objectives in the stipulated time. This research, intended to find out the major causes of cost and time overrun that affect a project success. Also another pivotal question that guided this study was that does project delay during implementation of construction project affect project cost overruns? In line with Le-Hoai et al. (2008), this study focusses on the following objectives:

- To identify the variables that causes delays and cost overruns
- To rank the causes of delays and cost overruns in terms of degree of occurrence and level of severity
- To test the correlation between rankings of the respondents
- To suggest recommendation for avoiding cost and delay overruns

2. LITERATURE REVIEW

Even though several studies have highlighted the budgetary issues in projects that lead to construction project delays, there is strong evidence in the literature that there are several other factors that challenge the construction industry. The success of a project is based on cost performance (Olawale and Sun, 2010; Frimpong et al., 2003). However, several studies in the literature have tried to identify the major factors contributing to the delay of projects with respect to cost and time. According to Ahsan and Gunawan (2010), India had the worst schedule

performance compared to China, Thailand and Bangladesh. Harisaweni (2007) showed that the poor site management was one of the major causes in delay that led to negative cost performance in construction industry in Indonesia. Sambasivan and Soon (2007), and Alinaitwe (2008) proposed that “poor site management, poor planning, delayed payments, inadequate supervisory skills of the contractor, equipment availability and failure, labour supply, poor communication and rework were some of the most important causes of delay in Malaysian construction industry”.

Shrestha et al. (2013) carried out a survey study for 363 public construction projects and found that as the size of construction project work increases, it resulted in significantly higher cost overrun. These construction projects are often considered as mega projects which can be defined in term of physical nature, excessiveness and their impact on civilization leading to increased public attention (Altshuler and Luberoff, 2003). There are very strong indications that large project could yield in higher cost overrun and it also appears that contrary aspects have been reported. Another investigation was conducted by Odeck (2004) on cost overrun exclusively for road project and showed that small sized project contributed towards lower cost overrun than larger ones. An observation that he ascribes is that the larger road project had better administrative system than the smaller equivalents. Though Odeck (2004), do not propose any clarification for the contrary results, Cantarelli et al. (2010) offers that the contrary results may be due to the smaller size of the sample of large projects listed in the study.

Van et al. (2015) highlighted that cost overrun can be described as when the project objective that has not been achieved within the estimated budget or the surplus of actual cost over the budget in a project plan. The cost overrun in a construction project could arise from various factors such as lack of inexperienced contractors, frequent changes in the design of the structure, fluctuation in material cost, poor budget planning, and poor supervision and project management. Time delay or overrun can defined as the addition of time beyond planned completion time for a construction project dates accountable to the contractor. Delay is an event which tends to postpone the project activities and impacts the progress of the project. These includes, unavailability of resources, weather delay, design delay etc. The time delay can also be defined as the difference between the actual completion time and the estimated completion time and measured in number of days.

In India, Iyer and Jha (2005) distinguished the project failure and success attributes and their dormant failure are due to conflict among project parties, ignorance and poor knowledge, reluctance in making decision, aggressive competition during tender phase etc. The period of delay duration depends on the type of project that has been undertaken. Projects such as maintenance works experiences most intense time delay (Bordat et al.2004). Kouskili and Kartan (2004) in their findings suggests that the factors affecting time and cost overrun are due to defective tools and plants, uncertain sources of materials in the local market and negligence accidents at the site. The above-mentioned causes agree with the finding of Majid and Mc Caffer (1998) who concluded that if these causes are dealt effectively then time overrun can be mitigated effectively.

3. METHODOLOGY

Based on literature review and personal interviews of professionals in construction organization, a questionnaire was prepared to understand the viewpoint of owners, contractors and clients in the causes of delay in project. A total of 30 delay causing factors have been identified and listed for this research study. Since most of the literature related to delay has been from various countries around the world, only those factors which are consistent with the circumstances and conditions in the state of Kerala has been considered in this study and also with interviews with the professionals in the construction industry in Kerala. Changes and

modifications in the questions were done based on interview of experienced personals in this industry. The population considered to carry out this research included various professionals in the construction fields namely the owners of the respective firms, contractors of the project and the client associated with each project having valid registration according to KPWD (Kerala Public Work Department) or PWD (Public Work Department). This project data collection has been carried out for the civil works belonging to A and B class categories only. The factors were identified from various attributes affecting delays for owner, contractor and client. The owner, client and contractor related attributes consist of 7, 7 and 16 factors respectively. All these delays causing attributes were individually identified and framed into 30 questions in the questionnaire. Here, convenience sampling method was adopted in carrying out the study for 208 construction professionals. In this study, 58.00% (121) contractors, 30.00% (62) clients and 12.00% (25) owners cooperated in the questionnaire. 57.69% (120) of owner's project are in buildings, 22.50% (47) are in roads, 12.01% (25) are in road and bridge, 0.48% (1) in building and piling, 0.96% (2) are in road, building and canal, 2.40% (5) are in building and bridge, 3.84% (8) are in bridge. 71.63% (149) of the respondents are in the age group above 15+ years in the field of construction, 20.19% (42) of respondents have an experience between 10-15 years, 7.69% (16) of respondents belong to 6-10 years and 0.48 % (1) of respondent belonged to 0-6 years.

