CAUSES AND EFFECTS OF DELAYS IN MEDIUM SCALE BUILDING CONSTRUCTION PROJECT'S IN SRI LANKA

By
S.M.S. Samarakoon

Supervised by
Dr L.L. Ekanayake

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Department of Civil Engineering
University of Moratuwa
Sri Lanka

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Abstract

The main purpose or this study is to identify the causes or delays in medium scale building projects in Sri Lanka. highlight its impact on the construction industry and to forward recommendations for minimization or such delays .

A questionnaire survey was carried out among the professionals engaged in medium scale building projects to identify the delays and their effects. Hundred and twenty two professionals responded. The relative important index method was adopted to rank the GIUSCS and effects in the order 01" their importance and "Improper project management by the contractor" was identified as the main cause. Other causes for the project delays were identified as "Shortage of " labour". "Improper planning by contractor" and "Financial problems or the clients".

The most damaging effect or the delays was identified as the "Cost overrun" whilst other adverse effects were recognized as "Time overrun". "Disputes" and ..Arbitron".

Key players in the construction industry are contractors. Consultants and clients. They hold diverse views on the causes for delays. But at times agree on certain issues. Hence. Spearman's Rank Correlation Coefficient method was used to check the agreement among them.

Having identified the causes for the delays and ranking the same, separate set of guidelines were prepared for each party. identifying the areas they need to improve/concentrate to overcome the problem or delays.

These guidelines will ensure that clients would pay more attention on aspects such as project management. identification or rlit requirements or the building. minimizing design structural changes during construction and setting realistic time targets whereas the main areas in relation to the contractors would be efficient project management. financial management. and material procurement.

Further. the proposed Guidelines will focus the attention of the Consultants on issues such as minimizing discrepancies in bidding documents. effective approval process. and identification of the client' s requirements.

Declaration

I hereby declare that the research dissertation entitled "Causes and effects of delays in medium scale building construction projects in Sri Lanka" submitted by me in partial fulfillment of the requirements for MBA. is my original work and that it has not previously formed the basis of any other academic qualification at any institution.

Date – 08th February 2009 .....

S.M.S. Samarakoon

I certify above statement.

Date – 08th February 2009 .. ***UOM Verified Signature*** .....

Signature of the supervisor

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S.M. Sudheera Samarakoon

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Abbreviations

ADB - Asian Development Bank

JBIC - Japan Bank International Corporation

ICTAD - Institute of Construction Training and Development

IESL - Institute of Engineers of Sri Lanka

Chapter 1: Introduction

1.1 Background

The construction sector is one of the important sectors that contributes to Sri Lanka's economic growth. This sector accounted for nearly 9.2% growth in year 2006 and 9.0% in year 2007 (Central Bank of Sri Lanka, 2008). During the first half of the year 2008, the value added in construction sector is increased by 9.2% (Central Bank of Sri Lanka, 2008a).

Major construction projects are consisting of both infrastructure development projects and building construction projects. Construction activities of government sector were mainly concentrated in infrastructure development projects. These include construction of roads, bridges, tunnels, power plants, etc. Such major construction projects are upper Kotmale development project, Hambantota port development project, Norochcholei coal power plant construction project and Southern expressway construction project (Central Bank of Sri Lanka, 2008).

The reconstruction activities in the Eastern province increases public sector involvement in construction sector (Central Bank of Sri Lanka, 2008a). The construction sector development is expected to grow at a higher pace in 2009, due to the reconstruction activities in liberated area in North and East of Sri Lanka (Central Bank of Sri Lanka, 2008a).

Private sector contribution to the construction sector development was limited to condominium and housing projects.

Projects are classically defined by the need to complete a task on time, to budget, and appropriate quality of technical performance (Williams, 2003). Most of the construction projects cannot be completed on planned date even though customers request their projects to be completed on due date. This is a huge problem in the construction industry, where both contractors and clients have to suffer.

Few examples of project delays in Sri Lanka are as follows.

High-rise building projects

- **Havelock city construction project, Colombo 6**

  Havelock city project is one of the largest residential and commercial real state development projects in south Asia. This project consists of nine towers and each tower consists of 22 floors. The project was initially planned to construct at four phases. Project was started on May 2004 and first phase was proposed to open for the public on August 2008 (Wikipedia encyclopedia, 2008). However, phase 1 of the project was not completed even at the end of December 2008. At that time, structural works were completed but finishing works were on progress (Havelock City website, 2008).

  Financial problems of the developer was the main reason for the delay. The developers were supposed to sell the residences while the construction is on progress. However, the process was not succeeded as expected and resulted in financial shortages thus project delays.

- **Celestial tower construction project, Colombo 3**

  The celestial tower is a 43-storied building, which consists of 176 luxury apartments and a hotel. The project was started on early 2005 and it was scheduled to complete on March 2010. The hotel of the building, which consists of 16 stories was planned to complete and open to the public on first quarter of 2009 (Ceylinco Celestial Tower web site, 2008). At the end of November 2008 only structural part of 14 stories were completed (Ceylinco Celestial Tower web site, 2008a). The construction work was stop for about 5 month due to the security reasons as it was located at the midst of high security zone in Colombo.

Medium scale building projects

- **Renovation of centre for banking studies hostel building at Rajagiriya.**

This project was owned by the Central Bank of Sri Lanka. The project consists of renovation of a three-storied building. The project was awarded to a government corporation involved in construction on September 2006 and planned to complete within a year. However, the project was completed on June 2008. (Central Bank of Sri Lanka, 2008b)

One reason for the delays was changing the design by the client at the progress of the building. In addition to that, contractor's improper site management, unforeseen site conditions and shortage of labour were also contributed to the slowing of the process. Since the contractor of this project was a government organization, rigid procurement procedures of them also contributed for the above delays.

- **Construction of Central Bank regional office building at Matale**

This project was also owned by the Central Bank of Sri Lanka. The project consists of constructing a regional office, which consists of three-storied building at Matale. The project was awarded on December 2007 and proposed to complete within 10 months. However, the building was completed on January 2009 (Central Bank of Sri Lanka, 2009).

The construction was not completed on scheduled date due to improper project management and financial problems of the contractor. Change of original scope by client was also affected to the project delays.

Infrastructure development projects

- **Southern express way construction project**

  This project consists of 128 km highway connecting Colombo, Galle and Matara. The project was financed by Asian development bank, Japan Bank for international development, Nordic development fund and Swedish international development agency. The project was planned to complete on end of 2005 according to the original schedule. (Asian Development Bank news, 1999)

  But it was abandoned for long time and at year 2005 project was restarted and scheduled to be completed on 2008. (Sri Lanka news, 2005)

  Even at the end of 2008, only part of the construction was completed. The main reasons for delays were political issues, difficulties arise when acquiring of lands, etc..

- **Katunayaka Colombo express way construction project**

The proposed project consists of 24 km expressway joining Colombo and Katunayake. The project was initially planned on 1994 and the cost estimate at that time was Rs 5 billion (Sunday Observer, 2006). The project was abandoned for long time and restarted on 2007. The project was planned to complete within 33 months. However, at the end of 2008 the progress of the project was negligible. The main reason for delays can be political issues.

Delaying of the completion of the construction projects is a global phenomenon (Sambasivan & Soon, 2006). There can be several causes for delays in construction projects, which lead to several effects at the end.

Normally three parties involve in the construction projects. That is client, consultant and contractor. Therefore, the causes of the delay of the construction projects can be client, consultant or contractor related.

The client related causes can be client's financial problems, slow decision-making, changing the original scope and proposing unrealistic contract duration. Delays originate due to contractor can be improper project planning, wrong construction methods, mistakes and problems due to sub contractors. The consultant related causes can be improper contract management, delays in approvals, delays in providing designs, etc.. Except to those causes, there can be other external causes as well such as shortage of labour, weather conditions, unforeseen site conditions and regulatory changes.

The most common effects due to project delays were time overrun and cost overrun. Cost overrun observed due to the delays in southern highway construction project is a good example. Another effect due to project delays was disputes. Delays will lead to liquidation damages and it can end up with disputes among client and contractor. Those disputes ultimately leads to arbitration or litigation. Arbitration and litigation can be identified as devastating effects of project delays. Some projects were totally abandoned due to project delays.

The relative importance of above causes and effects can be vary according to the conditions of the project concern.

Identification of causes of project delays and their effects is of immense help to the future project managers to take precautionary actions and proactive measures to mitigate delays.

Several studies were carried out to identify causes of project delays in Malaysia, Saudi Arabia, Jordan, Ghana and Sri Lanka (Alaghbari et. al., 2007; Asaaf and Al-Hejji, 2006; Odeh and Battaineh, 2002; Fringpong et.al., 2003; Jayawardane and Pandita,2003). Some were focused on effects due to project delays (Aibinu and Jagboro, 2002). Whereas few studies were carried out to identify both causes and effects of project delays (Sambasivan & Soon, 2007).

1.2 Research Problem

There were limited numbers of studies available in Sri Lanka, which deals with causes of project delays. One such research was carried out by Jayawardane and Pandita (2003) to understand and mitigate the factors affecting construction delays, addresses the building construction industry of Sri Lanka as a whole. However, the causes of project delays can be varied according to the type of the project.

The researches to identify the effects due to project delays are limited in Sri Lanka. Although such researches were carried out in other parts of the world, their applicability to Sri Lanka is inappropriate since the conditions are different from country to country.

Medium scale building projects are contributing 35% of construction projects in Sri Lanka (Central Bank of Sri Lanka, 2008). Delays are inevitable in these medium scale-building projects. Therefore, identification of causes and effects of project delays specific to medium scale building projects are of great importance to mitigate those delays.

Identification of causes and effects of the delays in medium scale building projects will help the future project mangers to reduce project delays. Therefore, this problem i.e. Identification of causes and effects due to project delays in the medium scale building projects is used as the research problem.

1.3 Research Objectives

The purpose of this study is to discover causes and effects of project delays and provide guidelines to minimize those delays.

The specific objectives of this research are,

- To identify the major causes for delays in medium scale building projects
- To identify effects due to the delays in medium scale building projects
- To develop guidelines for contractors, consultants and clients to reduce the project delays in medium scale building projects.

1.4 Significance of the study

This research mainly concerns about the medium scale building projects in Sri Lanka. Even though the medium scale buildings are constructed in all parts of Sri Lanka, most of them are consolidated to urban areas. Large proportion of medium scale buildings are utilized for office buildings, apartments or shopping complexes.

Delays are highly observed in these medium scale building projects. The involvement of the consultants in the medium scale building projects are low when compare with the high-rise building construction projects. Normally site engineers from consultants are allocated for the high rise building projects. In Sri Lanka very limited number of medium scale projects has consultants' site engineers. Therefore project management activities and quality assurance processes are limited in medium scale building projects when compare with high-rise building projects.

Contractors having M-1 grade can only involve in construction of the high rise buildings. The experiences of the M-1 contractors are very high and those companies have good financial background. Therefore the problems arises at the construction stage are minimum and as a result delays can also be minimized. But, for the medium

scale building projects contractors with M-4 grade can contribute. The financial background and experience of those contractors are limited when compare with the M-1 contractors. Therefore, the problems arise at the medium scale building projects are high. This can lead to project delays.

Identification of causes for these delays in medium scale building projects is highly useful for the contractors and other professionals, in construction industry to mitigate delays in their future projects.

Medium scale building projects are contributing to 35% of construction projects in Sri Lanka (Central Bank of Sri Lanka, 2008). The growth of construction sector is 9.2% in first half of the year 2008. It was observed that Sri Lankan economy was grown by 6.8% and 6.6% in 2007 and in first half of the 2008 respectively. The growth in construction sector immensely contributes to the above economic growth of the country. Delays in construction projects affects to the growth of the construction sector and therefore to the growth of the Sri Lankan economy. Therefore, minimizing project delays is of paramount importance to improve the growth of the construction sector and finally to the economic growth of the country.

1.5 Methodology

The causes and effects of the project delays were identified using the findings of previous researches and interviewing the professionals working in the medium scale building projects in Sri Lanka. A questionnaire was prepared using the findings and a pilot study was carried out among ten professionals working in medium scale building construction projects. The sample was selected according to snowball sampling method. The questionnaire was distributed using e-mail and manual means. i.e. by hand and by post.

Importance and severity of each cause and effects was calculated using the importance index and severity index respectively. By using those two indices, relative important index was calculated. This was used to rank identified causes and effects.

This was done separately for responses of consultants, contractors, clients and general basis. Then the agreements among those groups were checked using the spearman's rank correlation coefficient.

According to those findings, guidelines were developed for consultants, contractors and clients to minimize project delays in medium scale building projects.

1.6 Scope and Limitations

This research was mainly aim for the medium scale building projects. Therefore the findings of this research may only applicable to the medium scale building projects in Sri Lanka.

The questionnaire was distributed via e-mail and manual means. Most of the responses came through the e-mails. The paper-based questionnaires were distributed among the professionals working in medium scale building projects. However, responses from paper-based questionnaire were minimal. Therefore, the findings of this research may more applicable to the medium scale building projects constructing in urban areas of Sri Lanka. The views of the professionals, who are not using e-mail were limitedly included in this research.

1.7 Key Findings

Identified major cause of project delays of the medium scale building projects is the improper project management by the contractor. Remaining causes are: shortage of labour, improper planning of the contractor, financial problems of the clients, poor contract management by the consultant, client changes their original scope, weather conditions, shortage of equipments, delay in preparation of drawings and shortage of material at the market.

The highest agreement was observed among consultants and clients, whereas the lowest agreement was observed among clients and contractors.

The main effects of project delays are cost overrun, time overrun, disputes, arbitration, litigation and total abandonment of the project. In relate to effects, high agreement among all three parties was observed.

1.8 Chapter Breakdown

Chapter 2 gives the theoretical background of the study. It describes about the past studies carried out to identify the causes of project delays and effects due those delays.

Chapter 3 gives the methodology adopted to find the causes and effects of project delays in medium scale building projects in Sri Lanka.

Chapter 4 describes the methods of analysis and compares the findings of the causes and effects of project delays in Sri Lankan medium scale building projects with the findings of other researches all over the world.

Chapter 5 provides summary and conclusions of the research. It describes about main causes and effects of project delays in medium scale building projects and recommendations done for the consultants, contractors and clients to minimize project delays in medium scale building projects.

Chapter 2: Literature Review

2.1 Categories of building projects

Building construction projects can be divided in to three parts.

1. High rise building projects
2. Medium scale building projects
3. Small scale building construction projects

High-rise buildings are buildings, which have 10 or more than 10 stories. Mainly high rise buildings are used for office complexes and apartment complexes. These are owned by private companies or the government. Most of these buildings are constructed by private construction companies. Since the cost involvements of these constructions are high, these buildings can be constructed only by the construction companies, which have ICTAD grades M1 or M2. The private consultancy companies do the consultancy part of these buildings. High-rise building projects are normally constructed at urban areas. Recently most of these building projects were started in Colombo and suburbs in Sri Lanka to facilitate the housing demand of urban population.

Medium scale buildings are those, which have 2 to 10 stories. These buildings also used as office complexes, shopping complexes and apartment complexes. These are owned by individuals, private companies or the government. Most of these buildings are constructed by private construction companies with the consultancy of private consultation companies. Due to the cost involvement, construction companies which having ICTAD grades M1, M2 or M 3 can engage in construction of these buildings.

Small-scale construction projects are mainly consists of house construction projects. Houses are considered as individual dwelling units. Normally houses consist of single or two-storied buildings. Most of the occasions in house construction projects, the involvement of the consultants is limited to prepare of designs. Usage of proper project management methods is also minimal in these projects.

In this research, our focus is mainly on medium scale building construction projects. Since these buildings are constructed all over the Sri Lanka, identification of causes of project delays and their effects can be of great help for the professionals working in those projects.

2.2 Types of Project Delays

Delays can be due to the fault of consultant, contractor or client. They can be categorized in to three types (Williams, 2003).

- **Excusable compensable delays**

These delays are occurring due to the fault of clients. Therefore, contractors can claim for damages and extension of time.

- **Excusable non compensable delays**

These are occurring due to other causes excluding the faults of clients and contractors. Therefore, contractor can claim for extension of time. However, contractor cannot claim for the damages. At the same time, clients cannot claim for liquidation damages as well.

- **Non excusable non compensable delays**

These delays occurred due to contractors' faults. Therefore, the contractor cannot claim extension of time whereas, clients can claim for the liquidation damages of such delays.

2.3 Studies on Causes of Project delays

There are many studies carried out in all over the world to identify the causes of the project delays. However, specific studies to identify the causes and effects of project delays were limited.

Sambasivan and Soon (2007) conducted a study to identify the causes and effects of the project delays in Malaysian construction industry. They have initially identified 28 causes for delays of construction projects. They have divided these causes in to eight categories as follows,

1. Client related causes

    i. Finance and payments of completed work
    ii. Owner Interference
    iii. Slow decision making
    iv. Unrealistic contract duration and requirements imposed

2. Contractor related causes

    i. Subcontractors
    ii. Site management
    iii. Construction methods
    iv. Improper planning
    v. Mistakes during construction stage
    vi. Inadequate contractor experience

3. Consultant related causes

    i. Contract management
    ii. Preparation and approval of drawings
    iii. Quality assurance/control
    iv. Waiting time for approval of tests and inspection

4. Material related causes

    i. Quality of material
    ii. Shortage in material

5. Labor and equipment category causes

    i. Labor supply
    ii. Labor productivity
    iii. Equipment availability and failure

6. Contract related causes

    i. Change orders
    ii. Mistakes and discrepancies in contract document

7. Contract relationship related causes

    i. Major disputes and negotiations
    ii. Inappropriate overall organizational structure linking to the project
    iii. Lack of communication between the parties

8. External causes

    i. Weather condition
    ii. Regulatory changes
    iii. Problem with neighbors
    iv. Unforeseen site condition

Accordingly, major causes of project delays in Malaysian construction industry are identified as follows (Sambasivan & Soon, 2006).

1. Contractor's improper planning
2. Contractor's poor site management
3. Inadequate contractor experience
4. Inadequate client's finance and payments for completed work
5. Problems with subcontractors
6. Shortage in material
7. Labor supply
8. Equipment availability and failure
9. Lack of communication between parties
10. Mistakes during the construction stage

In this study, the analysis was done by considering the total construction industry as a whole. However the causes and effects of delays can be, vary with the type of the project. For example, the causes of delays in building construction project can be different from road construction project. Whereas the causes and effects of project delays can be, vary from country to country.

Same kind of study was carried out by Alagbari et. al (2007). to identify the main causes of delays in building construction projects in Malaysia. They have divided the causes of project delays according to the responsibility. They have initially identified 32 causes of building project delays and categorized them according to the responsibility of contractor, owner, consultant or external as follows.

