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A STUDY OF FACTORS INFLUENCING PUBLIC CONSTRUCTION PROJECTS DELAY IN BHUTAN

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A Thesis Submitted in Partial Fulfillment of the Requirements
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อโศก ซันวา: การศึกษาปัจจัยที่ส่งผลกระทบต่อความล่าช้าของงานก่อสร้างของภาครัฐในประเทศภูฏาน (A STUDY OF FACTORS INFLUENCING PUBLIC CONSTRUCTION PROJECT DELAY IN BHUTAN) อาจารย์ที่ปรึกษาวิทยานิพนธ์หลัก : ผศ.ดร. นพดล จอกแก้ว, 208 หน้า.

จุดประสงค์ของงานวิจัยนี้เพื่อระบุถึงปัจจัยที่ส่งผลกระทบต่อความล่าช้าของงานก่อสร้างของภาครัฐในประเทศภูฏาน โดยจัดลำดับตามความสำคัญของปัจจัย พร้อมทั้งศึกษาข้อเสนอแนะเพื่อการป้องกันความล่าช้าของงานก่อสร้างของภาครัฐในประเทศภูฏาน โดยปัจจัยได้จาก การสำรวจด้วยแบบสอบถาม การตรวจสอบสถานที่ก่อสร้าง การสังเกตวิธีการทำงาน และการสัมภาษณ์วิศวกรของรัฐบาลและผู้รับเหมา การวิเคราะห์ ความสำคัญของปัจจัย โดยใช้ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน สัมประสิทธิ์ความแปรปรวน ดัชนีความสำคัญสัมพัทธ์ และการทดสอบ (T-test) คือปัจจัยที่มีค่าเฉลี่ยตั้งแต่ 3.50 ขึ้นไปถูกใช้ในการจัดลำดับ

ผลของงานวิจัยนี้ชี้ให้เห็นถึงปัจจัยสำคัญที่สุดของงานภาครัฐ ในประเทศภูฏาน คือความล่าช้าเนื่องมาจากการขาดแคลนแรงงานภายในประเทศ ในทำนองเดียวกันการจัดลำดับความสำคัญของปัจจัยโดยแยกตามมุมมองของผู้รับเหมาและวิศวกรของรัฐบาลแสดงให้เห็นว่าแรงงานที่ ไร้ฝีมือ คือปัจจัยหลักที่ส่งผลกระทบต่อความล่าช้าของการก่อสร้างในภูฏาน เพื่อแก้ปัญหาการล่าช้าของงานก่อสร้าง จากการสัมภาษณ์เชิงลึกกับผู้เชี่ยวชาญจำนวน 10 ท่าน ได้ข้อแนะนำว่าควรมีการเพิ่มจำนวนสถาบันพัฒนาฝีมือแรงงาน และควรสนับสนุนแรงงานโดยการจูงใจและสิ่งแวดล้อมในการทำงานที่ดีกว่า นอกจากนี้ผู้เชี่ยวชาญยังแนะนำให้มีการ จัดตั้งศูนย์ฝึกฝีมือแรงงานภายในประเทศเป็นต้น

ภาควิชา.....วิศวกรรมโยธา.....ลายมือชื่อนิสิต.....

สาขาวิชา.....วิศวกรรมโยธา.....ลายมือชื่อ.ที่ปรึกษาวิทยานิพนธ์.....

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The objectives of this research are to identify the factors influencing public construction project delay in Bhutan, rank the important level of factors and to provide useful recommendations to prevent public construction project delay in Bhutan. The questionnaire survey, site investigation and interview technique with the government engineers and contractors were conducted for gathering the essential data. Statistical methods like mean, standard deviation, coefficient of variation, relative importance index and t- test were applied for data analysis. The important level for influencing the project delay is ranked and screened by mean value 3.50 and above.