4. DATA PROCESSING AND ANALYSIS

The data analysis was carried out using IBM SPSS version 25 and Microsoft Excel. Index analysis such as frequency index and severity index were used to rank the factors based on the number of occurrences of the factors and intensity of problems occurring in the project as used by Le-Hoai et al (2008). Frequency index indicates occurrence-frequency of a factor that is responsible for time and cost overrun. It is calculated by the following formula:

$$\text{Frequency index (F.I)} = \frac{\sum_0^4 a_i n_i}{4N}$$

Where a= constant expressing the weight assigned to each response which ranges from 0 for Not likely to happen to 4 for Always. n= frequency of each response and N= total number of responses.

Severity index indicates severity of factor that causes delay in time and cost overrun and is calculated by the following formula:

$$\text{Severity index (S.I)} = \frac{\sum_0^4 a_i n_i}{4N}$$

Where a= constant expressing the weight assigned to each response which ranges from 0 for No to 4 for extremely. n= frequency of each response and N= total number of responses. Importance index indicates overview of both frequency and severity factors and is calculated by the following formula: Importance index (IMP.I) = F.I X S.I

5. RANKING OF FACTORS

There are 30 factors and these are ranked based on the occurrence and severity and are shown in table 1 and 2 respectively. Each cause is rated by three parties of respondents. From both the tables it can be seen that there is merely any difference between the three parties especially when owners and contractors are compared. From the above rating it can be identified that more a factor has a tendency to occur, the more severe is that cause on the project budget and duration. The first three causes in the overall ranking of both frequency study and severity study shows good compatibility between all three parties of the project. However, it can be noted that there is a general agreement between the owners and contractors with overall ranking. It can also be noted that the first two causes belonged to client related attributes and as per the owner and

contractors perspective this has been a major reason for delays in the project. The main reason being insufficient fund or budget that is allotted to respective department by the state government. Every state has its own budget to spend in a year and every government work has an allotted budget. The allotted budget is given to every other respective government related project department and not an individual project. The state government sanctions the allotted budget based on the requirement put forward by their respective project department. So, from the professionals point of view it is a result of insufficient fund or budget that is sanctioned by the state government which leads to first two primary main causes of delay in handing over the project within the allotted time. Delay in payment to the contractor by the owner of the firm is ranked in the third in the delay study. Rahman et al. established that the top three significant attributes of cost overrun are varying prices of materials, poor site supervision and financial difficulties faced by contractors in Malaysia. This often leads to contractors having negative cash balance due to delay in payment on the owner's part. This cause is also related to payment issue when the owner is incapable of paying the salary and other allowances to the contractors wherein the output of an individual tends to reduce due to financial crises as a result of constant payment delays caused from the client or the concerned project department.

Any obstruction/obstacles from the government on construction can affect any organization. The cost of construction materials especially after the implementation of GST (Goods and Service Tax) has undergone changes. The construction materials that are frequently needed for construction purposes belong to high-end category and fall under 28% GST slab. A project cannot proceed without sufficient fund and the cost of sufficient financing can be quite large depending on the size of project, hence project financing or fund allocation is an important aspects of project management. This finding simultaneously matches with Vietnam construction industry delay findings (Le-Hoai et al., 2008). Lack of coordination between the client and contractor tend to occur in any construction project. The project cost estimation is done based on the produced design and having glitch in the form of omission or misinterpretation means the project estimation cost will also incorporate these omissions, resulting in change order, additional work etc. and also leading to wrong practices of techniques in achieving results and thus resulting in time and cost overrun. Shortage of skilled employees especially project managers creates poor impact on construction and general effects of poor skill leads to cost and time overrun, high accident rate, substandard quality of work and more rework. Mistake or errors made in the construction by the contractor has an impact on time and cost overrun of construction project. The main reason being negligence or lack of knowledge and poor awareness about the procedures that need to be followed in construction. Quality is an important parameter that need to be sustained throughout the construction work and ranges from structural support to plumbing. If adequate inspection is not carried out by the supervisor or project managers then they quality in construction can be compromised. Acquisition of low quality materials with the objective of saving cost is another issue likely to affect the quality of work and hence would result in substandard quality work. As a matter of fact, in finishing the work as early as possible.