1. Contractor's responsibility
    i. Delay in delivery of materials to site
    ii. Shortage of materials on site
    iii. Construction mistakes and defective work
    iv. Poor skills and experience of labour
    v. Shortage of site labour
    vi. Low productivity of labour

vii. Financial problems
viii. Coordination problems with others
ix. Lack of subcontractor's skills
x. Lack of site contractor's staff
xi. Poor site management
xii. Equipments and tool shortage on site

2. Consultant's responsibility
   i. Absence of consultant's site staff
   ii. Lack of experience on the part of the consultant
   iii. Lack of experience on the part of the consultant's site staff (managerial and supervisory personnel)
   iv. Delayed and slow supervision in making decisions
   v. Incomplete documents
   vi. Slowness in giving instructions

3. Owner's responsibility
   i. Lack of working knowledge
   ii. Slowness in making decisions
   iii. Lack of coordination with contractors
   iv. Contract modifications (replacement and addition of new work to the project and change in specifications)
   v. Financial problems (delayed payments, financial difficulties, and economic problems)

4. External factors
   i. Lack of materials on the market
   ii. Lack of equipment and tools on the market
   iii. Poor weather conditions
   iv. Poor site conditions (location, ground, etc.)
   v. Poor economic conditions (currency, inflation rate, etc.)
   vi. Changes in laws and regulations

vii. Transportation delays

viii. External work due to public agencies (roads, utilities and public services)

The main causes of project delays in Malaysian building construction projects were identified as follows (Algabari et al, 2007).

1. Financial difficulties and economic problems
2. Supervision too late and slowness in making decisions
3. Slow to give instructions
4. Lack of materials on market
5. Poor site management
6. Material shortages on site
7. Construction mistakes and defective work
8. Delay in delivery of materials to site
9. Slowness in making decisions
10. Lack of consultants experience
11. Incomplete documents

The study identified that the financial problems as the main factor in delaying construction projects from the contractor's as well as owners' point of view. From the consultants point of view the main factor that contributes to delay in construction projects was ineffective or lack of supervision, followed by slowness of giving instructions and lack of experience. The most important external factor that causes delays was lack of material, tools & equipments at the site.

The findings of Algabari et. al (2007) was different from that of Sambasivam and Soon (2007), although both researches were carried out in Malaysia at same time period. Sambasivam & Soon (2007) used generalized approach whereas Algabari et. al. (2007) used specific approach to identify project delays in building construction

projects in Malaysia. This shows that the causes of project delays can be vary from project to project.

Asaaf and Al-Hejji (2006) identified causes of delays and their importance in large-scale construction projects in Saudi Arabia. They identified 73 causes of project delays by literature survey and interviewing the professionals involved in the construction industry. They categorized those causes under nine categories as follows.

1. Project related
    i. Original contract duration is too short
    ii. Legal disputes b/w various parts
    iii. Inadequate definition of substantial completion
    iv. Ineffective delay penalties
    v. Type of construction contract (Turnkey, construction only)
    vi. Type of project bidding and award (negotiation, lowest bidder)

2. Owner related
    i. Delay in progress payments by owner
    ii. Delay to furnish and deliver the site to the contractor by the owner
    iii. Change orders by owner during construction
    iv. Late in revising and approving design documents by owner
    v. Delay in approving shop drawings and sample materials
    vi. Poor communication and coordination by owner and other parties
    vii. Slowness in decision making process by owner
    viii. Conflicts between joint-ownership of the project
    ix. Unavailability of incentives for contractor for finishing ahead of schedule
    x. Suspension of work by owner

3. Contractor related

   i. Difficulties in financing project by contractor
   ii. Conflicts in sub-contractors schedule in execution of project
   iii. Rework due to errors during construction
   iv. Conflicts b/w contractor and other parties (consultant and owner)
   v. Poor site management and supervision by contractor
   vi. Poor communication and coordination by contractor with other parties
   vii. Ineffective planning and scheduling of project by contractor
   viii. Improper construction methods implemented by contractor
   ix. Delays in sub-contractors work
   x. Inadequate contractor's work
   xi. Frequent change of sub-contractors because of their inefficient work
   xii. Poor qualification of the contractor's technical staff
   xiii. Delay in site mobilization

4. Consultant related

   i. Delay in performing inspection and testing by consultant
   ii. Delay in approving major changes in the scope of work by consultant
   iii. Inflexibility (rigidity) of consultant
   iv. Poor communication/coordination between consultant and other parties
   v. Late in reviewing and approving design documents by consultant
   vi. Conflicts between consultant and design engineer
   vii. Inadequate experience of consultant

5. Design related

   i. Mistakes and discrepancies in design documents
   ii. Delays in producing design documents
   iii. Unclear and inadequate details in drawings
   iv. Complexity of project design
   v. Insufficient data collection and survey before design
   vi. Misunderstanding of owner's requirements by design engineer
   vii. Inadequate design-team experience
   viii. Un-use of advanced engineering design software

6. Materials related

   i. Shortage of construction materials in market
   ii. Changes in material types and specifications during construction
   iii. Delay in material delivery
   iv. Damage of sorted material while they are needed urgently
   v. Delay in manufacturing special building materials
   vi. Late procurement of materials
   vii. Late in selection of finishing materials due to availability of many types in market

7. Equipment related

   i. Equipment breakdowns
   ii. Shortage of equipment
   iii. Low level of equipment-operator's skill
   iv. Low productivity and efficiency of equipment
   v. Lack of high-technology mechanical equipment

8. Labors related

   i. Shortage of labors
   ii. Unqualified workforce
   iii. Nationality of labors

iv. Low productivity level of labors

v. Personal conflicts among labors

9. External causes

i. Effects of subsurface conditions (e.g., soil, high water table, etc.)

ii. Delay in obtaining permits from municipality

iii. Hot weather effect on construction activities

iv. Rain effect on construction activities

v. Unavailability of utilities in site (such as, water, electricity, telephone, etc.)

vi. Effect of social and cultural factors

vii. Traffic control and restriction at job site

viii. Accident during construction

ix. Differing site (ground) conditions

x. Changes in government regulations and laws

xi. Delay in providing services from utilities (such as water, electricity)

xii. Delay in performing final inspection and certification by a third party

Ranking of causes for delays in large construction projects in Saudi Arabia were categorized according to the respondents as table 1.1. (Asaaf and Al-Hejji, 2006).

Table 1.1- Causes of project delays in large construction projects in Saudi Arabia (Asaaf and Al-Hejji, 2006)

	Causes identified by Clients	**Causes identified by contractors**	**Causes identified by consultants**
1	Shortage of labor	Delay in progress payments by owners	Type of project bidding and award
2	Unqualified work force	Late in reweaving & approving of design documents by owners	Shortage of labor
3	Ineffective planning by contractor	Change orders during constructions	Delay in progress payments by owners
4	Low productivity level of labor	Delay in producing design documents	Ineffective planning by contractor
5	Hot weather effect on construction activities	Late in reweaving & approving of design documents by consultant	Change orders by owner during constructions
6	Conflicts with sub contractors	Difficulties in financing project by contractor	Low productivity level of labor
7	Poor site management by contractors	Mistakes & discrepancies in design documents	Difficulties in financing project by contractor
8	Inadequate contractor experience	Late procurement of materials	Poor site management by contractors
9	Effects of surface conditions	Inflexibility of consultant	Poor qualifications of contractors technical staff
10	Change orders by owner during constructions	Slowness of decision making by owners	Delay in material delivery

Asaaf and Al-Hejji (2006) ranked the causes of delays as follows.

1. Owner related factors
2. Contractor related factors
3. Design team related factors
4. Labor related factors
5. Consultant related factors
6. Material related factors
7. External factors
8. Project elated factors
9. Equipment related factors

Average time overrun in large construction projects in Saudi Arabia was between 10% and 30% of original duration (Asaaf and Al-Hejji, 2006). Study indicated that the highest frequency factor for the delay was awarding the contracts to the lowest bidder. Common cause identified by all the parties was "Change orders by owner during construction".

Major causes of project delays in large construction projects in Saudi Arabia identified by Asaaf and Al-Hejji (2006) is different from findings of Sambasivam & Soon (2007). In Saudi Arabia labour problem is one of the major cause for project delays (Asaaf and Al-Hejji, 2006), whereas in Malaysia labour problem has obtained middle level significance (Sambasivam & Soon, 2007). This shows that causes of project delays can be different from country to country.

Odeh and Battaineh (2002) identified causes of delay in traditional type of contracts in Jordan. This research was aimed at identifying the main causes for delay in construction projects with traditional type contracts. Twenty-Eight causes of delays were identified in traditional construction projects in Jordan and categorized them in to following major groups (Odeh & Battaineh, 2002).

1. Client related factors
    i. Finance and payments of completed work
    ii. Owner interference
    iii. Slow decision making by owners
    iv. Unrealistic imposed contract duration

2. Contractor related factors
    i. Subcontractors
    ii. Site management
    iii. Construction methods
    iv. Improper planning
    v. Mistakes during construction
    vi. Inadequate contractor experience

3. Consultant related factors
    i. Contract management
    ii. Preparation and approval of drawings
    iii. Quality assurance & control
    iv. Waiting time for approval of tests and inspections

4. Material related factors
    i. Quality of material
    ii. Shortage of material

5. Labor & equipment related factors
    i. Labor supply
    ii. Labor productivity
    iii. Equipment availability and failure

6. Contract related factors
    i. Change orders
    ii. Mistakes and discrepancies in contract document

7. Contractual relationship related factors
    i. Major disputes and negotiations
    ii. Inappropriate overall organization structure linking all parties to the project
    iii. Lack of communication among parties

8. External factors
    i. Weather conditions
    ii. Regulatory changes and building code
    iii. Problems with neighbors
    iv. Unforeseen ground conditions

According to findings of Odeh and Battaineh (2002) major causes of project delays in traditional construction projects can be ranked as follows.

Table 1.2- Causes of project delays in traditional contracts in Jordan (Odeh and Battaineh, 2002)

	Causes identified by consultants	**Causes identified by contractors**
1	Inadequate contractor experience	Labor productivity problems
2	Finance & payment problems of clients	Owner interference
3	Subcontractor related issues	Inadequate contractor experience
4	Owner interference	Finance & payment problems of clients
5	Slow decision making by owners	Improper site management by contractors
6	Unrealistic contract durations given by clients	Improper construction methods by contractors
7	Improper contract management by consultants	Equipment availability & failures
8	Improper planning by contractor	Slow decision making by owners
9	Labor productivity problems	Subcontractor related issues
10	Shortage of labor	Improper planning by contractor

Accordingly, the main factor contributes to delays in traditional construction projects in Jordan was lack of labour productivity. This was again different from the Malaysian studies (Sambasivam & Soon, 2006). This depicts causes of delays can be varied from country to country.

Frimpong et. al. (2003) carried out a case study to analyze causes of delays of groundwater projects in Ghana. Ground water projects consists of ground water exploration, bore hole drilling, pumping test, water quality analysis and civil works.

Frimpong et. al. (2003) had identified 26 factors for the project delays by taking in to consideration of a specific ground water project in Ghana. The identified causes of delays are as follows.

1. Planning and scheduling deficiencies
2. Deficiencies in cost estimates prepared
3. Inadequate control procedures
4. Delays in work approval
5. Waiting for information
6. Mistakes during construction
7. Delays in inspection and testing of work
8. Cash flow during construction
9. Frequent breakdowns of construction plant and equipment
10. Shortages of technical personnel
11. Labor shortages
12. Monthly payment difficulties
13. Poor contract management
14. Shortage of materials, Plant/equipment parts
15. Contractor's financial difficulties
16. Low bid
17. Material procurement
18. Imported materials
19. Late delivery of materials and equipment
20. Escalation of material prices
21. Slow decision-making
22. Inflation
23. Difficulties in obtaining construction materials at official current prices
24. Ground problems
25. Bad weather
26. Unexpected geological conditions

According to findings of Frimpong et. al. (2003) ranked causes of delays of ground water project are as follows.

1. Monthly payment difficulties
2. Poor contract management
3. Material procurement

4. Inflation
5. Contractor's financial difficulties
6. Escalation of material prices
7. Cash flow during construction
8. Planning and scheduling difficulties
9. Bad weather
10. Deficiencies of cost estimate prepared

Findings of Nigeria (Frimpong et. al., 2003) were inline with that of Malaysia (Sambasivan & Soon, 2006). According to the both of studies, financial problems was identified as main cause for project delays. Research carried out by Frimpong et. al. (2003) did not consider whole construction industry in Ghana. It only considered about a specific project.

Jayawardane & Pandita (2003) identified 45 factors for project delays of construction industry in Sri Lanka. They categorized those causes in to 11 categories as follows.

1. Material related factors
    i. Shortage of material
    ii. Change the type and specifications
    iii. Slow delivery
    iv. Damage in storage on site
2. Manpower
    i. Shortage
    ii. Labour skills
    iii. Labour disputes/Strikes
3. Equipment
    i. Failure
    ii. Shortage
    iii. Unskilled operation
    iv. Slow delivery

v. Old machinery

4. Financing
   i. Contractor's cash position
   ii. Delay in payments by clients
   iii. Delay in certification by consultant

5. Changes
   i. Owner / consultant
   ii. Errors made by consultant
   iii. Foundation conditions encountered at field
   iv. Mistakes in soil investigation
   v. Water table condition
   vi. Geological condition at the site
   vii. Errors committed during construction at site

6. Government relations
   i. Obtaining permits from relevant authorities
   ii. Excessive bureaucracy in Government offices

7. Scheduling
   i. Preparation and approval of drawings
   ii. Lack of training of management to model the construction operation
   iii. Lack of data base in estimating duration and resources
   iv. Inadequate early planning

8. Controlling
   i. Waiting for sample approval
   ii. Inspection and testing procedure

9. Environment
    i. Rainy weather
    ii. Social and cultural factors
    iii. Limited working hours

10. Contractual Relationship
    i. Conflicts between contractor and consultant
    ii. Uncooperative owner
    iii. Slowness of owner's decision making process
    iv. Joint ownership
    v. Poor organization of contractor and consultant
    vi. Difficulties of coordination and insufficient communication
    vii. Delay due to sub contractor
    viii. Delay due to lack of facilities to sub contractor
    ix. Unavailability of professional construction management team
    x. Legal disputes between parties involved in the project

11. Location of site
    i. Access to the site
    ii. Surrounding
    iii. Lack of area for operation/ material stocks

According to Jayawardane & Pandita (2003), main delaying factor identified was rainy weather. Since Sri Lanka is a tropical country, this can be well acceptable. The other main causes of project delays identified by them were "Design changes by owners & consultants" and "Manpower shortages". Jayawardane & Panditha (2003)'s findings were generalized to the building construction projects in Sri Lanka.

Project size, which measured in m^2 gross external floor area, and project standard, which measured in building construction cost/m^2 gross external floor area are founded as significant drivers of construction speed in residential building projects in

Germany (Stoy et.al., 2007). This shows that the speed of construction can be vary with the type of the project.

The causes of delays can be varied according to following factors.

1. Geographical location of the project
2. Type of the construction project
3. Method of the construction project (i.e. traditional construction projects, Turn key projects, etc.)

2.4 Studies on Effects due to construction delays

Aibinu and Jagboro (2002) identified the effects of construction delays in Nigeria. The identified effects due to project delays in Nigeria are as follows,

1. Time overrun
2. Cost overrun
3. Disputes
4. Arbitration
5. Litigation
6. Total abandonment

According to their analysis ranking of effects of project delays were as follows (Anibu and Jagboro 2002).

1. Time overrun
2. Cost overrun
3. Disputes
4. Total abandonment
5. Arbitration
6. Litigation

Effects of the delays in construction projects can be changed according to the type of project (Samabasivan & Soon, 2006). For example, delays in infrastructure development project like southern high way will cause huge economic loss to the whole country, whereas delay in construction of house can only affect to the respective client.

Sambasivan & Soon (2007) adopted same effects of project delays identified by Anibu and Jagboro (2002). The ranking of effects due to project delays in Malaysian construction industry as follows (Sambasivan & Soon, 2007).

1. Time overrun
2. Cost overrun
3. Disputes
4. Arbitration
5. Litigation
6. Total abandonment

Although the first two effects due to project delays were identical in Malaysia (Sambasivan & Soon, 2007) and in Nigeria (Anibu & Jagaboro, 2002) "total abandonment" was more prominent in Nigeria. In Malaysia, "total abandonment" was categorized at last. This shows that the effects due to project delays can be varied from the country to country.

2.5 Methods to minimize project delays

Most of studies identified that the improvement of 'contractors managerial skills' was one of the basic needs to reduce project delays Fringpong et.al. (2003) suggested introducing continuous training programs to contractors' managerial staff as a solution.

To reduce the selecting of incapable contractors at bidding stage Sambasivan & Soon (2007) suggested introducing different selection process that gives more weight to capabilities rather than the price of the bid.

"Change orders" is one of the major factors contributes to delays. To reduce delays most of the studies suggested to minimize the change orders (Sambasivan & Soon, 2007; Assaf & Al-Hejji, 2006; Jayawardane & Pandita, 2003).

Fringpong et.al. (2003) suggested, introducing effective and efficient material procurement system at the site level to minimize the shortage of materials at site.

To mitigate the delays occurring due to approval of drawings Assaf and Al-Hejji (2006) suggested consultants to minimize the delays in the approval process.

Sambasivan and Soon (2007) suggested contractors to appoint able site managers for the smooth execution of work .Since the site managers should plan the work program according to day to day conditions they should be capable of handling those projects with good project management skills.

To minimize the delays due to changes in weather conditions Jayawardane & Pandita (2003) suggested to consider the weather patterns at the initial planning stage of the project.

Since the 'shortage of labour' is a huge problem in construction industry encouragement of existing workers to acquire new specialized skills was suggested by Jayawardane & Pandita (2006) after considering the construction industry in Sri Lanka.

Aibinu and Jagboro (2002) suggested two methods to minimize project delays. First was acceleration of site activities and the second was to increase the contingency allowances.

2.6 Relative Important Index

Sambasivan & Soon(2007), Jayawardane & Pandita (2003), and Abinu & Jagoor (2002) used the relative important index to determine the relative importance of the causes of project delays.

They have adopted five point Liket scale to define the importance of the causes. The relative importance index as follow.

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

Where 'W' is the weighting given to each factor by the respondent (ranging from 1 to 5), 'A' is the highest weight (i.e. 5), and 'N' is the total number of respondents. 'RII' value had a range from 0 to 1. Higher value of RII gives higher significance for the cause.

Frimpong et. al. (2003) used same method to analyze the significance of causes. However, he names it as "relative important weight".

Assaf & Al. Hejji (2007) used different approach to calculate the importance of the causes. He defined "Frequency Index" and "Severity Index" as follows.

Frequency Index (FI) = $\sum$ a (n/N) * 100 /4

Where "a" is the constant expressing the weight given by each respondent, "n" is the frequency of the response, and "N" is total number of responses. Frequency index was used to categorize causes according to frequency of occurrence.

Severity Index (SI) = $\sum$ a (n/N) * 100 /4

Where "a" is the constant expressing the weight given by each respondent, "n" is the frequency of the response, and "N" is total number of responses. Severity index was used to categorize causes according to the severity of occurrence.

The importance of each cause is based on the frequency and severity of it. Therefore, Assaf & Al. Hejji (2007) defined relative important index as follows.

Relative Importance Index (RII) = FI * SI

Assaf & Al. Hejji (2007)'s approach of calculating relative importance index is better than that of the other researchers'. Respondent has to answer two questions for one cause (i.e. frequency of occurrence and degree of severity), it gives more realistic picture about the causes of delays.