The result from the overall ranking showed that shortage of national construction labor is the main factor influencing to project delay in Bhutan. Similarly, the ranking of factors discretely from the viewpoint of contractors and government engineers showed that unqualified workforce at site is the main factor influencing to construction delay in Bhutan. To solve the problem of construction project delay, in depth interview with 10 construction experts suggested for increasing the number of vocational training institutes and facilitating the workers with better incentives and working environment. The experts have also suggest for introducing authorized distributor of quality labor center in the country.

Department:.....Civil Engineering.....Student's Signature:.....
Field of Study:....Civil Engineering.....Advisor's Signature:.....
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CHAPTER I
INTRODUCTION

1.1 Research Background

The construction industry is the largest contributor to the Gross Domestic Product (GDP) in Bhutan's economy identical to most of the countries in the world even though it is not generating fullest to its potential. It is also one of the main sectors contributing to the employment opportunities and construction sector absorbs about 50-70% of the Gross Fixed Capital formation in Bhutan. Since 1980 till 2001, the contribution of GDP ranged from 8.1% to 15.5%. In 2002, the GDP of Bhutan's construction sector was 19% and it added a progress rate of 25% in the year. As per the National Statistics Bureau (NSB) of Bhutan, under the construction sector, the Gross Domestic Capital formation at current Prices in 2011 was 34,372.31 million Ngultrum. The Bhutanese public sector performs more as the enabler role than the provider role for the construction in private sector to participate in construction activities. Bhutan is administratively divided into twenty districts shown in Figure 1-1.

Figure 1-1 Map of Bhutan

As regards the construction industry, time is recognized as an important performance criteria for the success of any construction projects in the construction engineering and management. In reality, the time requirement for the completion of construction project is normally greater than what is specified in the contract documents. The delay in the construction industry ultimately leads to unsuccessful execution of the project and the time and resources are not utilized to its productivity. This can also add extra overheads as an indirect cost to the project. In other words project delay is directly proportional to the cost. However, the completion of the project within the specified duration will minimize the likelihood of disputes and disruption among the project participants.

The previous research on construction project performance concludes that delay is more common occurrence in construction projects executed in the developing countries. Sidawi (2002) states that the time overrun in Saudi Arabia experience between 10-30% and about 30% of construction works completed as per the schedule. Promkuntong and Ogunlana (1994) found that the resource supply problem and unskilled labor cause the major problem of the Thai construction industry. In Singapore, research conducted by Borvoon (2011) on survey of top building contractors in 1992 showed that the greatest concern of delay were found to be recruitment of supervisors, workers and high rate of labors turnover. Similarly, a study of construction project delay in India carried out by Sawhney and Dolio (2012) on the delay indicated two major factors of poor site communication and substandard contract documents. Furthermore, a study on the delay in Malaysian construction industry by Murali and Soon (2006) resulted on two main factors namely, shortage of labor and contractors' proper planning and scheduling difficulties.

Criticism of the construction industry has arisen because of the inefficient performance of the contractor, designer, consultant, project manager and project engineer executing the projects that takes a longer time to complete than the stipulated duration. However, it is not always possible to choose the best project practitioners with regard to efficient project team formation. These problems therefore affect the achievement of objectives, the day-to-day operations and the long-term viability of

the construction. Analyzing the factors influencing construction time delay, it indicates more clearly the nature of managerial actions that contribute to the timely delivery of projects and alleviate associated problems. Aibinu and Jagboro (2002) have stated that the economic growth at the national level can be achieved if an effort is made to improve construction precision and cost effectiveness. Al-Moumani (2000), Dvir et al. (2003) and Faridi and El-Sayegh (2006) stated that cost and time are the most important factors in construction. They are the visible factors, which are considered to be critical because of the direct economic implications they bear towards not meeting the required level. Therefore, effort of this study will be beneficial contributing to cost saving and better economic growth for the country.

Bhutan has opened its door to the outside world quite recently in terms of economic development and since then the measure of development in the country especially in capital city, Thimphu is increasing significantly in a span of short duration. The construction of apartment, real estate, residential and commercial complexes, government complex, flyovers, sports center etc, are some of the common structures multiplying in number in the capital because approximately one fifth of the country's population resides in Thimphu (www.nsb.gov.bt).