Table 1 Frequency index study and ranking

Attributes	Overall		Owner		Client		Contractor		Organization
	F. I	Rank	F. I	Rank	F. I	Rank	F. I	Rank	
Payment delay by the client	0.662	1	0.750	1	0.601	1	0.676	1	Client
Clients financial availability to pass the running bill	0.555	2	0.650	2	0.472	3	0.579	2	Client
Delay in payment to contractors by the owner	0.482	3	0.510	3	0.484	2	0.475	4	Owner
Any obstruction/obstacles from the government	0.471	4	0.430	5	0.46	4	0.486	3	Client
Slow response and decision making from the owner	0.457	5	0.480	4	0.452	5	0.455	6	Owner
The owners financing difficulty	0.448	6	0.430	5	0.423	6	0.465	5	Owner
Too many additional work and scope change by the client	0.388	7	0.360	9	0.359	9	0.409	7	Client
Lack of coordination between parties (clients and contractors)	0.377	8	0.320	15	0.375	7	0.390	8	Contractor
Inadequate experienced staff and contractors in the project management team	0.375	9	0.360	9	0.351	11	0.390	8	Contractor
Mistakes and omission in design documents	0.374	10	0.330	13	0.367	8	0.386	10	Client
Unrealistic project schedule and project planning	0.361	11	0.310	18	0.347	12	0.378	11	Contractor
Delay in material delivery	0.351	12	0.390	7	0.315	25	0.362	13	Contractor
Delay in procuring materials by the contractor	0.349	13	0.330	13	0.335	19	0.360	14	Contractor
Complexity of the project	0.346	14	0.370	8	0.339	16	0.345	20	Contractor
Shortage of skilled workers	0.345	15	0.320	15	0.339	16	0.353	17	Contractor
Delay in providing materials and other machinery resources by owner	0.341	16	0.280	23	0.31	26	0.370	12	Owner
Inaccurate estimates and ambiguous requirements	0.340	17	0.340	12	0.302	27	0.360	14	Client
Poor labour productivity	0.339	18	0.290	19	0.327	21	0.355	16	Contractor
Slow inspection of completed works from the client management	0.338	19	0.280	23	0.339	16	0.349	18	Client
Mistake in construction by the contractor	0.337	20	0.320	15	0.343	13	0.337	23	Contractor
Lack of control over subcontractors	0.334	21	0.350	11	0.319	23	0.339	22	Contractor
Conducting infrequent progress meetings	0.333	22	0.290	19	0.359	9	0.329	26	Owner
Inappropriate/obsolete construction methods during construction	0.331	23	0.290	19	0.343	13	0.333	24	Contractor
Poor supervision and site management	0.329	24	0.280	23	0.327	21	0.341	21	Contractor
Inadequate human resources for a project	0.328	25	0.290	19	0.335	19	0.333	24	Contractor
Poor monitoring and control by the owner	0.323	26	0.270	27	0.298	28	0.347	19	Owner
Poor relationship between labour and site management	0.320	27	0.280	23	0.343	13	0.316	28	Contractor
Site accident due to lack of safety measures	0.311	28	0.250	28	0.319	23	0.320	27	Contractor
Lack of top management commitment and unsuitable management structure	0.278	29	0.210	30	0.298	28	0.281	29	Owner
Delay in handing over the site	0.261	30	0.220	29	0.226	30	0.267	30	Contractor

Table 2 Severity index study and ranking

Attributes	Overall		Owner		Client		Contractor		Organization
	F. I	Rank	F. I	Rank	F. I	Rank	F. I	Rank	
Payment delay by the client	0.660	1	0.67	1	0.601	1	0.68	1	Client
Clients financial availability to pass the running bill	0.534	2	0.58	2	0.472	3	0.533	2	Client
Delay in payment to contractors by the owner	0.481	3	0.49	3	0.484	2	0.481	3	Owner
Slow response and decision making from the owner	0.459	4	0.43	5	0.452	5	0.457	4	Owner
The owners financing difficulty	0.444	5	0.42	6	0.423	6	0.446	5	Owner
Any obstruction/obstacles from the government	0.440	6	0.45	4	0.46	4	0.432	6	Client
Too many additional work and scope change by the client	0.400	7	0.4	7	0.359	9	0.407	7	Client
Inadequate experienced staff and contractors in the project management team	0.369	8	0.33	10	0.351	11	0.366	11	Contractor
Lack of coordination between parties (clients and contractors)	0.368	9	0.37	8	0.375	7	0.38	9	Contractor
Mistakes and omission in design documents	0.367	10	0.3	16	0.367	8	0.39	8	Client
Complexity of the project	0.355	11	0.3	16	0.339	16	0.368	10	Contractor
Inappropriate/obsolete construction methods during construction	0.353	12	0.26	22	0.343	13	0.353	13	Contractor