2.7 Spearman's Rank Correlation Coefficient

The objective of rank correlation methods is to assess the degree of monotonicity between two or more series of paired data (Costa & Roque, 2006). Correlation can be defined as relationship measure among different parties of factors. It gives the strength of their relationships. Spearman's rank correlation coefficient is a non-parametric test. (Distribution free tests) These tests have the obvious advantage of not requiring the assumption of normality or the homogeneity variance (Assaf & Al-Hejji, 2006).

Spearman's rank correlation coefficient can be defined as follows, when there are no tied ranks.

$$\rho = 1 - \frac{6 \sum d^2}{n (n^2-1)}$$

Where, 'd' is the difference in the rank of the values of each matched pair and 'n' is the Number of pairs of rank.

If tied rank exists, spearman's rank correlation coefficient can be defined as follows,

$$\rho = \frac{n (\sum x_i y_i) - (\sum x_i)(\sum y_i)}{[n (\sum x_i^2)^2 - (\sum x_i^2)^2]^{1/2} [n (\sum y_i^2)^2 - (\sum y_i^2)^2]^{1/2}}$$

Where, x_i is the rank given by first group, y_i is the rank given by second group and n is the number of pairs of ranks.

In spearman's rank correlation coefficient if concordance is perfect $\rho = 1$ If discordance is perfect $\rho = -1$. The value of ρ in all other cases lies between these limits (O'Brien & Griffiths, 1965). Spearman's rank correlation coefficient equal to 1 indicate the perfectly positive correlation. $\rho = -1$ indicates perfectly negative correlation. $\rho = 0$ indicates no correlation among the parties.

To check whether the value obtained for the spearman's rank correlation coefficient could be a result of chance, significance level of the relationship is used. This significance level can be checked by using a graph, which shows significant level and the degree of freedom (Appendix 3). If the results are above 0.1% significance level, it can be 99.9% confident that the correlation has not occurred by chance. If the results are above 1% significance level, it can be 99 % confident that the correlation has not occurred by chance.

2.8 Chapter Summary

There were quite a large number of researches were carried out in the world to identify causes of project delays and as well as there effects. The causes can be varied with the type of the project. Although there were few researches in Sri Lanka to identify the causes of project delays, no evidence was found regarding researches on their effects. Most of the researchers were used 'relative important index' method to identify the importance of the project delays. Those studies recommended 'improvement of project management skills of the contractors' staff', 'minimization of change orders', 'introduction of efficient material procurement', etc. to reduce project delays.

Chapter 3: Methodology

3.1 Identification of causes and effects of the project delays

The causes and effects of project delays were identified by referring previous research findings and interviewing the professionals working in the medium scale building projects. Those professionals were consisting of engineers, architects and quantity surveyors working in construction companies, consultancy companies and for the clients in Sri Lanka.

Most of the causes for project delays in Sri Lanka are inline with the causes identified in Malaysia by Sambasivan & Soon (2007). They had identified 27 causes for project delays. However, some of the causes identified by Sambasivan & Soon (2007) were not taken in to our research since they are minimal significance to Sri Lanka. Some additional causes identified by interviewing above parties were included to the causes obtained from Sambasivan & Soon (2007). Accordingly, below mentioned causes of project delays for medium scale building projects were used for the research.

Client Related Causes

1. Financial problems of clients
2. Owner's interference
3. Slow decision making by client
4. Unrealistic contract duration proposed by client
5. Clients change their original scope.

Contractor Related Causes

1. Improper project management
2. Improper construction methods
3. Improper planning

4. Errors during construction
5. Inadequate experience
6. Discrepancies with clients

Consultant related Causes

1. Poor contact management
2. Delay in preparation of drawings
3. Delay in approval
4. Delays in inspection
5. Lack of quality assurance

Other Causes

1. Shortage of materials
2. Shortage of labor
3. Shortage of equipments
4. Disputes
5. Lack of communication
6. Weather condition
7. Unforeseen site conditions
8. Regulatory changes

Effects of construction projects delays, which were identified, by Aibinu and Jagoor (2002) were taken in to consideration in Malaysia by Sambasivan & Soon (2002). According to interview with the professionals, similar kinds of effects of project delays were identified in Sri Lanka. Accordingly identified effects due to delays of medium scale building projects are as follows,

1. Time overrun
2. Cost overrun
3. Disputes
4. Arbitration
5. Litigation
6. Total abandonment

3.2 Questionnaire Design

Questionnaire was prepared to identify the frequency of occurrence and degree of severity of each cause and the effect. A sample questionnaire is attached in appendix-1 and appendix-2.

The questionnaire was consists of three parts. First part is used to identify background characteristics of the respondents. Accordingly following information was obtained.

1. Education qualifications of the respondent –
   Whether respondent having,
   - Diploma,
   - Basic degree,
   - Masters degree or
   - Doctorate
2. Experience of respondent in construction sector-
   It categorized as,
   - below 5 years,
   - Between 5 to 10 years,
   - Between 10 to 20 years or
   - Above 20 years
3. Gender of the respondent
4. Respondent working for a consultant, contractor or for a client

Second part of questionnaire was developed to identify the relative importance of the identified causes. Accordingly, respondents were asked to categories frequency of occurrence and degree of severity of each cause according to their experiences in the medium scale building projects. Four point Likert's scale was used to identify the causes of the project delays. Likert's scale used for the frequency of occurrence is as follows.

1. Rarely
2. Often
3. Sometimes
4. Always

Similarly, Likerts' scale used for the degree of severity is as follows.

1. Little
2. Moderate
3. Greater
4. Extreme

Finally in the second part, respondents were asked to write any additional cause they may think which can cause to the delays in medium scale building projects.

Sambasivam & Soon (2007), Fringpong et. al. (2003), Odeh & Battaineh (2002) and Aibinu & Jagboro (2002) directly asked importance of each cause of delay in their questionnaires. However, Assaf & Al-Hejji (2006) asked frequency of occurrence and degree of severity of each cause separately and calculated related importance from that. By analyzing the both methods, it was identified that method used by Assaf & Al-Hejji (2006) is more meaningful. Hence, same method was adopted for this study.

Third part of the questionnaire was designed to identify the effects, which can occur due to those delays. Same as the second part respondents were asked to categorise the

effects of delays according to frequency of occurrence and degree of severity. Same Likerts' scale, which was used at the second part, was used for the third part. Finally, respondents were asked to write any additional effect they might think which can occure due to delays in medium scale building projects.

3.3 Sample Selection

Sample was consists of professionals working in the medium scale building projects all over the Sri Lanka. These professionals were working for the consultants, contractors or clients. These professionals consists of engineers, architects, quantity surveyors, etc..

Snowball sampling technique is used for selection of a random sample. This sampling method comes under non-probability sampling techniques (Sambasivam & Soon, 2007). Sampling elements were identified by convenience and through referral networks. This method of sampling is preferred when it is difficult to get response from sample elements selected at random (Williams, 2003).

The questionnaire was distributed through e-mail and manually. The respondents were asked to fill the questionnaire and send it by e-mail or submit the questionnaire by hand or by post. Initially questionnaire was sent through referral network and asked them to forward it to their referrals. This method helps to send the questionnaire to the professionals working in all provinces in Sri Lanka, hence make the sample more random. In the questionnaire, it is specially mentioned that the people who is having experience in medium scale projects only should respond. Since the questionnaire was distributed, using referral network the respondent rate became high. Most of the responses were obtained through e-mail. The manual submission of questionnaire was negligible.

3.4 Calculation of relative importance

According to the responses obtained for the frequency of occurrence frequency index was calculated. Frequency index can be defined as follows.

Frequency Index $= \sum a\,(n/N) * 100/4$

Where 'a' is the constant expressing weighting given to the each response, (1 for rarely, 2 for sometimes, 3 for often and 4 for always)

'n' is number of respondents in each category

'N' is total number of respondents

According to the responses obtained for the degree of severity severity index was calculated. Severity index can be defined as follows.

Severity Index $= \sum a\,(n/N) * 100/4$

Where 'a' is the constant expressing weighting given to the each response, (1 for Little, 2 for Moderate, 3 for Great and 4 for Extreme)

'n' is number of respondents in each category

'N' is total number of respondents

Relative important index was calculated as follows,

$$\text{Relative important Index} = \frac{\text{Frequency Index X Severity Index}}{100}$$

Relative important indices were calculated separately for all the causes of project delays and all the effects due to those delays. Same calculation was used for consultants, contractors and clients separately and finally on overall basis. Same procedure was adopted for ranking of effects due to project delays.

Accordingly, causes and effects of project delays were categorized according to their importance. The causes and effects due to project delays were categorized separately

for the consultants' view, contractors' view, clients' view and overall respondents' view. This was used to compare the perception of the three groups.

3.5 Identification of agreement among groups

In order to test the degree of agreement between the three groups of respondents as to the causes of delays, a correlation analysis using Spearman's rank correlation coefficient was done. High correlation indicated that there is a high degree of agreement between the respondents.

Spearman's rank correlation coefficient can be defined as follows when there are no tied ranks.

$$\rho = 1 - \frac{6 \sum d^2}{n (n^2-1)}$$

Where,

ρ = Spearman's rank correlation coefficient

d = difference in the rank of the values of each matched pair

n = Number of pairs

Since in this analysis tied ranks were not observed, above equation was used for calculate the agreement among three parties. (i.e. contractors & consultants, consultants & clients, clients and contractors)

Spearman's rank correlation coefficient equals to +1 means the two variables are having perfectly positive correlation. ρ become -1 gives perfectly negative relationship among two groups. Accordingly if ρ came near to the 1 gives good correlation among two variables. Finally, to check the confidence level of the spearman's rank correlation significance level was checked using significance level graph (Appendix 3).

3.6 Chapter Summary

The causes of project delays and their effects were identified using previous researches and interviewing the professionals working in the medium scale building projects. Accordingly, 24 causes and 6 effects due to project delays were identified. Questionnaire was prepared according to those findings. The sample was selected using the snowball sampling method. Questionnaire was distributed among professionals working in the medium scale building projects, using emails and manually. The relative importance of causes and effects were checked using relative important index. This was done on the view of the contractors, consultants, clients and the overall basis. Agreement among groups was tested by calculating spearman's rank correlation coefficient.

Chapter 4: Analysis and Discussion of Results

4.1 Questionnaire survey

Since the snowball sampling technique was used, number of people who received the questionnaire cannot be identified. Initially the questionnaire was forwarded to 194 consultants, 208 contractors and 54 clients.

The responses were received through email, by post and by hand. Hundred and thirty-eight responses were received. When analyzing the responses, identified that 16 questionnaires were not fully completed. Since they were not fully completed, we assume that respondents had not taken good care to fill the questionnaire and their responses cannot be accurate. Therefore, those partly filled questionnaires were not taken in to the analysis.

Hundred and twenty-two completed questionnaires were taken for the analysis. These respondents were divided in to three groups as follows,

- Consultants - 51
- Contractors - 47
- Clients - 24

The summary of responses of questionnaire is annexed in appendix-4.

4.2 Demographic Characteristics

The demographic characteristics of the respondents were shown in tables 4.1.

Table 4.1- Demographic characteristics of the respondents

Demographic Characteristics	Consultants		Contractors		Clients		overall	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Gender								
Male	29	57%	35	74%	21	87%	85	70%
Female	22	43%	12	26%	3	13%	37	30%
Education Qualifications								
Diploma	0	0%	0	0%	0	0%	0	0%
Basic Degree	28	55%	29	62%	21	88%	78	64%
Masters Degree	15	29%	12	26%	3	13%	30	25%
Doctorate	8	16%	6	13%	0	0%	14	11%
Experience								
Below 5 years	18	35%	17	36%	13	54%	48	39%
Between 5 to 10 years	17	33%	12	26%	6	25%	35	29%
Between 10 to 20 years	11	22%	10	21%	3	13%	24	20%
Above 20 years	5	10%	8	17%	2	8%	15	12%