However, in view of the construction sector in Bhutan, the weakness of the project participants incapable of managing many dimensions of construction results in construction project delay. Project participants have more opportunities to enhance their technical and financial strength by competing in different public projects. The project practitioners require good managerial and supervisory ability in order to achieve the objectives of the project within the specified cost and time. This will benefit against the negative phenomenon of cost overrun and will have lower risk on the overall construction business development. In Bhutan, the trend of delay applies more significantly in the construction since the gain of experience and knowledge do not often exist to their required level for ensuring quality and efficiency in construction.

The past research studies like "the escalation of cost of construction of the private residential building due to project delay", by Koushki (2004) identified three major factors namely, the lack of financing the project, change of design during project execution and inexperience workers at the construction site causes project delay and extension of contract duration. Aibinu and Jagboro (2002) carried out a research in Nigerian construction industry had concluded that construction delay results in cost escalation, time extension and loss of overheads claims. Another research carried out by Sambasivan and Soon (2006) focusing on factors influencing delay found that inadequacy in managing construction sites by contractor, inefficient planning and scheduling, lack of adequate technical knowledge and poor financial stability of client results in construction time extension.

1.2 Problem Statements

In Bhutan, the construction delay features in every public project resulting in project time extension and cost overrun. The factors influencing construction project delay must be more focused due to its geographical location and position in terms of economic development. The problems related to the level of project delay can be categorized in the hierarchy of general level, industry level, construction project level and lastly at the management level.

In General level, Bhutan has bilateral relationships with many countries and organizations some of which are Australia, Thailand, Japan International Cooperation Agency (JICA), Government of India (GoI), SNV Netherlands, Asian Development Bank (ADB) and World Bank (WB). These international organizations provide financial and technical support towards infrastructure and human resource development. The public projects funded by these organizations experience series of site and management factors of project delay. This situation can have repercussions on the financial assistance that is received from these donor agencies which may involve risk premium on overall development of the country.

At Industry level, the purposes of construction are successful completion of project within the limitations of better quality, specified period and minimum cost. Achieving these objectives, an assurance in the improvement of efficiency and effectiveness in construction can be well established. However at this level, Bhutan construction industries have deficiency of the knowledge and advance technology, skilled human resource and appropriate procurement system thereby resulting in the project delay. The delay and cost overrun can be controlled if special provisions are made available after conducting proper research.

At the project level, there is no application of modern construction technology and many of the public construction projects are executed practicing aged old traditional method of construction and use of obsolete equipment's having lower working efficiency.

At the management level, the standard contract document for different category of projects between the public owner, contractor and subcontractor is important. The contract document requires provision for adding extra items and dealing with deviations during construction phases. Proper documentation of change order is important in order to avoid project delay.

The foreign consultants hired for the design of public buildings and infrastructure in Bhutan are not well versed with the building codes and regulations during the project design phase. During execution, a termination of site activities usually occurs which can adversely affect the issuance of occupancy certificate. These unapproved designs and drawings which requires longer duration for revision because of the absence of actual designer further influence project delay in Bhutan.

Construction projects in Bhutan are completely dependent on foreign labors. The demographic studies release of 2011 from the National Statistics Bureau (NSB) of Bhutan highlighted that only about 1.4 percent of the Bhutanese labor are employed in the construction sector. Simultaneously, large number of foreign labors largely from India are hired for the implementation of construction projects in Bhutan (Kuensel,

2012). This confers that Bhutanese express minimum interest to work as construction labor in uneven environment with low wages and incentives. Therefore, contractors have no alternatives than to employ Indian labors who are typically unsound in technical work. These situations of non-participation of Bhutanese workforce in the construction sector add extra importance for the foreign labor. Moreover, the problems face with foreign labor is that of abscond from the country after getting advance payment from the contractor (Kuensel, June 2012). The labor agents are not operative to their optimum and functions only as the commission agent.