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Attributes	Overall		Owner		Client		Contractor		Organization
	F. I	Rank	F. I	Rank	F. I	Rank	F. I	Rank	
Delay in procuring materials by the contractor	0.352	13	0.36	9	0.335	19	0.36	12	Contractor
Poor labour productivity	0.345	14	0.33	10	0.327	21	0.335	21	Contractor
Lack of control over subcontractors	0.344	15	0.31	13	0.319	23	0.347	14	Contractor
Unrealistic project schedule and project planning	0.343	16	0.31	13	0.347	12	0.345	15	Contractor
Mistake in construction by the contractor	0.341	17	0.27	19	0.343	13	0.343	16	Contractor
Inaccurate estimates and ambiguous requirements	0.339	18	0.32	12	0.302	27	0.341	18	Client
Delay in material delivery	0.337	19	0.27	19	0.315	25	0.337	20	Contractor
Shortage of skilled workers	0.335	20	0.31	13	0.339	16	0.343	16	Contractor
Inadequate human resources for a project	0.333	21	0.29	18	0.335	19	0.339	19	Contractor
Conducting infrequent progress meetings	0.331	22	0.23	25	0.359	9	0.335	21	Owner
Delay in providing materials and other machinery resources by owner	0.328	23	0.26	22	0.31	26	0.329	25	Owner
Poor monitoring and control by the owner	0.321	24	0.22	28	0.298	28	0.326	26	Owner
Poor supervision and site management	0.320	25	0.27	19	0.327	21	0.316	28	Contractor
Poor relationship between labour and site management	0.316	26	0.26	22	0.343	13	0.318	27	Contractor
Slow inspection of completed works from the client management	0.315	27	0.23	25	0.339	16	0.331	23	Client
Site accident due to lack of safety measures	0.310	28	0.23	25	0.319	23	0.331	23	Contractor
Delay in handing over the site	0.287	29	0.22	28	0.266	30	0.295	29	Contractor
Lack of top management commitment and unsuitable management structure	0.261	30	0.15	30	0.298	28	0.269	30	Owner

5.2. Importance of problem

Table 3 shows the importance indices and ranking based on various construction parties. The importance index is the product of severity and frequency index. The ranking based on the causes upon importance index shows almost no change in first three major delay causing factors in construction projects.

Table 3 Importance index study and ranking

Attributes	Overall		Owner		Client		Contractor		Organization
	F. I	Rank	F. I	Rank	F. I	Rank	F. I	Rank	
Payment delay by the client	0.437	1	0.503	1	0.361	1	0.460	1	Client
Clients financial availability to pass the running bill	0.296	2	0.377	2	0.223	3	0.309	2	Client
Delay in payment to contractors by the owner	0.232	3	0.250	3	0.234	2	0.228	3	Owner
Slow response and decision making from the owner	0.210	4	0.206	4	0.204	5	0.208	5	Owner
Any obstruction/obstacles from the government	0.207	5	0.194	5	0.212	4	0.210	4	Client
The owners financing difficulty	0.199	6	0.181	6	0.179	6	0.207	6	Owner
Too many additional work and scope change by the client	0.155	7	0.144	7	0.129	9	0.166	7	Client
Lack of coordination between parties (clients and contractors)	0.139	8	0.118	10	0.141	7	0.148	9	Contractor
Inadequate experienced staff and contractors in the project management team	0.138	9	0.119	8	0.123	11	0.143	10	Contractor
Mistakes and omission in design documents	0.137	10	0.099	16	0.135	8	0.151	8	Client
Unrealistic project schedule and project planning	0.124	11	0.096	17	0.120	12	0.130	11	Contractor
Delay in procuring materials by the contractor	0.123	12	0.119	8	0.112	19	0.130	12	Contractor
Complexity of the project	0.122	13	0.111	11	0.115	16	0.127	13	Contractor
Delay in material delivery	0.118	14	0.105	14	0.099	25	0.122	15	Contractor
Poor labour productivity	0.117	15	0.096	18	0.107	21	0.119	18	Contractor
Inappropriate/obsolete construction methods during construction	0.117	16	0.075	22	0.118	13	0.118	20	Contractor
Shortage of skilled workers	0.116	17	0.099	15	0.115	16	0.121	17	Contractor
Inaccurate estimates and ambiguous requirements	0.115	18	0.109	12	0.091	27	0.123	14	Client
Mistake in construction by the contractor	0.115	19	0.086	19	0.118	13	0.116	21	Contractor