Responded Consultants' demographic characteristics

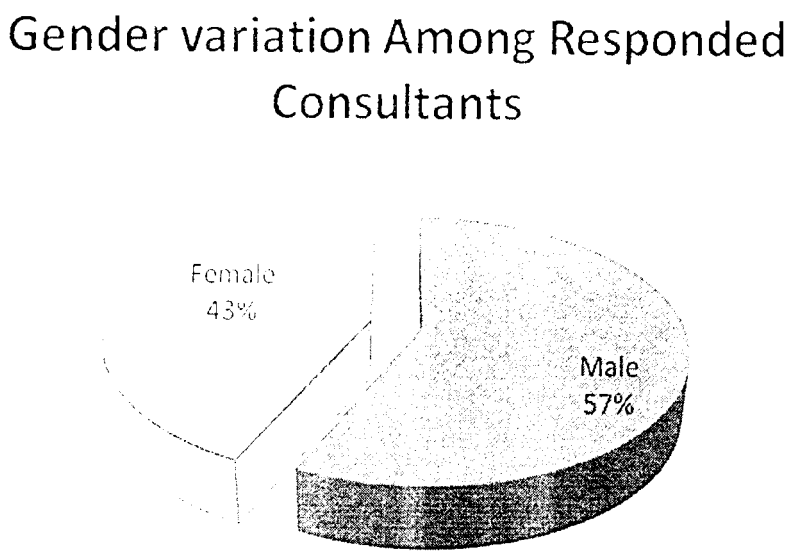

Figure 4.1- Gender variation among responded consultants

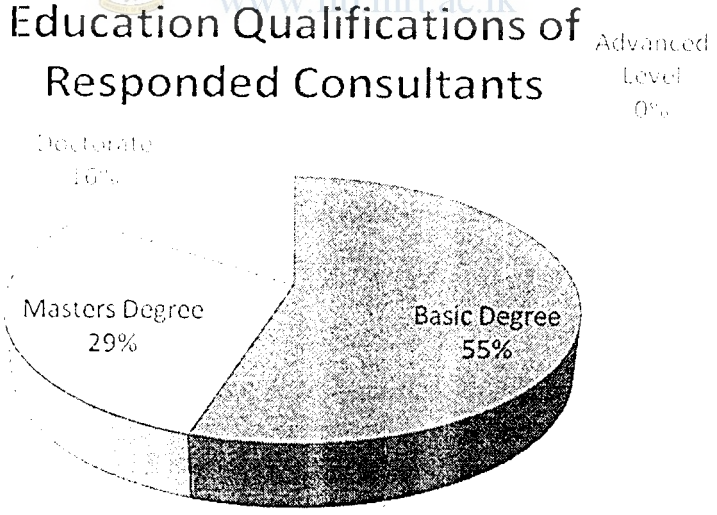

Figure 4.2- Education qualifications of responded consultants

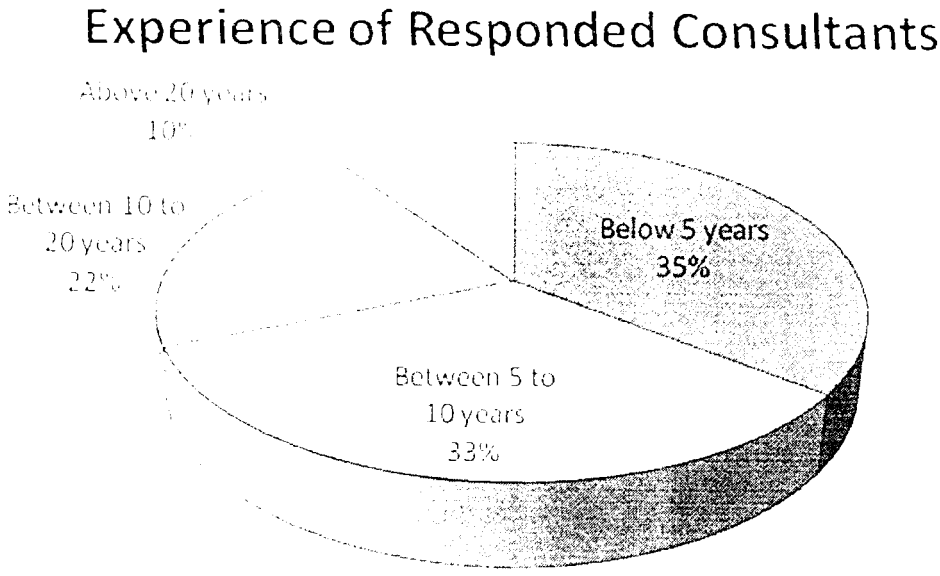

Figure 4.3- Experience variation among responded consultants

Responded Contractors' demographic characteristics

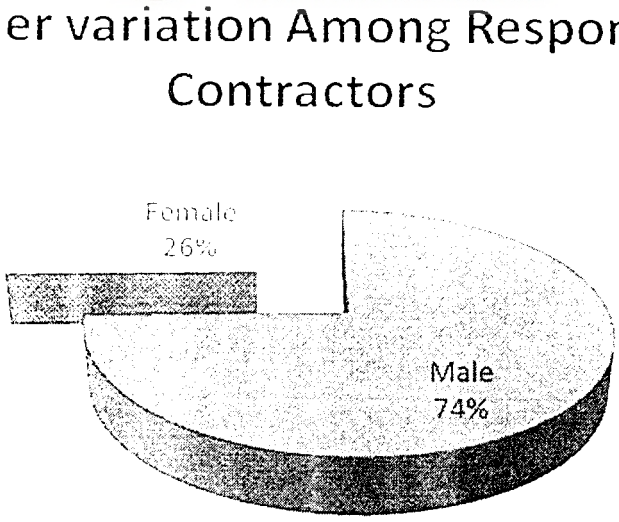

Figure 4.4- Gender variation among responded contractors

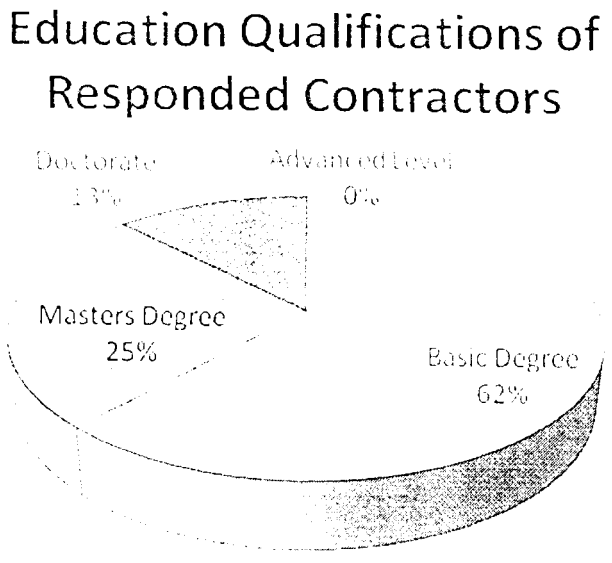

Figure 4.5- Education qualifications of responded contractors

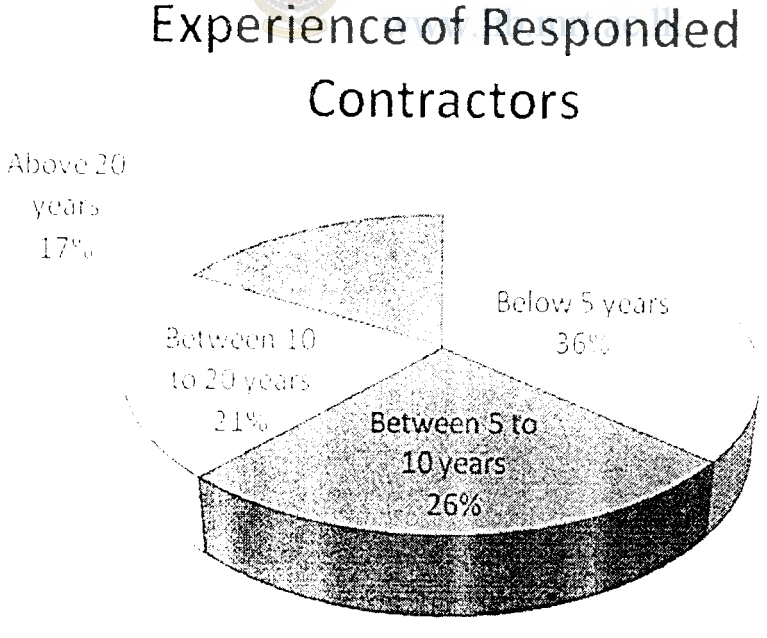

Figure 4.6- Experience variation among responded contractors

Responded Clients' demographic characteristics

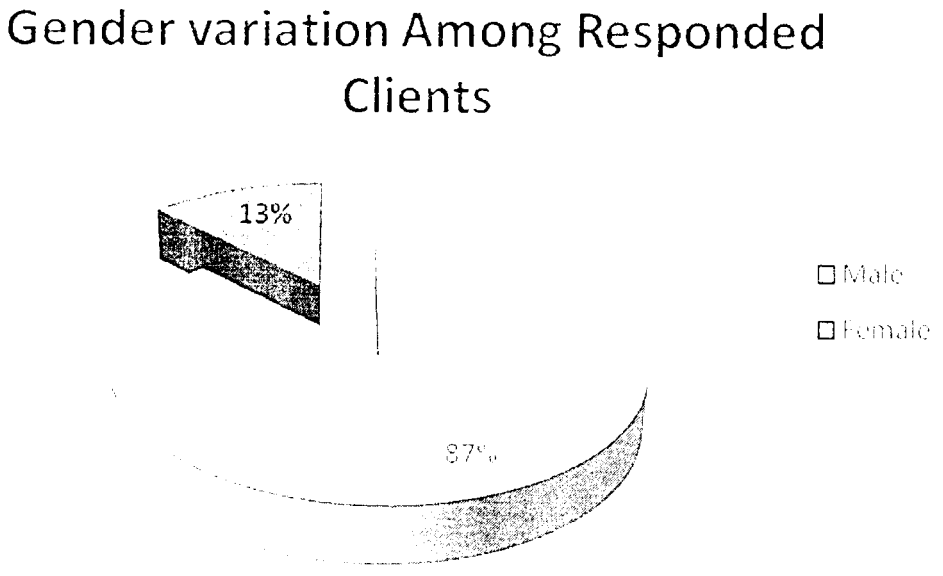

Figure 4.7- Gender variation among responded clients

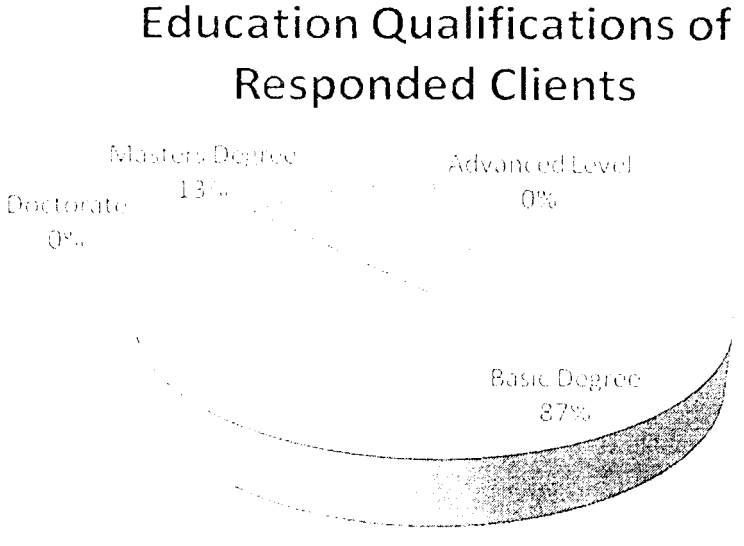

Figure 4.8- Education qualifications of responded clients

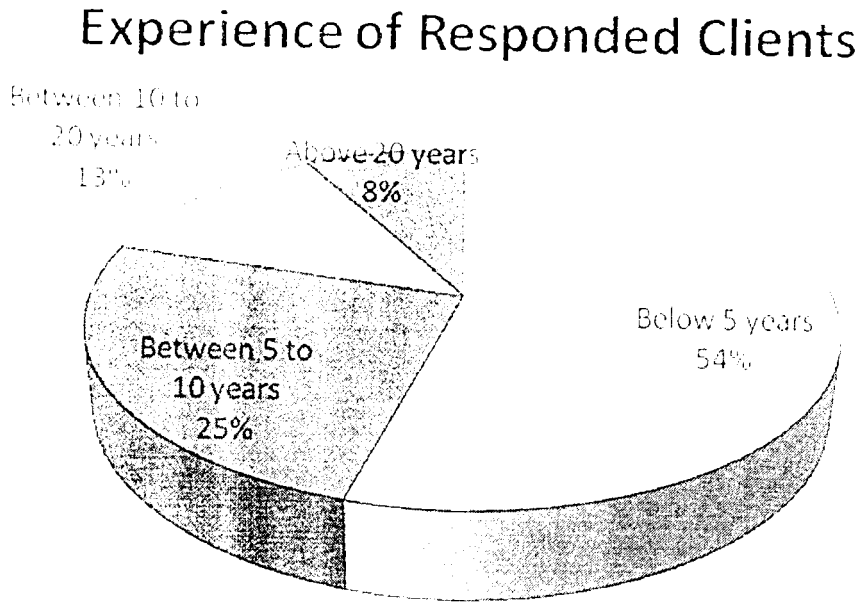

Figure 4.9- Experience variation among responded clients

Respondents' demographic characteristics

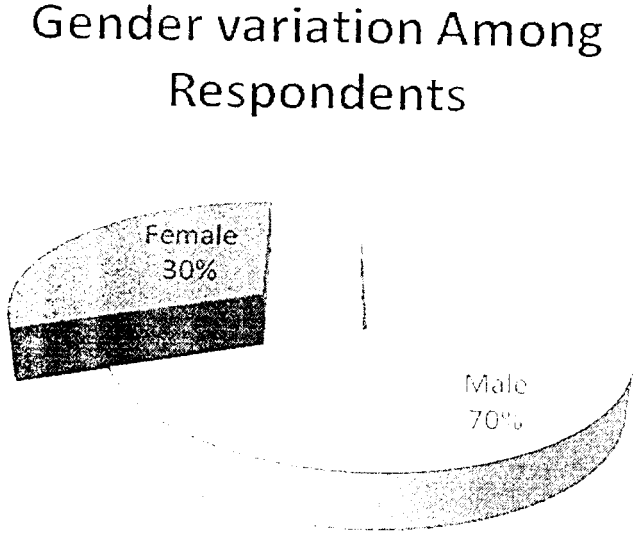

Figure 4.10- Gender variation among all respondents

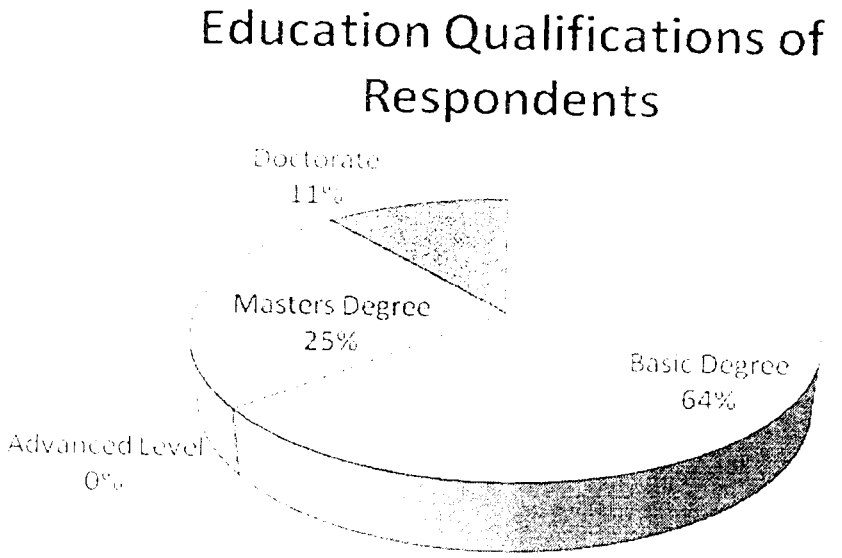

Figure 4.11- Education qualifications of all respondents

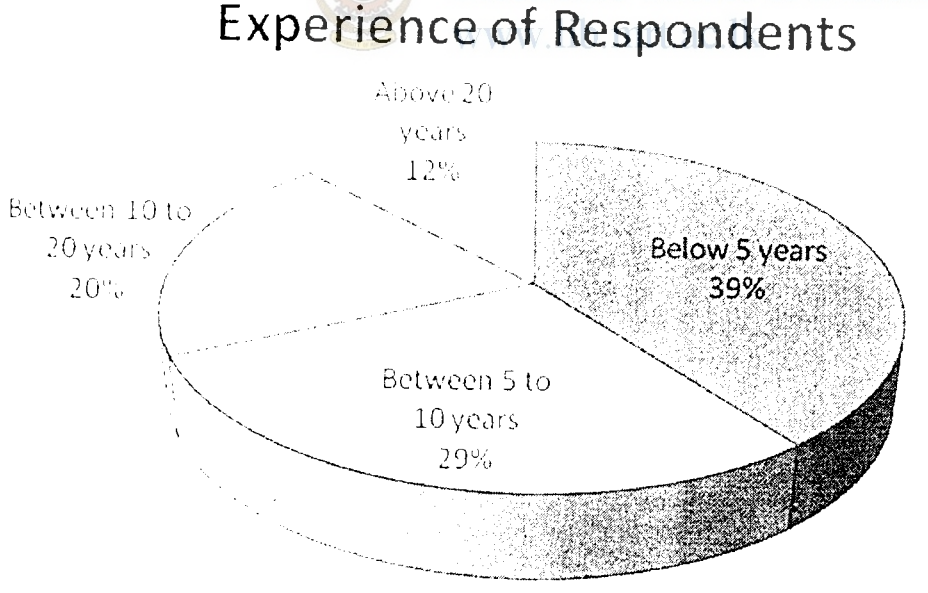

Figure 4.12- Experience variation among all respondents

Seventy percent of the participants of this research were male. Among the female participants most of them were working for the consultants. Least percentage of participants was working for client organizations.

All the responded professionals were having minimum of basic degree. This shows that most of people working in construction industry are well qualified. Other reason for this can be non-participation of the people who are not having at least a basic degree. may be they are not interested about research activities. 25% of participants had masters' degree and 11% of them had doctorate. Most of the doctorate holders were working for the consultants.

Thirty two percent of participants of this study were having more than 10 years experience. From that, 12% were having more than 20 years experience. Most of the participants were only having less than 5 years experience. This shows that young professionals were more enthusiastic about the research activities to improve the quality of construction industry.

4.3 Causes of Delays

Twenty four causes for the project delays were recognized after the preliminary interview with the professionals working in medium scale building projects and by referring the previous researches. Identified causes are as follows.

1 **Client Related factors**

i Financial Problems of clients
ii Owner interference for project
iii Slow decision making of client
iv Unrealistic Contract duration proposed by client
v Client changes their original scope

2 **Contractor related factors**

i Improper project management done by contractor
ii Improper construction methods used by the contactor
iii Improper planning by the contractor
iv Errors done by contractor during construction
v Inadequate experience of the contractor
vi Contractor's discrepancies with clients

3 **Consultant Related factors**

i Poor contract management done by the consultant
ii Delays in preparation of drawings by the consultant
iii Consultants delays in approvals
iv Consultants delays in inspections
v Lack of quality assurance by the consultant

4 **Other Factors**

i Shortage of materials at the market
ii Shortage of labor
iii Shortage of equipments
iv Disputes
v Lack of communication within parties involved to the project
vi weather conditions
vii Unforeseen site conditions
viii Regulatory changes during the construction

The frequency index and severity index was calculated separately for the responses of consultants', contractors', clients and in general. Hence, the calculated indices are figured out in table 4.2.

4.3.1 Consultants' view

Table 4.2- Consultants responses for causes of project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	**Client Related factors**				
i	Financial Problems of clients	59.31	71.57	42.45	5
ii	Owner interference for project	57.84	60.29	34.88	12
iii	Slow decision making of client	53.92	63.24	34.10	13
iv	Unrealistic Contract duration proposed by client	55.39	66.67	36.93	10
v	Client changes their original scope	66.18	73.04	48.33	3
2	**Contractor related factors**				
i	Improper project management of contractors	69.61	74.51	51.86	1
ii	Improper construction methods used by the contactor	52.45	56.37	29.57	16
iii	Improper planning by the contractor	66.67	71.57	47.71	4
iv	Errors done by contractors during construction	52.45	53.92	28.28	19
v	Inadequate experience of the contractor	45.59	60.78	27.71	18
vi	Contractor's discrepancies with clients	47.55	52.45	24.94	21
3	**Consultant Related factors**				
i	Poor contract management done by the consultant	46.57	78.43	36.52	6
ii	Delays in preparation of drawings by the consultant	49.51	61.76	30.58	15
iii	Consultants delays in approvals	41.67	55.39	23.08	22
iv	Consultants delays in inspections	35.78	77.94	27.89	11
v	Lack of quality assurance by the consultant	43.14	46.08	19.88	23
4	**Other Factors**				
i	Shortage of materials at the market	52.45	70.10	36.77	9
ii	Shortage of labor	67.16	75.98	51.03	2
iii	Shortage of equipments	46.08	75.49	34.78	8
iv	Disputes	53.43	53.92	28.81	17
v	Lack of communication within parties involved to the project	62.75	53.43	33.53	14
vi	weather conditions	66.67	58.33	38.89	7
vii	Unforeseen site conditions	51.96	52.45	27.25	20
viii	Regulatory changes during the construction	43.63	38.94	16.99	24

The graphical presentation of variation among relative important index is as follows. (Figure 4.13)

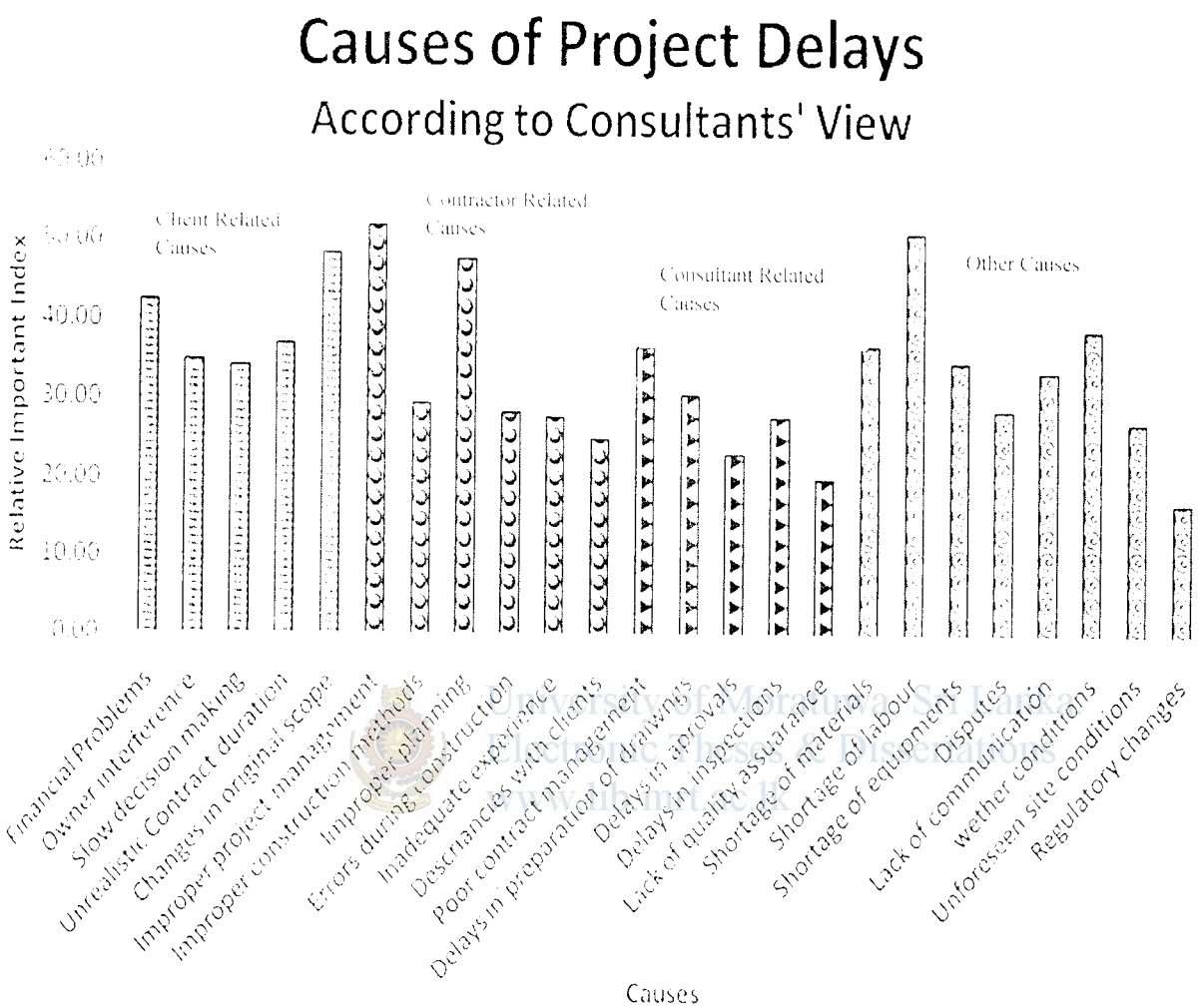

Figure 4.13- Consultants responses for project delays

Consequently, causes of project delays in medium scale building projects identified by the consultants can be ranked as follows. (Table 4.3)

Table 4.3- Ranking of causes of project delays as identified by consultants

	Cause	Relationship
1	Improper project management done by contractor	Contractor related
2	Shortage of labor	Other
3	Client changes their original scope	Client Related
4	*Improper planning by the contractor*	*Contractor related*
5	Financial Problems of clients	Client Related
6	Poor contract management done by the consultant	Consultant Related
7	weather conditions	Other
8	Shortage of equipments	Other
9	Shortage of materials at the market	Other
10	Unrealistic Contract duration proposed by client	Client Related
11	Consultants delays in inspections	Consultant Related
12	Owner interference for project	Client Related
13	Slow decision making of client	Client Related
14	Lack of communication within parties involved to the project	Other
15	Delays in preparation of drawings by the consultant	Consultant Related
16	Improper construction methods used by the contactor	Contractor related
17	Disputes	Other
18	Inadequate experience of the contractor	Contractor related
19	Errors done by contractor during construction	Contractor related
20	Unforeseen site conditions	Other
21	Contractor's discrepancies with clients	Contractor related
22	Consultants delays in approvals	Consultant Related
23	Lack of quality assurance by the consultant	Consultant Related
24	Regulatory changes during the construction	Other