Delay in processing the running bills and other heads submitted by the contractor to the public department is one of the reasons for deficient finance of the contractor. There is no proper process to support and balance these financial gaps which can benefit the contractor towards delivering better site performances. There is no extra time given to the contractor if the project is delayed for the late approval of bills. In addition, the fixing of contract duration is still an arbitrary approach which does not consider the volume and location of project and also the availability of the basic site amenities within the circumference of the project location. The present working practice reflects that the project durations are usually finalized predicting contractor's past similar work experience. Even the fixing of contract duration is based on negotiation between government engineer and contractor. The human and machine productivity are also not deliberated during project duration fixation. In principal, the productivity of equipment and machines can be calculated using equipment performance chart but the efficiency needs to be executed in real working situation otherwise the contractor experience overrun of time.

In some of the public projects, the contract is awarded to the contractor based on the lump-sum contract. In this system the site engineer concentrates less on the site measurement of items and the quality of construction. This system can also incur problem to contractors if the estimations prepared by the consultants are incorrect and not in correlation to the actual execution of work at the site. If there are some extra items to be added at the site, the estimated Bill of Quantity (BOQ) needs to be

reviewed (Kuensel, 2010). However in Bhutan, the contractor has right to claim for the bill only after project completion.

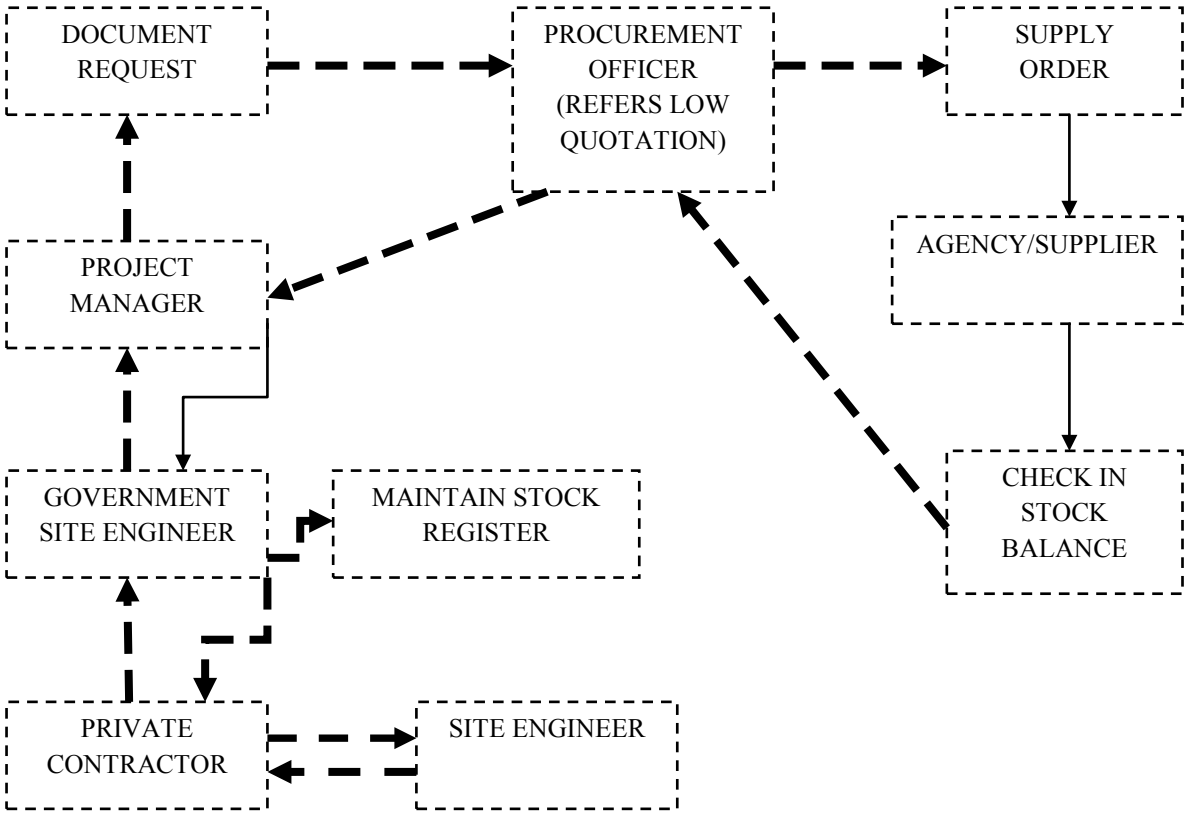

Figure 1-2 Bureaucratic procurement system in Bhutan (source: www.mof.gov.bt)