Attributes	Overall		Owner		Client		Contractor		Organization
	F. I	Rank	F. I	Rank	F. I	Rank	F. I	Rank	
Lack of control over subcontractors	0.115	20	0.109	13	0.102	23	0.118	19	Contractor
Delay in providing materials and other machinery resources by owner	0.112	21	0.073	23	0.096	26	0.122	16	Owner
Conducting infrequent progress meetings	0.110	22	0.067	25	0.129	9	0.110	25	Owner
Inadequate human resources for a project	0.109	23	0.084	20	0.112	19	0.113	24	Contractor
Slow inspection of completed works from the client management	0.106	24	0.064	26	0.115	16	0.116	22	Client
Poor supervision and site management	0.105	25	0.076	21	0.107	21	0.108	26	Contractor
Poor monitoring and control by the owner	0.104	26	0.059	27	0.089	28	0.113	23	Owner
Poor relationship between labour and site management	0.101	27	0.073	23	0.118	13	0.100	28	Contractor
Site accident due to lack of safety measures	0.097	28	0.058	28	0.102	23	0.106	27	Contractor
Delay in handing over the site	0.075	29	0.048	29	0.071	30	0.079	29	Contractor
Lack of top management commitment and unsuitable management structure	0.072	30	0.032	30	0.089	28	0.076	30	Owner

6. SPEARMAN'S RANK CORRELATION

Spearman's coefficient of rank correlation determines if there are any evidence of linear relationship between each pair of ordinal variables. Here the variables used in the study are owners, clients and contractors. Table 4 shows results of Spearman's coefficient and its significance level.

Table 4 Spearman's coefficient and significance level

	Frequency index (F.I)		Severity index (S.I)	
	Spearman rank	Significance	Spearman rank	Significance
Owner-	0.806	.000	0.881	.000
Contractor-	0.698	.000	0.714	.000
Owner-Client	0.693	.000	0.662	.000

From the above table it can be noted that in response to frequency and severity study, all the values are said to have a very good agreement between all three parties. The highest degree of concurrence is considered to be among owner-contractor pair with 80.6 % with frequency and 88.1% with severity. Whereas the lowest degree of agreement is among owner and client with 69.3 % with frequency and 66.2% with severity. Since there appears to be good agreement between the ranking of delay in cost and time overrun among the three parties, the data collected is true of the population and this test is assuming that the data was collected properly and representative of the population and hence the data could be used for further analysis.

7. CONCLUSION

Though many studies have been conducted on delays in construction projects this study is unique since it gives suggestions to all the major participants in a project namely owner, contractor and client. Results shows that delay in payment to the contractor by the owner creates major impact on the project and has been ranked number one in the owner related attribute factors. Payments to contractor is regarded as first priority, to complete the construction project on. Results also shows that "inadequate experience of contractors" has been the most importance contributor to the contractor related attributes among 16 other factors. It is recommended that management hire experienced and knowledgeable contractor who in a situation could find solutions to those problems that incurs in construction works which could avoid unnecessary delays. The study also indicates "payment delay by the client" as the top most factor in the client related attributes. This shows that any delay in the payment to the

organization would cause delay in the progress of construction work and also decline its productivity. This delay in payments would create a ripple effect among traders, suppliers and others related to project and eventually lead to sluggish work and delay in handing over of the project. Owners should reassess the bid documents which includes technical specifications of construction, drawings and designs, BOQ (bill of quantities) in a proper way in order to avoid variations in the bid document and any discrepancy would lead to disputes between the parties of construction and eventually leading to delay of work. Regular and progress payment to the contractor need to be adopted because it could help the contractor in financing the work properly and steadily.

8. LIMITATIONS AND FUTURE SCOPE

The study is confined to only Kerala hence the results cannot be generalised. The study limits itself to the factors that generally causes delays based on the literature and expert opinion. No attempts were made to explore more factors in this area. The study can be extended to other states as well. A comparative study of different states on the causes of delays will be more useful to the construction industry. An exploratory study can be carried out to find out the factors that causes delays among various respondents. Hence the study opens up further research work thus contributing to the body of knowledge in this area.

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