4.3.2 Contractors' view

Table 4.4- Contractors responses for causes of project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	**Client Related factors**				
i	Financial Problems of clients	77.13	86.70	66.87	1
ii	Owner interference for project	62.77	61.70	38.73	13
iii	Slow decision making of client	51.60	66.49	34.31	16
iv	Unrealistic Contract duration proposed by client	44.68	60.11	26.86	20
v	Client changes their original scope	64.36	67.55	43.48	9
2	**Contractor related factors**				
i	*Improper project management of* contractors	64.36	82.45	53.06	3
ii	Improper construction methods used by the contactor	50.53	64.36	32.52	18
iii	Improper planning by the contractor	70.74	76.60	54.19	5
iv	Errors done by contractors during construction	40.43	65.96	26.66	19
v	Inadequate experience of the contractor	51.06	69.15	35.31	15
vi	Contractor's discrepancies with clients	40.96	61.17	25.05	21
3	**Consultant Related factors**				
i	Poor contract management done by the consultant	58.51	81.38	47.62	6
ii	Delays in preparation of drawings by the consultant	65.96	74.47	49.12	7
iii	Consultants delays in approvals	74.47	73.94	55.06	4
iv	Consultants delays in inspections	59.04	59.57	35.17	17
v	Lack of quality assurance by the consultant	46.81	51.06	23.90	22
4	**Other Factors**				
i	Shortage of materials at the market	47.87	75.00	35.90	12
ii	Shortage of labor	71.81	77.66	55.77	2
iii	Shortage of equipments	48.40	71.81	34.76	14
iv	Disputes	34.57	53.72	18.57	23
v	Lack of communication within parties involved to the project	62.23	63.83	39.72	11
vi	weather conditions	73.94	66.49	49.16	8
vii	Unforeseen site conditions	56.91	70.74	40.26	10
viii	Regulatory changes during the construction	30.32	34.57	10.48	24

The relative important index variation among the causes can be shown graphically as follows. (Figure 4.14)

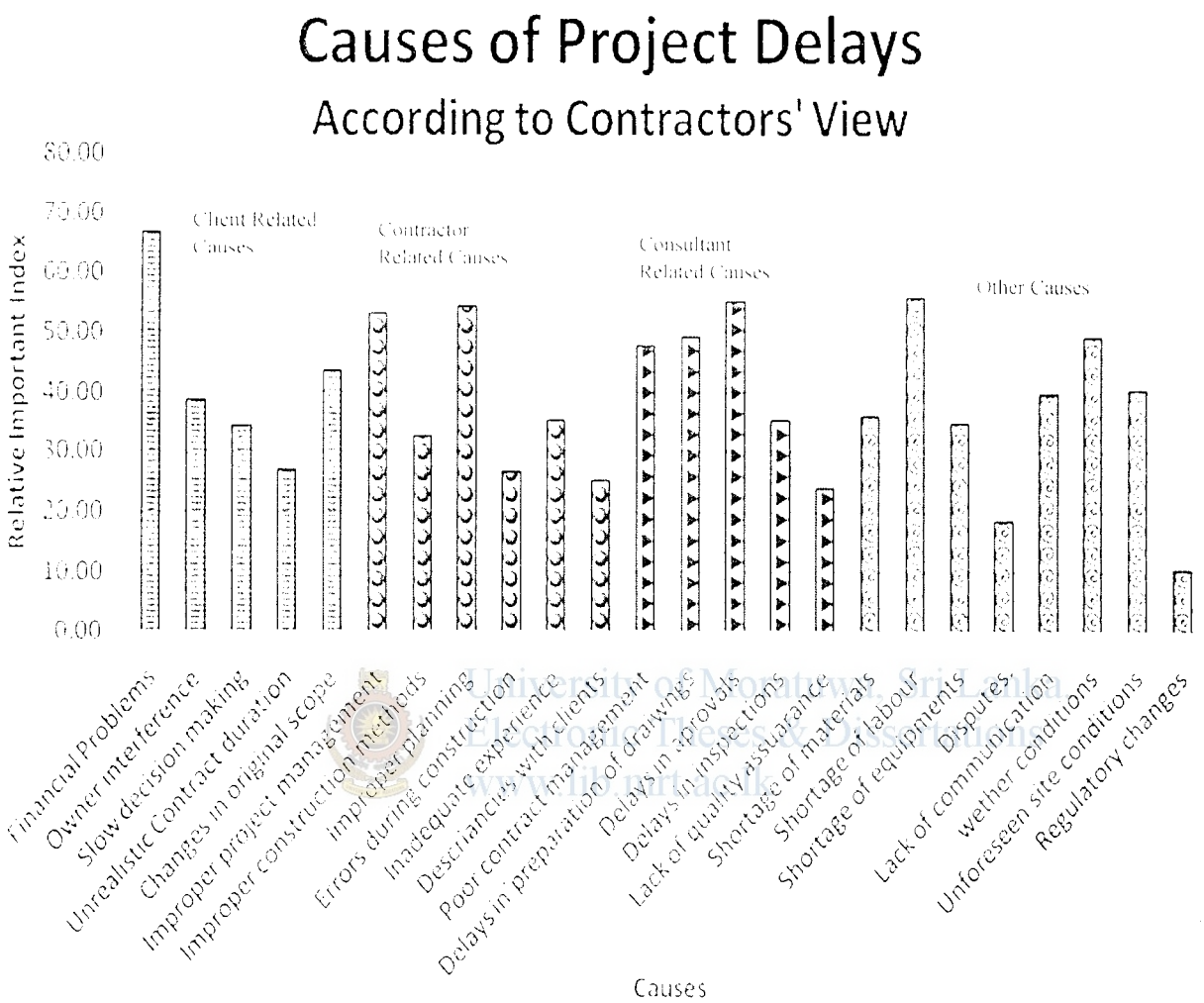

Figure 4.14- Contractors responses for project delays

Causes of project delays in medium scale building projects identified by the contractors can be ranked as follows.

Table 4.6- Ranking of causes of project delays as identified by contractors

	Cause	Relationship
1	Financial Problems of clients	Client Related
2	Shortage of labor	Other
3	Improper project management done by contractor	Contractor related
4	Consultants delays in approvals	Consultant Related
5	Improper planning by the contractor	Contractor related
6	Poor contract management done by the consultant	Consultant Related
7	Delays in preparation of drawings by the consultant	Consultant Related
8	weather conditions	Other
9	Client changes their original scope	Client Related
10	Unforeseen site conditions	Other
11	Lack of communication within parties involved to the project	Other
12	Shortage of materials at the market	Other
13	Owner interference for project	Client Related
14	Shortage of equipments	Other
15	Inadequate experience of the contractor	Contractor related
16	Slow decision making of client	Client Related
17	Consultants delays in inspections	Consultant Related
18	Improper construction methods used by the contactor	Contractor related
19	Errors done by contractor during construction	Contractor related
20	Unrealistic Contract duration proposed by client	Client Related
21	Contractor's discrepancies with clients	Contractor related
22	Lack of quality assurance by the consultant	Consultant Related
23	Disputes	Other
24	Regulatory changes during the construction	Other

4.3.3 Clients' view

Table 4.7- Clients responses for causes of project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	**Client Related factors**				
i	Financial Problems of clients	38.54	80.21	30.91	9
ii	Owner interference for project	42.71	54.17	23.13	23
iii	Slow decision making of client	42.71	77.08	32.92	10
iv	Unrealistic Contract duration proposed by client	39.58	78.13	30.92	11
v	Client changes their original scope	69.79	72.92	50.89	6
2	**Contractor related factors**				
i	Improper project management of contractors	90.63	89.58	81.18	1
ii	Improper construction methods used by the contactor	80.21	70.83	56.81	5
iii	Improper planning by the contractor	82.29	87.50	72.01	2
iv	Errors done by contractors during construction	64.58	63.54	41.04	8
v	Inadequate experience of the contractor	58.33	57.29	33.42	17
vi	Contractor's discrepancies with clients	41.67	60.42	25.17	22
3	**Consultant Related factors**				
i	Poor contract management done by the consultant	60.42	88.54	53.49	4
ii	Delays in preparation of drawings by the consultant	46.88	68.75	32.23	14
iii	Consultants delays in approvals	44.79	70.83	31.73	13
iv	Consultants delays in inspections	45.83	68.75	31.51	15
v	Lack of quality assurance by the consultant	41.67	66.67	27.78	20
4	**Other Factors**				
i	Shortage of materials at the market	44.79	68.75	30.79	16
ii	Shortage of labor	76.04	82.29	62.58	3
iii	Shortage of equipments	52.08	76.04	39.61	7
iv	Disputes	39.58	62.50	24.74	21
v	Lack of communication within parties involved to the project	57.29	65.63	37.60	12
vi	weather conditions	64.58	48.96	31.62	18
vii	Unforeseen site conditions	48.96	61.46	30.09	19
viii	Regulatory changes during the construction	38.54	35.42	13.65	24

The relative important index variation among the causes can be shown graphically as follows. (Figure 4.15)

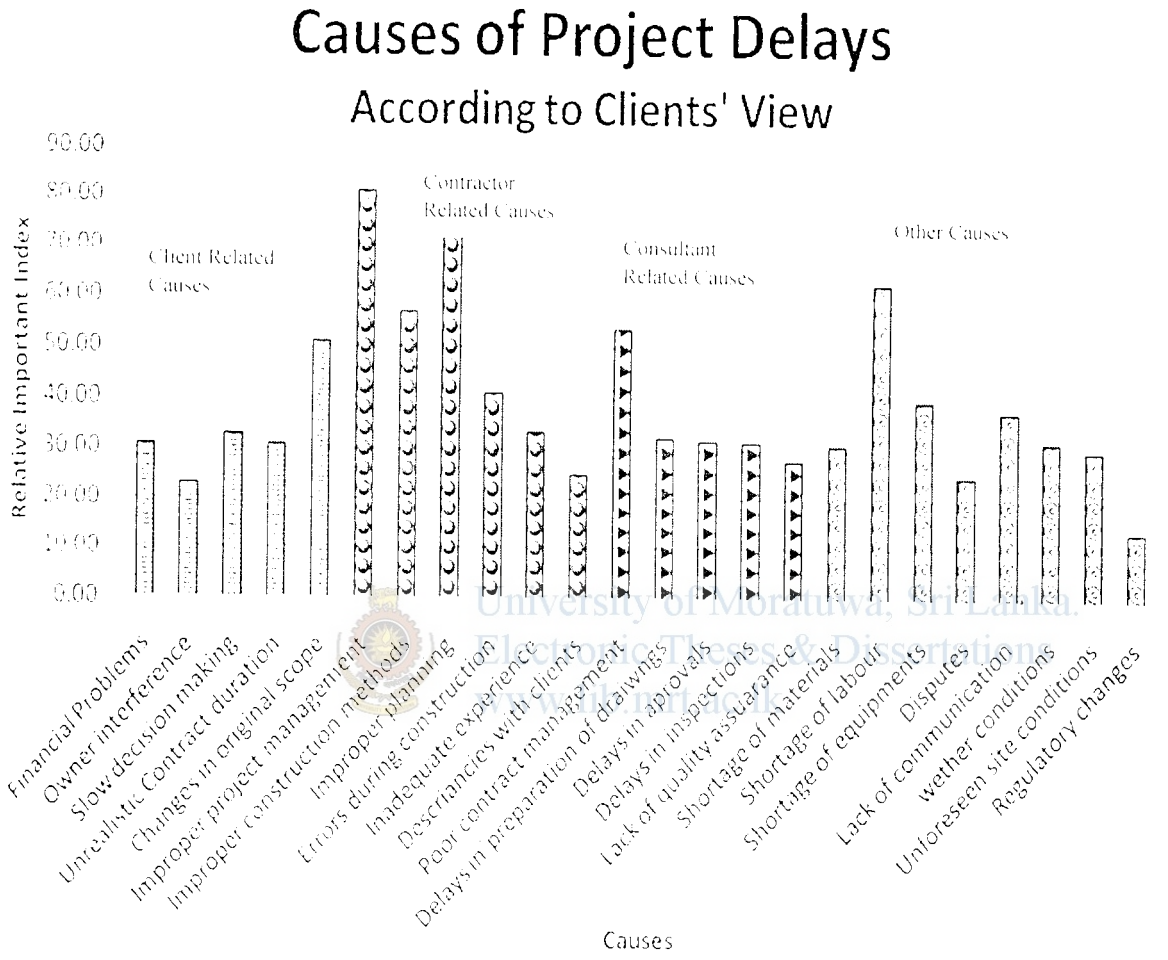

Figure 4.15- Clients responses for project delays

Causes of project delays in medium scale building projects identified by the clients can be ranked as follows.

Table 4.8- Ranking of causes of project delays as identified by clients

	Cause	Relationship
1	Improper project management done by contractor	Contractor related
2	Improper planning by the contractor	Contractor related
3	Shortage of labor	Other
4	Poor contract management done by the consultant	Consultant Related
5	Improper construction methods used by the contactor	Contractor related
6	Client changes their original scope	Client Related
7	Shortage of equipments	Other
8	Errors done by contractor during construction	Contractor related
9	Financial Problems of clients	Client Related
10	Slow decision making of client	Client Related
11	Unrealistic Contract duration proposed by client	Client Related
12	Lack of communication within parties involved to the project	Other
13	Consultants delays in approvals	Consultant Related
14	Delays in preparation of drawings by the consultant	Consultant Related
15	Consultants delays in inspections	Consultant Related
16	Shortage of materials at the market	Other
17	Inadequate experience of the contractor	Contractor related
18	weather conditions	Other
19	Unforeseen site conditions	Other
20	Lack of quality assurance by the consultant	Consultant Related
21	Disputes	Other
22	Contractor's discrepancies with clients	Contractor related
23	Owner interference for project	Client Related
24	Regulatory changes during the construction	Other

4.3.4 Generalized view

Table 4.9- General view for causes of project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	**Client Related factors**				
i	Financial Problems of clients	62.09	79.10	49.11	4
ii	Owner interference for project	56.76	59.63	33.85	16
iii	Slow decision making of client	50.82	67.21	34.16	14
iv	Unrealistic Contract duration proposed by client	48.16	66.39	31.97	17
v	Client changes their original scope	66.19	70.90	46.93	6
2	**Contractor related factors**				
i	Improper project management of contractors	71.72	80.53	57.76	1
ii	Improper construction methods used by the contactor	57.17	62.30	35.62	13
iii	Improper planning by the contractor	71.31	76.64	54.65	3
iv	Errors done by contractors during construction	50.20	60.45	30.35	20
v	Inadequate experience of the contractor	50.20	63.32	31.79	19
vi	Contractor's discrepancies with clients	43.85	57.38	25.16	21
3	**Consultant Related factors**				
i	Poor contract management done by the consultant	53.89	81.56	43.95	5
ii	Delays in preparation of drawings by the consultant	55.33	68.03	37.64	9
iii	Consultants delays in approvals	54.92	65.57	36.01	12
iv	Consultants delays in inspections	46.72	69.06	32.26	15
v	Lack of quality assurance by the consultant	44.26	52.05	23.04	23
4	**Other Factors**				
i	Shortage of materials at the market	49.18	71.72	35.27	10
ii	Shortage of labor	70.70	77.87	55.05	2
iii	Shortage of equipments	48.16	74.18	35.72	8
iv	Disputes	43.44	55.53	24.12	22
v	Lack of communication within parties involved to the project	61.48	59.84	36.78	11
vi	weather conditions	69.06	59.63	41.18	7
vii	Unforeseen site conditions	53.28	61.27	32.64	18
viii	Regulatory changes during the construction	37.50	36.59	13.72	24

The relative important index variation among the causes can be shown graphically as follows. (Figure 4.16)

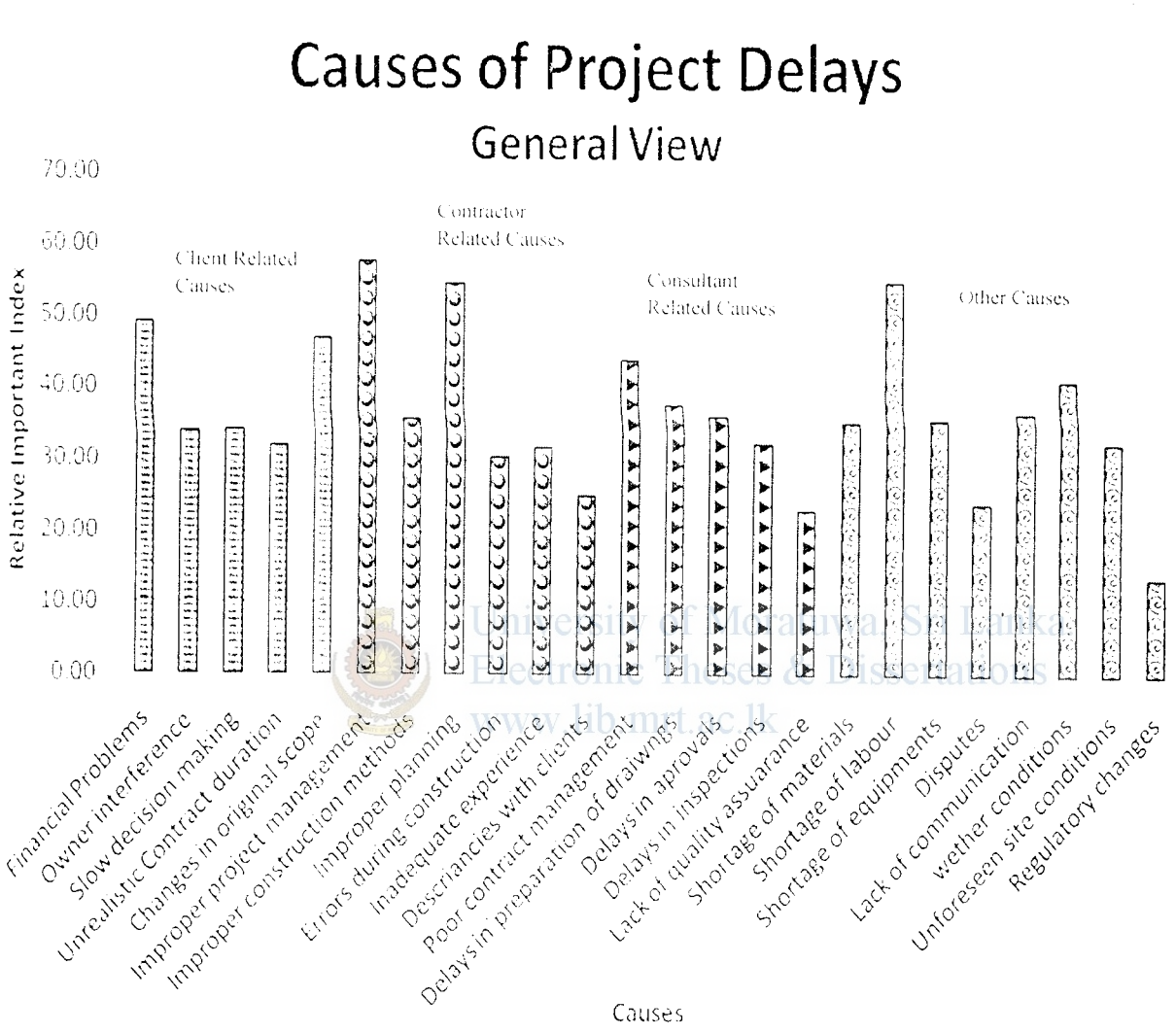

Figure 4.16- Overall respondents view for project delays

Causes of project delays in medium scale building projects identified by the all the people (i.e. consultants, contractors and clients) can be ranked as follows.