The procurement system flow in Bhutan for procuring material and machinery including other project stationeries is diagrammatically represented in Figure1-2. As shown, for any required items, the site engineer of the contractor informs the main or sub-contractor. Secondly, the contractor makes a remark to the government site engineer who further has to informs the project manager. Thirdly, the project manager submits the document of request to the procurement officer who in turn places the supply order referring the quotation rate to the supplier. On his part, the supplier checks in stock balance. If the required stocks and packages are available, the supplier then intimates the procurement officer who ultimately informs the project manager

updating on the availability of the required package. Finally, the participants are informed. This is a lengthy procedure which consumes time and resources thereby delay the progress of activities in project.

Many government agencies assisting Bhutan makes late payment especially for projects funded by Government of India (GOI). This compels the contractor to avail loan from financial institutions to fund the project and incurring huge repayment with additional interest rate. Contractors hesitate to claim interest although the procurement documents mention specific provisions to claim interest if payment of bill is delayed by more than a month. Further, the mobilization advance provided to the contractor is only 10% of the contract estimate which is low as compared to many developing countries.

The basic construction materials like cement and brick are in short supply in Bhutan which have raised concern to construction industry in a precarious situation. Even the minor works like up gradation and renovation of public infrastructures confront problem because of shortage of these basic construction materials. The local supplier sometime cannot supply these basic materials even in lower quantity (Kuensel, 2012). All these issues describe that Bhutan still experiences construction projects delay on a smaller to a larger scale.

Table 1-1 Human resource requirement for medium and small contractor

Serial no.	**Permanent key employees requirement**	**Medium contractor**	**Small Contractor**
1	Manager	1	1
2	Site engineer (diploma)	1	1
3	Site supervisor (civil)	1	1
4	Site supervisor (electrical)	1	-
5	**Total No. of employees**	**4**	**3**
6.	Contract allowable range(In million Ngultrum)	4.0 – 15.0	<= 4.0

(Source: www.cdb.gov.bt).

As per the contractor classification system of Bhutan formed by CDB, the human resource requirement for the medium and small contractor is highlighted in Table 1-1. However, the human resources are not in correlation to the category of public project that requires execution. In other words, the requirement of human resources is generalized without segregating the category of project inviting for further reformation.

In general, the defect liability period for the public project is fixed to six months duration as per the terms of reference of the contract document. The poor quality performance of works executed by inexperienced and unqualified contractors results in extra reconstruction effort to correct the defects that occurs within the defect liability period. Such cases are reportedly increasing in projects executed by the district offices resulting in project delay in Bhutan.

As per the contractor classification system of Bhutan, the requirement of construction equipment for the medium and small contractor is depicted below.

Table 1-2 Equipment requirements

Serial No.	Mandatory Equipment and Facilities	Medium Contractor	Small Contractor
1	Truck	1	-
2	Concrete Vibrator	1	-
3	Water pump	1	-
4	Meggar (Electric test equipment)	1	-

(Source: www.cdb.gov.bt)

In working environment, it is presumed that different category of work requires the process of selecting the equipment as per the project requirement. In Bhutan, as per the regulation of CDB, the mandatory equipment's requirements for the medium and small contractor do not support the scope of the project. The contractors finally

end up with equipment allocation problem at site. In addition, lack of modern equipment hiring agency and lack of supplier for construction equipment parts has made the construction industry to practice traditional methods which escalates project duration. Nevertheless, some contractors manages to operate obsolete equipment with lower working efficiency to complete the project beyond the specified contract duration.