Table 4.10- Ranking of causes of project delays as identified by all participants

	Cause	Relationship
1	Improper project management done by contractor	Contractor related
2	Shortage of labor	Other
3	Improper planning by the contractor	Contractor related
4	Financial Problems of clients	Client Related
5	Poor contract management done by the consultant	Consultant Related
6	Client changes their original scope	Client Related
7	weather conditions	Other
8	Shortage of equipments	Other
9	Delays in preparation of drawings by the consultant	Consultant Related
10	Shortage of materials at the market	Other
11	Lack of communication within parties involved to the project	Other
12	Consultants delays in approvals	Consultant Related
13	Improper construction methods used by the contactor	Contractor related
14	Slow decision making of client	Client Related
15	Consultants delays in inspections	Consultant Related
16	Owner interference for project	Client Related
17	Unrealistic Contract duration proposed by client	Client Related
18	Unforeseen site conditions	Other
19	Inadequate experience of the contractor	Contractor related
20	Errors done by contractor during construction	Contractor related
21	Contractor's discrepancies with clients	Contractor related
22	Disputes	Other
23	Lack of quality assurance by the consultant	Consultant Related
24	Regulatory changes during the construction	Other

4.3.5 Discussion

- **Improper project management of contractors**

Improper project management of contractors was identified as the main cause of project delays by both consultants and clients, whereas, contractors categorized it as third.

In Sri Lanka project management carried out by contractors are minimal. They submit the work program at the tendering stage of the project since it is mandatory for all the bidders. After obtaining the contract, they neglect to work according to the submitted program and work in their own programs. This is a severe problem encountered by the consultants when evaluating the progress of project.

In Malaysian construction industry, the major cause for project delays was identified as improper planning (Sambasivan and Soon, 2007). "Poor site management" comes as the second major contractor related factor for project delays (Alagbari et. al., 2007). This shows that improper project management is not a fact limited to Sri Lanka. When analyzing the Malaysian experiences we can identify that this factor is true not only for medium scale building projects but also for the other construction projects.

However in Ghana "planning and scheduling deficiencies" was categorized in 8th position for the project delays (Fringpong et. al., 2003). Since this study is a case study carried out for specific project the finding of it can be vary with general condition.

Ineffective planning and scheduling was identified as the third main factor for project delays in Saudi Arabian large construction projects (Asaaf and Al-Hejji,2006). There results also inline with findings in Sri Lanka.

According to above factors we can say that improper planning is one of major cause for project delays. This may be due to lack of knowledge and expertise of project management activities. Project leaders' professional qualifications, leadership style,

team composition are highly correlated with project performance (Odusami et.al. 2003). Therefore, contractors should appoint qualified team to their construction to minimize the delays and make the project a success.

- **Shortage of labor**

The second major cause for delays of medium scale building projects identified by both consultants and Contractors was "Shortage of labor". Whereas clients recognized this as the 3rd cause. In general categorization "Shortage of labor" comes as the second cause of project delays in medium scale building projects.

"Man power shortage" was identified as the second main cause of the delays in building construction projects in Sri Lanka (Jayawardane and Pandita, 2003). This synonym with the findings of this study as well.

In Malaysian construction projects, "inadequate labour supply" was categorized in 5th place (Sambasivan and Soon, 2007). This was labeled at 6th place in a study carried out in Malaysia (Alagbari et. al., 2007). This shows that the above factor is not a major cause for project delays in Malaysian construction industry.

In studies carried out in Saudi Arabia, shortage of labour was identified as main cause of project delay (Assaf & Al-Hejji,2006). This shows that there is significant shortage of skilled workers in Saudi Arabia.

In Sri Lanka unemployment is 6% in 2007 (Central Bank of Sri Lanka, 2008) and 5.2% in second quarter of 2008 (Central Bank of Sri Lanka, 2008a). Therefore, we can identify a declining trend in unemployment rate, which is a good sign. Still large proportion of workers in construction industry employed in temporary basis, therefore, when they found a better job opportunity they will leave the former construction site. This creates a huge labour shortage in Sri Lankan construction projects.

- **Improper Planning by Contractors**

This is the third categorized cause for project delays. Consultants' categorized this at fourth place, whereas contractors at 5th place. However, clients categorized this in to second place. Project planning is considered as the most important factor contributes to success of the project (Dvir et.al., 2003). Most contractors neglect prior planning. They just submit a work program with the bidding document but did not implement it properly.

In Ghana 'planning and scheduling difficulties' was categorized at 8th position of causes of project delays (Fringpong et. al., 2003). Since this study carried out by Fringpong et. al. (2003) was confined to a single project their findings may not tally with situation in a normal construction projects.

In Malaysian construction industry, 'improper planning' was categorized as the main cause for the project delays (Sambasivam & Soon, 2007). This shows that not only in Sri Lanka but also in other countries improper planning is a considerable problem for construction project delays.

- **Financial problems of clients**

Financial problems of the clients was identified as the fourth cause of project delays. Most of the clients do not have clear view about the cost of the construction project at the planning stage. Even though estimates have been prepared at the beginning of the projects, most often cost overrun is common in Sri Lankan construction projects. The main cause for the cost overrun is inflation of the country. In 2007 annual average inflation rate of Sri Lanka was 17.5% (Central Bank of Sri Lanka, 2008). The inflation was further increased to 28.2% in second quarter of 2008 (Central Bank of Sri Lanka, 2008b). This shows the rapid inflation of the country. Therefore, it was difficult to make a realistic estimate for a medium scale building projects beforehand.

Consequently, most often clients will have to face financial difficulties at the midst of the construction projects that ultimately results delays of project.'

In Malaysian construction industry, 'financial problems of the clients' were categorized in fourth position (Sambasivam & Soon, 2007). Financial difficulties and economic problems are categorized as first cause of delays in Malaysian building construction projects (Algabari et. al., 2007). In Malaysia inflation was 2% in year 2007 (Central Bank of Sri Lanka, 2008b). In such a country even with good economic conditions, financial problems of clients were common. Hence, financial problems of the clients, in a country like Sri Lanka is unavoidable.

- **Poor contract management of consultants**

This is recognized as fifth cause of project delays. Clients identify this as the fourth majour cause, while consultants and contractors placed this as the sixth cause for the project delays. Most of the consultants who work in the construction industry are well-qualified professionals. It is the normal practice of Sri Lanka, in which both project consultancy and project management is handled by one party. Most of the consultancy firms use their main emphasis on project consultancy, which includes designing, quality assurance, etc. whereas project management was ignored.

In Malaysian construction industry 'poor contract management' was categorized as the 19th cause of project delays (Sambasivan & Soon, 2006). This shows that consultants with good contract managerial skills, serves for Malaysian construction industry. In Saudi Arabian large construction projects, 'poor contract management of consultants' was categorized in 8th position (Asaaf & Al-Hejji, 2006). This shows that 'poor contract management' is not a majour problem in other countries, as in Sri Lanka.

When considering the situation in Sri Lanka, we can propose that allocation of separate party for the project management could be a good remedy for this. Since this third party only conducts the project management, the outcome could be more

effective. This may add additional cost to the client, but final saving of this can be more than that.

- **Clients change their original scope**

This is the 6th majour cause of the project delay. Consultants identify this as the 3rd cause while clients categorized it to 6th place and contractors to 9th place. Most of the clients are not aware of building designs. While construction is in progress, clients will propose changes to the building design. This is one major cause for project delays. This may cause cost escalation as well. Not only in building construction projects but also in other manufacturing projects 'design changes and delay in design approval' have contributes for delay to the project (Williams et. al., 1995).

Jayawadane & Pandita (2003) identified that the changes done by the owners and consultants are major cause for project delays in building construction projects. Findings of this research are inline with their findings.

In Saudi Arabia large construction projects, this cause is categorized as 10th cause for the project delays (Asaaf and Al-Hejji, 2006). This shows that not only in Sri Lanka but also in other countries "clients changing their original scope" become a majour cause for the project delays.

This can be minimized if the consultants explain the whole design to the clients before the implementation. A vivid explanation about the design can be given if the consultant uses a model of the building or a 3D animation of the model. In that case, clients will undoubtedly understand the proposal before implementation. Consequently, the scope changes can be minimized.

- **Weather conditions**

'Weather conditions' was recognized as the seventh main cause of project delays. The main weather condition affecting this is rain. Rain interrupts construction activities

such as site preparation, excavation for foundations, external plaster works, fixing of formwork, concreting, external painting, etc. which are executed outside the building (Jayawardane & Pandita, 2003). They identified rainy weather as main cause of delays in building construction projects in Sri Lanka. Even so, our findings are deviate from them.

In Sri Lanka, two types of monsoons can be identified. Sri Lanka had average annual rainfall of 2,204 mm in 2006 and 1640mm in 2007 (Central Bank of Sri Lanka, 2008). Sri Lanka had 106 rainy days and 91 rainy days in year 2006 and 2007 respectively (Central Bank of Sri Lanka, 2008). Since Sri Lanka is a tropical country, it is difficult to predict the weather changes.

The projects delays due to weather conditions can be minimized if the contractors have given consideration to weather patterns before implementing the project.

- **Shortage of Equipments**

This is identified as the 8th cause of project delays. Consultants categorized this in to 8th place and clients in to 7th position. However, contractors identify this as the 14th cause. When considering the construction industry of Sri Lanka we can identify that in most of the cases contractors not use desirable equipments for the construction work. This may be due to high cost of those equipments. This not only affects to the project delays but also reduce the quality of the construction.

Jayawardane & Pandita (2003) identified that 'equipment shortage' as the 10th important cause for the project delays in building projects in Sri Lanka. Findings of them are similar to the findings of this research.

In Malaysian construction industry 'shortage of equipment' was categorized in to 8th cause of the project delays (Sambasivan & Soon, 2007). In Ghana shortage of materials were categorized in to 15th place (Fringpong et. al.,2003). This shows that 'shortage of equipments' is a universal problem.

'The equipments available with the contractors' is one of the factors taken in to consideration at the evaluation of the bids. If the contractor lacks proper plants and equipments to handle the project, the delays can be occurred. Therefore, it is suggested to measure the equipment factor thoroughly before awarding the project.

- **Delays in preparation of drawings by the consultants**

This is the ninth cause identified in this study. Delays due to this can be minimized by improving the proper communication among the contractors & clients and by preparing the work program before the commencement of project. If proper work program is available, consultants would be able to furbish drawings on time.

- **Shortage of materials at the market**

This is the 10th recognized cause for the project delays. All three parties respond in similar way. For example, construction material likes sand, which has a huge demand, requires permit from mining & mineral department for its transportation, thus affects its continuous supply. This can be minimized if the contractor is adhere to a proper work program, and if they manage the site accordingly.

Jayawardane & Pandita (2003) identified that shortage of material is one of the main causes for the project delays in building construction projects in Sri Lanka. According to that study, contractors categorized this as sixth main cause while consultants categorized as seventh. This is inline with the findings of the medium scale building projects in this research.

Some times the procurement delays may also contribute to shortage of materials at site. This will not only cause for time overrun but also cost overrun. Delay in the delivery of materials and equipment to construction sites is often thought as a

contributory cause of cost overruns in construction projects in developing countries (Manavazhi & Adhikari, 2001).

In Sri Lanka, government regulations and transport delays contributes for the delays in transporting materials to sites. These material procurement delays can be minimized if the contractor adhere to a proper work schedule.

- **Lack of communication within parties involved in a project**

Lack of communication among the parties is categorized as 11th cause of project delays. The effects due to communication gap can be very high. Low and Omar (1996) identified that communication is essential for the different professionals working in construction process to improve the quality of the construction. This is because each construction process is highly dependent on one another.

Malaysian construction industry this was categorized as the 9th factor (Smabasivan & Soon, 2007).

To minimize delays due to lack of communication, it is recommended to conduct weekly progress meetings with contractors, consultants and clients. At these meetings, all the things related to the progress of the work can be discussed. This will helps to reduce delays and to increase the quality of the work.

4.3.6 Agreement among groups

To access the agreement among the three groups spearman's rank correlation coefficient was used. Accordingly, calculated spearman's correlation coefficient and significance level of three groups were shown in following table 4.11.

Table 4.11 Agreement for causes of delays among groups

Group	Spearman's Rank Correlation Coefficient	Significance level
Consultants & Contractors	0.6539	1%
Contractors & Clients	0.5687	1%
Consultants & Clients	0.6922	1%

High agreement was observed among consultants and clients whereas least agreement was observed among contractors and clients. The significant levels of the all groups are less than 1%. Therefore, we can be 99% confident that the correlation has not occurred by chance.

In construction industry most of the instances disputes arise among clients and contractors, at the execution stage of the construction projects. Therefore, it is acceptable to observe low agreement among clients and contractors.

Similar sort of agreement was identified in studies carried out in Saudi Arabia (Asaaf & Al-Hejji,2006). Relationship was observed in research carried out in Malaysia (Sambasivan & Soon,2006) is not differ to that of Saudi Arabia.

4.4 Effects due to Delays

Six effects due to the project delays were identified after the preliminary interview with the professionals working in medium scale building projects and by referring the previous studies. Accordingly identified delays due to project delays are as follows.

1 Time Overrun
2 Cost Overrun
3 Disputes
4 Litigation
5 Arbitrations
6 Total abandonment

Frequency index and severity index was calculated for above effects for each group separately and in general.

4.4.1 Consultants' view

According to the responses of the consultants' relative important index of effects due to project delays are as follows. (table 4.12)

Table 4.12 - Consultants view for effects happening due to project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	Time Overrun	85.78	76.96	66.02	2
2	Cost Overrun	82.35	81.86	67.42	1
3	Disputes	53.43	59.31	31.69	3
4	Litigation	32.84	49.02	16.10	5
5	Arbitrations	33.82	54.41	18.40	4
6	Total abandonment	29.90	48.04	14.36	6

The relative important index variation among the effects due to project delays can be shown graphically as follows. (Figure 4.17)

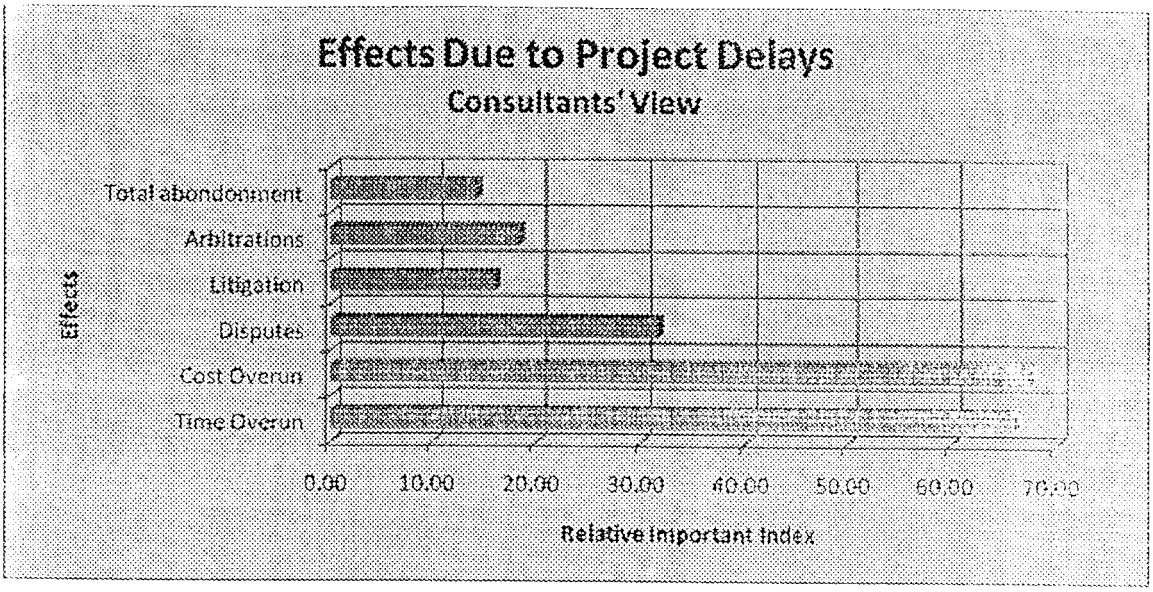

Figure 4.17- Consultants' view for effects happening due to project delays

Effects due to project delays in medium scale building projects identified by consultants can be ranked as follows.

1. Cost Overrun
2. Time Overrun
3. Disputes
4. Arbitrations
5. Litigation
6. Total abandonment

4.4.2 Contractors' view

According to the responses of the contractors' relative important index of effects due to project delays are as follows. (table 4.13)

Table 4.13 Contractors' view for effects happening due to project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	Time Overrun	92.02	77.13	70.97	2
2	Cost Overrun	91.49	85.64	78.35	1
3	Disputes	34.04	61.70	21.00	3
4	Litigation	31.38	50.53	15.86	5
5	Arbitrations	28.72	54.26	15.58	4
6	Total abandonment	29.79	50.53	15.05	6

The relative important index variation among the effects due to project delays can be shown graphically as follows. (figure 4.18)

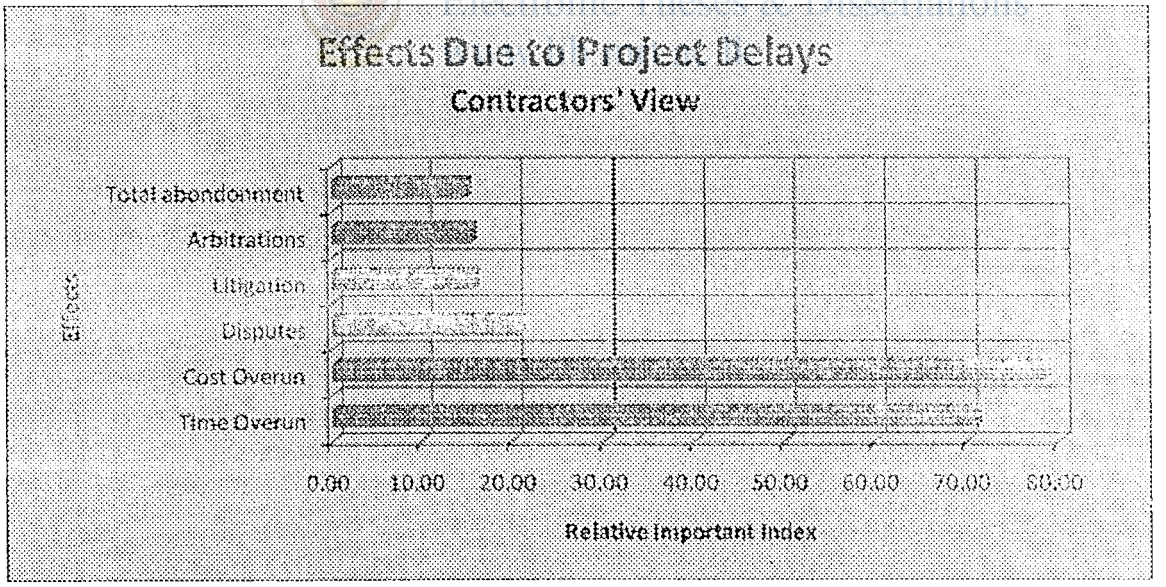

Figure 4.18- Contractors' view for effects happening due to project delays

Effects due to project delays in medium scale building projects identified by contractors can be ranked as follows.