The qualification requirement is not a criterion to procure the construction license in Bhutan and formalizing of such criteria has proliferated huge number of unqualified small class contractors in Bhutan. These unqualified contractors cannot execute the work successfully on stipulated time and cost thereby influencing project delay with poor quality work.

Figure 1-3 Unfavorable site conditions in Bhutan

The unfavorable site condition and allocation of project largely influence project delay in Bhutan as shown in Figure 1-3. The heavy snow fall especially during winter blocks all the access to the construction and the equipments like back hoe requires

longer time to clear these blocks. Similarly, during monsoon, blockage of highway due to heavy landslides are common in many regions which has a repercussion effect on timely delivery of material and equipment at the construction site. The project feasibility study is very poor and locations for the implementation of public projects are approved without conducting proper project feasibility study.

In view of the above construction problems in Bhutan, it is worth mentioning that the public construction projects delay are influenced by factors related to material, construction labor, equipment, contractor, government engineer, consultant and other external factors. The influence of each factor varies affecting the project completion time and cost. In Bhutan, no proper research is conducted which can identify the critical factors influencing project delay. The identification of main factors and providing useful recommendations for the critical factors influencing delay in Bhutan can help the public construction project to prevent and minimize construction delay.

1.3 Research Objectives

The main objectives of this research are

1. To identify factors influencing public construction project delay in Bhutan as perceived by the two main project participants (government engineers and contractors) in Bhutan.

2. To rank the important level of factors influencing public construction project delay in order to identify the critical factors that have greater influence on project delay.

3. To provide useful suggestions and recommendations for the critical factors influencing projects delay in order to prevent and minimize public construction project delay in Bhutan.

1.4 Scope of the Research

The scope of this research covers the current state of the Bhutanese construction industry in Thimphu, capital of Bhutan and other three districts that is Chhukha, Phuentsholing (sub- district) and Paro. In addition, this study will focus on factors influencing public construction project from the viewpoint of contractor and government engineer. Finally, this study will list and rank all the factors from the viewpoint of contractor and government engineer that influence the public construction project delay in Bhutan.

1.5 Research Methodologies

The research methodology is designed to identify the factors that influence the public construction project delay in Bhutan and to rank them accordingly. The research will study the delay factors from government engineer and contractor perception since they are the key participants in the public construction projects in Bhutan. The following are the steps which form the research methodology:

1. Review the whole literatures to find the factors influencing project delay of the construction industry and identify factors influencing construction delay from two main sources. The first source identifies factors from literature of construction management journals, electronic text in project management, international conference papers, text books and websites. The second source identifies factors from survey of seven construction sites and interview with seven government engineers and four contractors. The detail of the literature review is provided in chapter two of this research.

2. List down all the factors from the two sources and group them. After that establish a method and frame the questionnaire for the existing status of construction problem and the factors influencing the construction delay in the form of level of influence using Likert scaling technique. The appropriate questionnaire is designed and this data source used for the face to face interview with the

government engineers and contractors to screen the factors influencing construction delay in Bhutan.

3. Design and develop the questionnaire for the data collection. Resort to distribution of questionnaire to the two key project participants namely government engineer and contractor from four districts of Bhutan. The influencing factors at the pilot area are observed and the viewpoints noted.

4. The collected data and information from sample size of 90 project participants from the questionnaire survey interview technique be analyzed in order to rank the most important factors influencing construction project delay after screening the least important factors setting the datum 3.5 and above. This value measures the level of agreement for the factors from the viewpoint of contractor and government engineer. The methodological tool used to analyze the data is mean score (descriptive statistics) to rank the factors. The methodology is explicitly illustrated in chapter 3 of this research.

5. Providing useful suggestions and recommendations after conducting in depth interview with at least ten experts having minimum of ten years of working experiences in public construction projects in Bhutan.

6. The discussion and conclusion along with the limitations of this study and further research needed are provided in the last section of this thesis.

1.6 Benefit of Research

The expected benefits of this research are as below:

1. To explore existing construction problems and the factors influencing construction delay in Bhutan.

2. To screen and rank the factors influencing the public construction project delay from government engineer and contractor viewpoints.