1 Cost Overrun
2 Time Overrun
3 Disputes
4 Arbitrations
5 Litigation
6 Total abandonment

4.4.3 Clients' view

According to the responses of the clients' relative important index of effects due to project delays are as follows. (table 4.14)

Table 4.14 Clients' view for effects happening due to project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	Time Overrun	93.75	94.79	88.87	1
2	Cost Overrun	91.67	89.58	82.12	2
3	Disputes	34.38	69.79	23.99	3
4	Litigation	32.29	59.38	19.17	5
5	Arbitrations	30.21	66.67	20.14	4
6	Total abandonment	30.21	58.33	17.62	6

The relative important index variation among the effects due to project delays can be shown graphically as follows. (figure 4.19)

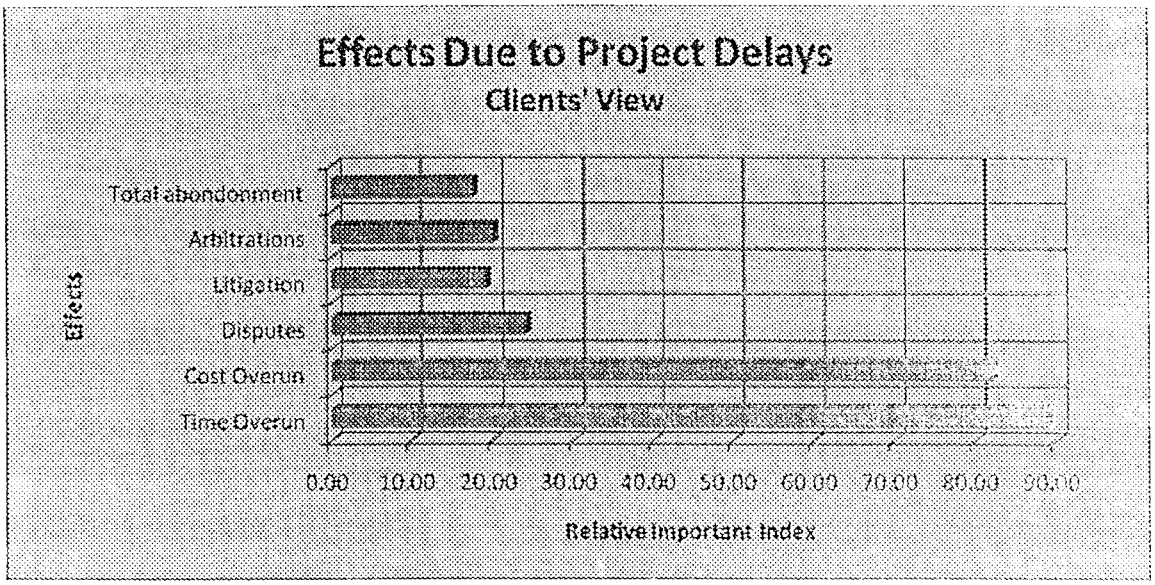

Figure 4.19- Clients' view for effects happening due to project delays

Effects due to project delays in medium scale building projects identified by clients can be ranked as follows.

1 Time Overrun
2 Cost Overrun
3 Disputes
4 Arbitrations
5 Litigation
6 Total abandonment

4.4.4 Overall view

According to the all responses relative important index of effects due to project delays are as follows. (table 4.15)

Table 4.15 – Overall respondents' view for effects happening due to project delays

	Cause	Frequency Index	Severity Index	Relative Important Index	Rank
1	Time Overrun	89.75	80.53	72.28	2
2	Cost Overrun	87.70	84.84	74.41	1
3	Disputes	42.21	62.30	26.30	3
4	Litigation	32.17	51.64	16.61	5
5	Arbitrations	31.15	56.76	17.68	4
6	Total abandonment	29.92	51.02	15.27	6

The relative important index variation among the effects due to project delays can be shown graphically as follows. (figure 4.20)

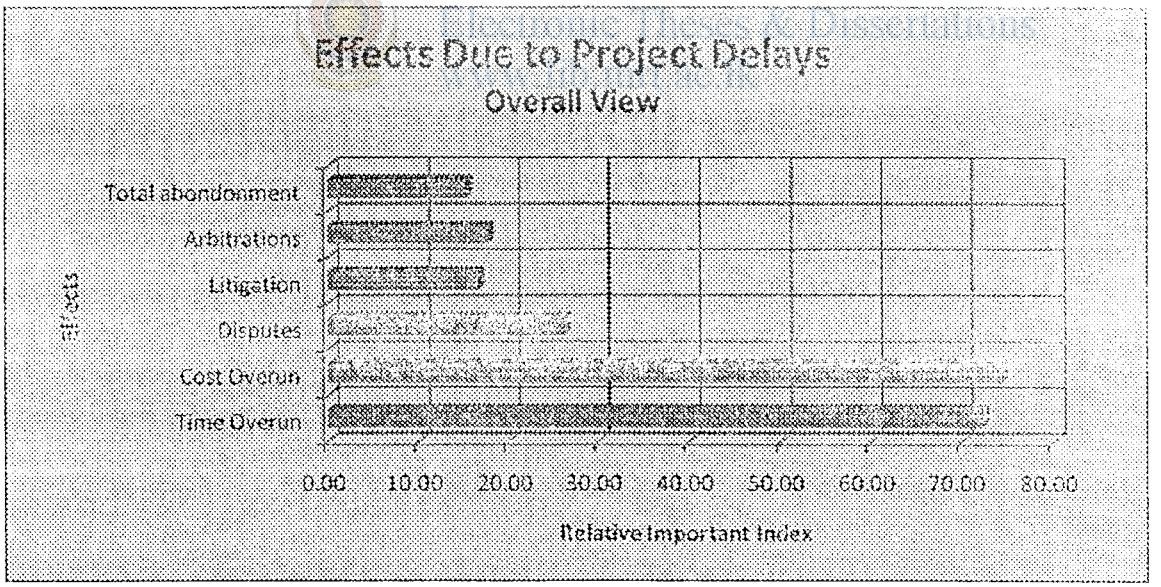

Figure 4.20- Overall respondents' view for effects happening due to project delays

Effects due to project delays in medium scale building projects identified by all parties can be ranked as follows.

1 Cost Overrun
2 Time Overrun
3 Disputes
4 Arbitrations
5 Litigation
6 Total abandonment

4.4.5 Discussion

- **Cost overrun**

Cost overrun is identified as main effect of project delay. Consultants and contractors ranks this as the majour effect due to project delays. However, clients placed this as second. It shows that consultants and contractors are more concern about the cost overrun than the time overrun. Whereas clients mainly concern about the time overrun.

Cost overrun includes payments to the consultants for additional time, increase of prices of material due to inflation and contract related factors such as change orders & discrepancies in bidding document. In most instances, time overrun leads to cost overrun (Sumbasivan & Soon, 2007).

Both Malaysian and Nigerian studies second most important effect due to project delays was identified as cost overrun (Sumbasivan & Soon, 2007; Aibinu & Jagboro, 2002).

- **Time overrun**

The second effect identified due to project delays is time overrun. In Nigerian study 'time overrun' was identified as main effect of project delays (Aibinu & Jagboro, 2002).

Time element is a vital factor for construction contracts. Failure to complete a contract on specified date would render substantial failure in performance. Therefore, time is the essence of the contract (Lawrence, 2002).

Due to the time overrun, liquidation damages can be claimed by the clients from contractors. However, liquidation damages are recoverable merely on proof of breach (Lawrence, 2002). Clients are liable to compensate all natural losses resulting from their action, which disrupt the progress of contractor (Lawrence, 2002). According to above factors we can understand that the time overrun can leads to other effects such as dispute, litigation, etc..

Therefore, it is suggested to clients, to give realistic time targets to their contractors. Clients should monitor the progress of project always in order to minimize the time overrun. Contractors should also take necessary action to recover delays from the initial stage of the project.

According to the experience of the Japanese construction industry, Japanese contractors utilizes shorter construction times by using more human resources on site, planning in more detail and working more closely with their subcontractors (Xiao & Proverbs, 2002). Therefore, to achieve time targets contractors should adhere to their work plan and should work more closely with their subcontractors.

- **Disputes**

Disputes are identified as the third main effect due to project delays. In Malaysian projects, this was identified as the third effect (Sambasivan & Soon, 2006).

Resolution of disputes can be done by arbitration or litigation. However, resolution of disputes either through arbitration or through litigation involves substantial amount of time and money therefore it is best to avoid them (Lawrence, 2002).

Lack of communication among the parties involved in the project is one of the main causes for the disputes. Erroneous and incomplete tender documents also make possibilities for disputes. The consultants should take every possible action to prepare the tender documents correctly. The bidders also take their time to analyze the tender documents properly before bidding for the job. The contractors should clarify any incomplete or missing work with the consultant before make the bid.

Mistakes of the contractors' at constructions, identified as another factor leading to disputes. Therefore, consultants should take their strength to assure quality of the work. However, inspection by consultants only is merely a quality control activity, which does not necessarily assure the quality of final product (Gunawardena & Kandamby, 2003). Hence, contactors should always take preventive measures to eliminate potential non-conformities. This will help to reduce disputes arising due to the quality aspects of the projects.

- **Arbitration**

Arbitration is identified as the fourth effect of project delays. In Malaysian construction industry, arbitration process was identified as the 4th majour effect due to project delays (Sambasivan & Soon, 2006). However, in Nigeria arbitration is identified as the 5th main effect due to project delays (Aibinu & Jagboro, 2002). This shows that Sri Lankan findings are going hand in hand with findings of the world.

In all construction contracts there is a clause dealing with dispute resolution. If any pre arbitral alternate dispute resolution mechanism fails arbitration can be done. The

law related to arbitration in Sri Lanka is covered by the arbitration act no 11 of 1995. In Sri Lanka, arbitration process is time-consuming dispute resolution method.

Including a pre arbitral, alternate dispute resolution mechanism to contract is a good way to minimize the arbitrations. Most important method to diminish the arbitration process is by reducing the disputes.

- **Litigation**

This is the fifth majour effect of project delays. Litigation is used to dispute resolution when arbitration clause not available. Litigation is conduct under the jurisdiction of the courts.

In Sri Lanka common law governing contract is Roman Dutch law. English law has been introduced by legislative action in certain areas relating to contracts (Lawewnce, 2002). Litigation involves substantial amount of time and money. When considering the Sri Lankan construction industry, litigation process is time consuming dispute resolution method. Therefore, it is recommended to minimize disputes and if any disputes, solve them through pre arbitral dispute resolution methods.

- **Total Abandonment of Project**

Due to the delays some construction projects were totally abandoned. This is high at governmental construction projects like roads, power plants, etc. However, the effect of total abandonment of project is low in medium scale building projects. Most of the abandonment of projects occurs due to disputes. Sometimes dispute resolution methods such as litigation take long time. Due to these delays, some projects were totally abandoned at certain occasions.

Abandonment of project is waste of both time and money. It will badly affect to the development of the country. Therefore, all the parties involve in construction should take full attention to reduce them.

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Abandonment of project is waste of both time and money. It will badly affect to the development of the country. Therefore, all the parties involve in construction should take full attention to reduce them.

Total abandonment is identified as least important effect in Malaysian construction industry (Sambasivan & Soon, 2006). The Malaysian findings are inline with Sri Lankan observations. In Nigeria, this was identified as the 3rd important effect due to project delays (Aibinu & Jagboro, 2002). The project abandonment in Nigeria may high when compare with other countries. Therefore, the findings in Nigeria is different to that of Sri Lanka.

4.4.6 Agreement among groups

To check the agreement among the three groups spearman's rank correlation coefficient was used. Accordingly, calculated spearman's correlation coefficient and significance level of three groups for the effects due to project delays were shown in following table.

Table 4.16 Agreement among groups for effects happening due to delays

	Spearman's Rank Correlation Coefficient	Significance level
Consultants & Contractors	1.0000	1%
Contractors & Clients	0.9429	1%
Consultants & Clients	0.9429	1%

This shows that there is a good agreement for the effects due to project delays by all three parties. Significance levels of the above data are higher than 1%. Thus, we can say at 99% confident that the correlation has not occurred by chance.

4.5 Chapter Summary

Hundred and thirty-eight responses were received and 122 were used for the analysis. The study consists of responses of 51 professionals working for consultants, 47 for contractors and 24 for clients. All the professionals were having minimum qualification of the basic degree. Among the respondents, 32% of them were having more than 10 years of experience.

Identified main causes of project delays were 'improper project management by the contractor', 'shortage of labour' and 'improper planning by the contractor'. Whereas identified main effects were 'cost overrun', 'time overrun' and 'disputes'.

Chapter 5: Conclusion and Recommendations

5.1 Conclusion

Improper project management of contractors is identified as main factor for project delays in medium scale building projects. Both consultants and clients identify this as the main cause, whereas, contractors placed it at the third place. Shortage of labour is the second majour cause of the project delays.

Causes of project delays are ranked as follows.

1 Improper project management done by contractor
2 Shortage of labor
3 Improper planning by the contractor
4 Financial Problems of clients
5 Poor contract management done by the consultant
6 Client changes their original scope
7 weather conditions
8 Shortage of equipments
9 Delays in preparation of drawings by the consultant
10 Shortage of materials at the market

All three parties agreed that following causes are least important for the project delays in medium scale building projects.

1 Regulatory changes during the construction
2 Lack of quality assurance by consultant
3 Disputes
4 Contractor's discrepancies with client

Main effect of project delays is identified as cost overrun. The ranking of effects of project delays are as follows.

1 Cost overrun
2 Time overrun
3 Disputes
4 Arbitrations
5 Litigation
6 Total abandonment

To minimize the project delays guidelines can be recommended to parties involved in the projects.

5.2 Guidelines to clients

Clients should take special attention to following factors to reduce delays in medium scale building projects.

- Identify the requirements of the building and available budget prior to commencement of construction. In this case, delays due to changing orders and changes of design can be minimized during construction.
- Assess the capabilities of the contractors and their past performances during evaluation of tender. Give more weight to the capabilities and past performance of the contractor and less weight to the price.
- Clients can nominate project management consultant for project management activities on behalf of client. Normally project management work is also carried out by the design consultant. By dividing the project management and designing in to two parts, desirable results can be achieved.
- Pay progress payments to the contractor at timely manner.

- Minimize changes during construction.
- Give realistic time targets to the contractors to complete the project.

5.3 Guidelines to contractors

Contractors should take their special attention to following factors to minimize delays

- Contractors should always visit the site and look for the site conditions prior to bidding process. If there are discrepancies in bidding document, they should contact consultant before the bidding process. By this method, disputes can be minimized during the progress of work.
- Contractors should give special consideration to the weather patterns, at the planning stage of the project.
- Contractors should take special care to project management work. It is necessary to analyze the progress every day and take necessary actions to delays whenever needed. Contractors can achieve optimum resource allocation by using proper project management process.

- Contractors should plan their cash flows and manage the construction activities accordingly.
- Contractors should plan their equipment needs at the initial stage of the projects, should arrange means to obtain them whenever necessary.
- Contractors should develop effective and efficient material procurement system within the project. This will help to minimize the project delays due to material shortages.

5.4 Guidelines to consultants

Consultants should take their special attention to following factors to minimize delays

- Consultants should identify the requirements of the clients correctly. It is recommended to explain the design to the clients using a model or 3D modeling software. This will help to reduce the change orders at the middle of the construction.
- Consultants should take necessary measures to minimize errors and discrepancies in bidding documents.
- Consultants should take their special attention to the project management work. Weekly progress meetings can be a good way to make communication among all parties, to discuss about the project delays, and to adopt precautionary measures where necessary.
- Consultants should submit necessary drawings, specifications on time to the contractors according to their work program.

5.5 Guidelines to policy makers of the Sri Lanka

Labour shortage is one of the key factors causing project delays. Skilled workers like masons, plumbers and carpenters are very difficult to find for the construction activities. Therefore, government can introduce more technical colleges in country. The curriculums at the technical colleges should be changed according to the current needs of the country.

5.6 Recommendations for further studies

Another study can be carried out to analyze and compare causes and effects of project delays in different type of construction projects such as high rise building projects, house construction projects, road construction projects, etc..

Since causes and effects of project delays are unique to a country similar studies can be done in other parts of the world.

Similar studies can be carried out to analyze the causes of delays in building construction projects in different provinces of Sri Lanka since causes of delays can be vary from one province to other.

Same kind of studies can be carried out in different types of contracts, such as turn key projects, design and build projects, etc.. Because, the importance of the causes of project delays can be vary with the type of projects.

A further research can be done to find relationship between duration of delay and cost overrun.

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Appendix – 1

Questionnaire Survey

ject - Causes and effects of delays in construction projects in Sri Lanka

tructions
1. Only those who were involve in building construction projects should take part
2. Mark your choices using "X" mark in appropriate box

Background Information

Highest education Qualification :

- Advanced Level ☐
- Basic Degree (g- B.Sc. Eng.) ☐
- Masters Degree (eg- M. Sc.) ☐
- Doctorate (eg - Phd) ☐

Experience in construction industry (Years) :

- Below 5 Years ☐
- Between 5 to 10 Years ☐
- Between 10 to 20 Years ☐
- Above 20 Years ☐

Sex:

- Male ☐
- Female ☐

Working as a:

- Consultant ☐
- Contractor ☐
- Client ☐

dentification of Causes of Project Delays.

(x) your preference for "frequency of occurrence" & "Degree of severity" of following causes of ject delays

Cause	Frequency of Occurrence 1 - Rarely 2 - Some Times 3 - Often 4 - Always	Degree of Severity 1 - Little 2 - Moderate 3 - Great 4 - Extreme
Client Related factors		
Financial Problems	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
Owner interference	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐

Appendix – 1

Questionnaire Survey

Project - **Causes and effects of delays in construction projects in Sri Lanka**

Instructions

1. Only those who were involve in building construction projects should take part
2. Mark your choices using "X" mark in appropriate box

Background Information

1 Highest education Qualification :

- Advanced Level ☐
- Basic Degree (g- B.Sc. Eng.) ☐
- Masters Degree (eg- M. Sc.) ☐
- Doctorate (eg - Phd) ☐

2 Experience in construction industry (Years) :

- Below 5 Years ☐
- Between 5 to 10 Years ☐
- Between 10 to 20 Years ☐
- Above 20 Years ☐

3 Sex:

- Male ☐
- Female ☐

6 Working as a:

- Consultant ☐
- Contractor ☐
- Client ☐

Identification of Causes of Project Delays.

Tick (x) your preference for "frequency of occurrence" & "Degree of severity" of following causes of project delays

Cause	Frequency of Occurrence 1 - Rarely 2 - Some Times 3 - Often 4 - Always	Degree of Severity 1 - Little 2 - Moderate 3 - Great 4 - Extreme
1 Client Related factors		
i Financial Problems	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
ii Owner interference	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐

iii	Slow decision making	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
iv	Unrealistic Contract duration	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
v	Changes in original scope	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
2	**Contractor related factors**								
i	Improper project management	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
ii	Improper construction methods	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
iii	Improper planning	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
iv	Errors during construction	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
v	Inadequate experience	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
vi	Discrepancies with clients	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
3	**Consultant Related factors**								
i	Poor contract management	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
ii	Delays in preparation of drawings	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
iii	Delays in approvals	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
iv	Delays in inspections	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
v	Lack of quality assurance	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
4	**Other Factors**								
i	Shortage of materials	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
ii	Shortage of labour	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
iii	Shortage of equipments	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
iv	Disputes	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
v	Lack of communication	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐
vi	whether conditions	1 ☐	2 ☐	3 ☐	4 ☐	1 ☐	2 ☐	3 ☐	4 ☐

vii Unforeseen site conditions	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
viii Regulatory changes	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐

Indicate any additional causes for project delays

1 _____

2 _____

Identification of Effects of Project Delays.

Tick (x) your preference for "frequency of occurrence" & "Degree of severity" of following effects of project delays

Cause	Frequency of Occurrence 1 - Rarely 2 - Some Times 3 - Often 4 - Always	Degree of Severity 1 - Little 2 - Moderate 3 - Great 4 - Extreme
1 Time Overrun	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
2 Cost Overrun	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
3 Disputes	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
4 Litigation	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
5 Arbitrations	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐
6 Total abandonment	1☐ 2☐ 3☐ 4☐	1☐ 2☐ 3☐ 4☐

Indicate any additional effects happening due to project delays

1 _____

2 _____

Appendix – 2

Questionnaire Survey

Project - Causes and effects of delays in construction projects in Sri Lanka

Instructions

1. Only those who were involve in medium scale (2 to 10 stories) building construction projects should take part
2. Select your choices from the list (Drop down menu)
3. Use tab key to go to next question
4. Your information used for a research

Background Information

1 Highest education Qualification :

2 Experience in construction industry (Years) :

3 Sex:

6 Working for a:

Identification of Causes of Project Delays.

Select your preference from the list for "frequency of occurrence" & "Degree of severity" of following causes of project delays

	Cause	Frequency of Occurrence	Degree of Severity
1	**Client Related factors**		
i	Financial Problems of clients		
ii	Owner interference for project		
iii	Slow decision making of client		
iv	Unrealistic Contract duration proposed by client		
v	Client changes their original scope		

2	**Contractor related factors**		
i	Improper project management done by contractor		
ii	Improper construction methods used by the contractor		
iii	Improper planning by the contractor		
iv	Errors done by contractor during construction		
v	Inadequate experience of the contractor		
vi	Contractor's discrepancies with clients		
3	**Consultant Related factors**		
i	Poor contract management done by the consultant		
ii	Delays in preparation of drawings by the consultant		
iii	Consultants delays in approvals		
iv	Consultants delays in inspections		
v	Lack of quality assurance by the consultant		
4	Other Factors		
i	Shortage of materials at the market		
ii	Shortage of labor		
iii	Shortage of equipments		
iv	Disputes		
v	Lack of communication within parties involved to the project		

vi weather conditions		
vii Unforeseen site conditions		
viii Regulatory changes during the construction		
** Other Factors for project delays (Pls specify)	1 2	

Identification of Effects Due to Project Delays.

Select your preference for "frequency of occurrence" & "Degree of severity" of following effects of project delays

Cause	Frequency of Occurrence	Degree of Severity
1 Time Overrun		
2 Cost Overrun		
3 Disputes		
4 Litigation		
5 Arbitrations		
6 Total abandonment of the project		
** Other effects due to delays (Pls specify)	1 2	

Appendix -3

Consultant's Responses

Causes of Project Delays.

		Frequency of occurrence						Degree of Severity						Importance Index	Rank
	Cause	1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	**Client Related factors**														
i	Financial Problems	5	23	22	1	51	59.31	0	21	16	14	51	71.57	42.45	5
ii	Owner interference	3	33	11	4	51	57.84	6	25	13	7	51	60.29	34.88	12
iii	Slow decision making	13	19	17	2	51	53.92	9	17	14	11	51	63.24	34.10	13
iv	Unrealistic Contract duration	13	18	16	4	51	55.39	4	21	14	12	51	66.67	36.93	10
v	Changes in original scope	3	21	18	9	51	66.18	2	13	23	13	51	73.04	48.33	3
2	**Contractor related factors**														
i	Improper project management	1	16	27	7	51	69.61	2	12	22	15	51	74.51	51.86	1
ii	Improper construction methods	4	39	7	1	51	52.45	10	22	15	4	51	56.37	29.57	16
iii	Improper planning	5	9	35	2	51	66.67	2	13	26	10	51	71.57	47.71	4
iv	Errors during construction	7	35	6	3	51	52.45	11	24	13	3	51	53.92	28.28	19
v	Inadequate experience	13	34	4	0	51	45.59	8	21	14	8	51	60.78	27.71	18
vi	Discrepancies with clients	12	32	7	0	51	47.55	11	29	6	5	51	52.45	24.94	21
3	**Consultant Related factors**														
i	Poor contract management	12	34	5	0	51	46.57	0	14	16	21	51	78.43	36.52	6
ii	Delays in preparation of drawings	11	32	6	2	51	49.51	3	26	17	5	51	61.76	30.58	15
iii	Delays in approvals	27	17	4	3	51	41.67	8	27	13	3	51	55.39	23.08	22
iv	Delays in inspections	31	18	2	0	51	35.78	2	14	11	24	51	77.94	27.89	11
v	Lack of quality assurance	23	19	9	0	51	43.14	20	19	12	0	51	46.08	19.88	23
4	Other Factors														
i	Shortage of materials	9	28	14	0	51	52.45	5	12	22	12	51	70.10	36.77	9
ii	Shortage of labour	5	14	24	8	51	67.16	1	15	16	19	51	75.98	51.03	2
iii	Shortage of equipments	16	27	8	0	51	46.08	3	11	19	18	51	75.49	34.78	8
iv	Disputes	2	40	9	0	51	53.43	14	18	16	3	51	53.92	28.81	17
v	Lack of communication	3	30	7	11	51	62.75	18	14	13	6	51	53.43	33.53	14
vi	weather conditions	0	25	18	8	51	66.67	4	26	21	0	51	58.33	38.89	7
vii	Unforeseen site conditions	10	27	14	0	51	51.96	15	20	12	4	51	52.45	27.25	20
viii	Regulatory changes	23	20	6	2	51	43.63	34	10	5	3	52	38.94	16.99	24

Consultant's Responses

Effects Due to Project Delays.

	Cause	Frequency of occurrence						Degree of Severity						Importance Index	Rank
		1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	Time Overrun	0	6	17	28	51	85.78	3	11	16	21	51	76.96	66.02	2
2	Cost Overrun	0	10	16	25	51	82.35	2	10	11	28	51	81.86	67.42	1
3	Disputes	9	29	10	3	51	53.43	7	27	8	9	51	59.31	31.69	3
4	Litigation	35	16	0	0	51	32.84	21	16	9	5	51	49.02	16.10	5
5	Arbitrations	33	18	0	0	51	33.82	15	19	10	7	51	54.41	18.40	4
6	Total abandonment	41	10	0	0	51	29.90	23	16	5	7	51	48.04	14.36	6

Contractor's Responses

Causes of Project Delays.

	Cause	Frequency of occurrence						Degree of Severity						Importance Index	Rank
		1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	**Client Related factors**														
i	Financial Problems	0	7	29	11	47	77.13	0	7	11	29	47	86.70	66.87	1
ii	Owner interference	0	24	22	1	47	62.77	4	22	16	5	47	61.70	38.73	13
iii	Slow decision making	19	11	12	5	47	51.60	6	11	23	7	47	66.49	34.31	16
iv	Unrealistic Contract duration	16	25	6	0	47	44.68	5	19	22	1	47	60.11	26.86	20
v	Changes in original scope	0	28	11	8	47	64.36	5	7	32	3	47	67.55	43.48	9
2	**Contractor related factors**														
i	Improper project management	3	18	22	4	47	64.36	0	4	25	18	47	82.45	53.06	3
ii	Improper construction methods	4	38	5	0	47	50.53	5	13	26	3	47	64.36	32.52	18
iii	Improper planning	2	12	25	8	47	70.74	1	2	37	7	47	76.60	54.19	5
iv	Errors during construction	18	29	0	0	47	40.43	4	14	24	5	47	65.96	26.66	19
v	Inadequate experience	5	35	7	0	47	51.06	1	15	25	6	47	69.15	35.31	15
vi	Discrepancies with clients	17	30	0	0	47	40.96	4	22	17	4	47	61.17	25.05	21
3	**Consultant Related factors**														
i	Poor contract management	3	25	19	0	47	58.51	0	11	13	23	47	81.38	47.62	6
ii	Delays in preparation of drawings	4	19	14	10	47	65.96	0	7	34	6	47	74.47	49.12	7
iii	Delays in approvals	0	9	30	8	47	74.47	1	11	24	11	47	73.94	55.06	4
iv	Delays in inspections	3	24	20	0	47	59.04	8	18	16	5	47	59.57	35.17	17
v	Lack of quality assurance	18	17	12	0	47	46.81	19	11	13	4	47	51.06	23.90	22
4	**Other Factors**														
i	Shortage of materials	4	43	0	0	47	47.87	3	5	28	11	47	75.00	35.90	12
ii	Shortage of labour	0	15	23	9	47	71.81	4	6	18	19	47	77.66	55.77	2
iii	Shortage of equipments	13	24	10	0	47	48.40	6	8	19	14	47	71.81	34.76	14
iv	Disputes	29	18	0	0	47	34.57	10	22	13	2	47	53.72	18.57	23
v	Lack of communication	5	19	18	5	47	62.23	8	12	20	7	47	63.83	39.72	11
vi	weather conditions	4	6	25	12	47	73.94	2	16	25	4	47	66.49	49.16	8
vii	Unforeseen site conditions	2	30	15	0	47	56.91	7	8	18	14	47	70.74	40.26	10
viii	Regulatory changes	37	10	0	0	47	30.32	32	12	3	0	47	34.57	10.48	24

Contractor's Responses

Effects Due to Project Delays.

	Cause	Frequency of occurrence						Degree of Severity						Importance Index	Rank
		1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	Time Overrun	0	4	7	36	47	92.02	1	13	14	19	47	77.13	70.97	2
2	Cost Overrun	0	0	16	31	47	91.49	2	5	11	29	47	85.64	78.35	1
3	Disputes	30	17	0	0	47	34.04	2	25	16	4	47	61.70	21.00	3
4	Litigation	35	12	0	0	47	31.38	16	17	11	3	47	50.53	15.86	5
5	Arbitrations	40	7	0	0	47	28.72	10	22	12	3	47	54.26	15.58	4
6	Total abandonment	38	9	0	0	47	29.79	14	21	9	3	47	50.53	15.05	6

Client's Responses

Causes of Project Delays.

	Cause	Frequency of occurrence						Degree of Severity						Importance Index	Rank
		1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	**Client Related factors**														
i	Financial Problems	13	9	2	0	24	38.54	0	3	13	8	24	80.21	30.91	9
ii	Owner interference	12	7	5	0	24	42.71	5	12	5	2	24	54.17	23.13	23
iii	Slow decision making	13	5	6	0	24	42.71	0	8	6	10	24	77.08	32.92	10
iv	Unrealistic Contract duration	12	10	2	0	24	39.58	2	3	9	10	24	78.13	30.92	11
v	Changes in original scope	0	9	11	4	24	69.79	2	6	8	8	24	72.92	50.89	6
2	**Contractor related factors**														
i	Improper project management	0	2	5	17	24	90.63	0	2	6	16	24	89.58	81.18	1
ii	Improper construction methods	0	5	9	10	24	80.21	3	6	7	8	24	70.83	56.81	5
iii	Improper planning	0	2	13	9	24	82.29	0	3	6	15	24	87.50	72.01	2
iv	Errors during construction	0	10	14	0	24	64.58	2	9	11	2	24	63.54	41.04	8
v	Inadequate experience	2	12	10	0	24	58.33	3	13	6	2	24	57.29	33.42	17
vi	Discrepancies with clients	12	8	4	0	24	41.67	3	11	7	3	24	60.42	25.17	22
3	**Consultant Related factors**														
i	Poor contract management	3	11	7	3	24	60.42	0	1	9	14	24	88.54	53.49	4
ii	Delays in preparation of drawings	9	9	6	0	24	46.88	1	8	11	4	24	68.75	32.23	14
iii	Delays in approvals	10	9	5	0	24	44.79	2	5	12	5	24	70.83	31.73	13
iv	Delays in inspections	9	10	5	0	24	45.83	1	8	11	4	24	68.75	31.51	15
v	Lack of quality assurance	12	8	4	0	24	41.67	0	9	14	1	24	66.67	27.78	20
4	**Other Factors**														
i	Shortage of materials	9	11	4	0	24	44.79	2	6	12	4	24	68.75	30.79	16
ii	Shortage of labour	0	3	17	4	24	76.04	0	4	9	11	24	82.29	62.58	3
iii	Shortage of equipments	4	14	6	0	24	52.08	0	7	9	8	24	76.04	39.61	7
iv	Disputes	13	8	3	0	24	39.58	2	9	12	1	24	62.50	24.74	21
v	Lack of communication	5	11	4	4	24	57.29	5	6	6	7	24	65.63	37.60	12
vi	weather conditions	2	8	12	2	24	64.58	5	15	4	0	24	48.96	31.62	18
vii	Unforeseen site conditions	7	11	6	0	24	48.96	0	13	11	0	24	61.46	30.09	19
viii	Regulatory changes	13	9	2	0	24	38.54	16	6	2	0	24	35.42	13.65	24

Client's Responses

Effects Due to Project Delays.

	Cause	Frequency of occurrence						Degree of Severity						Importance Index	Rank
		1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	Time Overrun	0	0	6	18	24	93.75	0	0	5	19	24	94.79	88.87	1
2	Cost Overrun	0	1	6	17	24	91.67	0	1	8	15	24	89.58	82.12	2
3	Disputes	15	9	0	0	24	34.38	0	8	13	3	24	69.79	23.99	3
4	Litigation	17	7	0	0	24	32.29	4	7	13	0	24	59.38	19.17	5
5	Arbitrations	19	5	0	0	24	30.21	0	8	16	0	24	66.67	20.14	4
6	Total abandonment	19	5	0	0	24	30.21	1	15	7	1	24	58.33	17.62	6

Overall Responses

Causes of Project Delays.

	Cause	Frequency of occurrence						Degree of Severity						Importance Index	Rank
		1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	**Client Related factors**														
i	Financial Problems	18	39	53	12	122	62.09	0	31	40	51	122	79.10	49.11	4
ii	Owner interference	15	64	38	5	122	56.76	15	59	34	14	122	59.63	33.85	16
iii	Slow decision making	45	35	35	7	122	50.82	15	36	43	28	122	67.21	34.16	14
iv	Unrealistic Contract duration	41	53	24	4	122	48.16	11	43	45	23	122	66.39	31.97	17
v	Changes in original scope	3	58	40	21	122	66.19	9	26	63	24	122	70.90	46.93	6
2	**Contractor related factors**														
i	Improper project management	4	36	54	28	122	71.72	2	18	53	49	122	80.53	57.76	1
ii	Improper construction methods	8	82	21	11	122	57.17	18	41	48	15	122	62.30	35.62	13
iii	Improper planning	7	23	73	19	122	71.31	3	18	69	32	122	76.64	54.65	3
iv	Errors during construction	25	74	20	3	122	50.20	17	47	48	10	122	60.45	30.35	20
v	Inadequate experience	20	81	21	0	122	50.20	12	49	45	16	122	63.32	31.79	19
vi	Discrepancies with clients	41	70	11	0	122	43.85	18	62	30	12	122	57.38	25.16	21
3	**Consultant Related factors**														
i	Poor contract management	18	70	31	3	122	53.89	0	26	38	58	122	81.56	43.95	5
ii	Delays in preparation of drawings	24	60	26	12	122	55.33	4	41	62	15	122	68.03	37.64	9
iii	Delays in approvals	37	35	39	11	122	54.92	11	43	49	19	122	65.57	36.01	12
iv	Delays in inspections	43	52	27	0	122	46.72	11	40	38	33	122	69.06	32.26	15
v	Lack of quality assurance	53	44	25	0	122	44.26	39	39	39	5	122	52.05	23.04	23
4	**Other Factors**														
i	Shortage of materials	22	82	18	0	122	49.18	10	23	62	27	122	71.72	35.27	10
ii	Shortage of labour	5	32	64	21	122	70.70	5	25	43	49	122	77.87	55.05	2
iii	Shortage of equipments	33	65	24	0	122	48.16	9	26	47	40	122	74.18	35.72	8
iv	Disputes	44	66	12	0	122	43.44	26	49	41	6	122	55.53	24.12	22
v	Lack of communication	13	60	29	20	122	61.48	31	32	39	20	122	59.84	36.78	11
vi	weather conditions	6	39	55	22	122	69.06	11	57	50	4	122	59.63	41.18	7
vii	Unforeseen site conditions	19	68	35	0	122	53.28	22	41	41	18	122	61.27	32.64	18
viii	Regulatory changes	73	39	8	2	122	37.50	82	28	10	3	123	36.59	13.72	24

Overall Responses

Effects Due to Project Delays.

	Cause	Frequency of occurrence Consultants						Degree of Severity Consultants						Importance Index	Rank
		1	2	3	4	Tot	F.I.	1	2	3	4	Tot	S.I.		
1	Time Overrun	0	10	30	82	122	89.75	4	24	35	59	122	80.53	72.28	2
2	Cost Overrun	0	11	38	73	122	87.70	4	16	30	72	122	84.84	74.41	1
3	Disputes	54	55	10	3	122	42.21	9	60	37	16	122	62.30	26.30	3
4	Litigation	87	35	0	0	122	32.17	41	40	33	8	122	51.64	16.61	5
5	Arbitrations	92	30	0	0	122	31.15	25	49	38	10	122	56.76	17.68	4
6	Total abandonment	98	24	0	0	122	29.92	38	52	21	11	122	51.02	15.27	6

Graph used to calculate significance level of the Spearman's rank Correlation coefficient