3. To framing useful suggestions and recommendation that will be useful to minimize as well as prevent public construction project delay in Bhutan.

CHAPTER II
LITERATURE REVIEW

2.1 Introduction

Construction industry requires large capital investments. The construction process can be divided into three phases namely the project definition phase, design phase and construction phase. The project definition phase involves the identification and analysis of project requirements and constraints. The design phase involves translation of ideas into drawings and finally at the construction stage, the design is translated to the physical form. In many of the developing countries, one of the most frequently occurring problems in the construction sectors is time and cost overrun. However the magnitude of delay resulting in time and cost overrun differs depending upon the type of project that is being executed. Before deliberating the other issues related to delay, it is essential to understand the meaning of delay defined by researchers of other countries.

2.1.1 Definition of Delay

In the construction project, every activity is assigned with specific duration of time and the cumulating of all the time specified within each activity delivers the duration of the project.

Majid (2006) defines delay in construction as the late completion of works as compared to the planned schedule or contract schedule. It is the time loss and time over run that occur when the work is not completed as per the planned schedule.

Braimah and Ndekugri (2007) concludes that in the construction industry, the delay

and disruption lead to major source of claim, disputes and litigation because of diverse characteristics of delay.

Momani (2000) perceive that the time required to complete the construction project is frequently greater than the time specified in the contract and these time extensions caused due to many reasons can be defined as delay.

Arditi and Pattanakitchamroon (2005) describes that the time over run in the construction project can lead to many changes in the activities of the project such as late completion, acceleration, increased cost, loss of productivity and even termination of contract and the responsible crew will be experiencing damages and are responsible for the recovery of loss time.

Assaf and Hejji (2005) state that construction delay as the slipping of time over its planned schedule considering the time duration that both the client and constructor agree to complete the construction project.

Hamzah, Khoiry, Arshad, Tawil and Ani (2011) mentions delay as the extension of time or the time overrun to finish the construction work or it is the condition when the construction progress is slower than the planned schedule.

In general, construction project delay always diminishes the growth of construction sector as it is measured as an expensive to all the construction project performer and usually result in clashes and claims between parties and breaking the relationship within the team of construction project management.

2.1.2 Delay in Public Construction Project

The construction delay is the most common phenomenon in the developing economy. The demands for financial investment in the public projects are usually higher in comparison to the private project investment. Despite of massive financial input, the project fails to follow the planned schedule. In most of the developing

countries, the construction projects are characterized by cost overrun and time overrun. The execution of any class of project in the developing countries requires necessary experts for planning, implementation and accomplishing the construction project as per the planned schedule.

Dlakwa and Culpin (2002) studied for the federal government on cost overrun aimed at the public funded construction project in Nigeria and the findings are that the liberation of many government regulations has made the small construction firms to contribute lower beneficial outcome to national problems in Nigeria.

Lim and Alum (1995) carried out study on Singapore construction industry and found that the construction in Singapore is largely dependent on foreign labor with low skill and productivity. The construction productivity in Singapore is lower than 3.1% as compared to the overall economy of Singapore.

The public project consists of three basic components: scope, budget and schedule as shown in Figure 2-1. Scope states details of work that need to be done including quantity and excellence of work. Budget refers to the amount of finance required to complete the work. Schedule refers to the rational sequencing and effectiveness of the work to be performed.

The construction project has to review each proposal for economic viability. The most common methods of evaluation of economic viability are rate of return, payback period, capital recovery or benefit and cost ratios. However, this kind of evaluation may not be applicable to the social development activities like construction of public infrastructures for instance school, highway, hospitals etc. where monetary benefits are less important as compared to the overall benefit to the people.

In the construction industry, the causes of delay and cost overrun are examined by inspecting the data relating to construction projects. The delay in the project due to project team as a result of cost overrun and it is contributed by the factors related to finance and payment provisions, poor contract management, labor and material

shortages, inaccurate estimating, and overall price fluctuations in the market creating inflations in the construction sector.

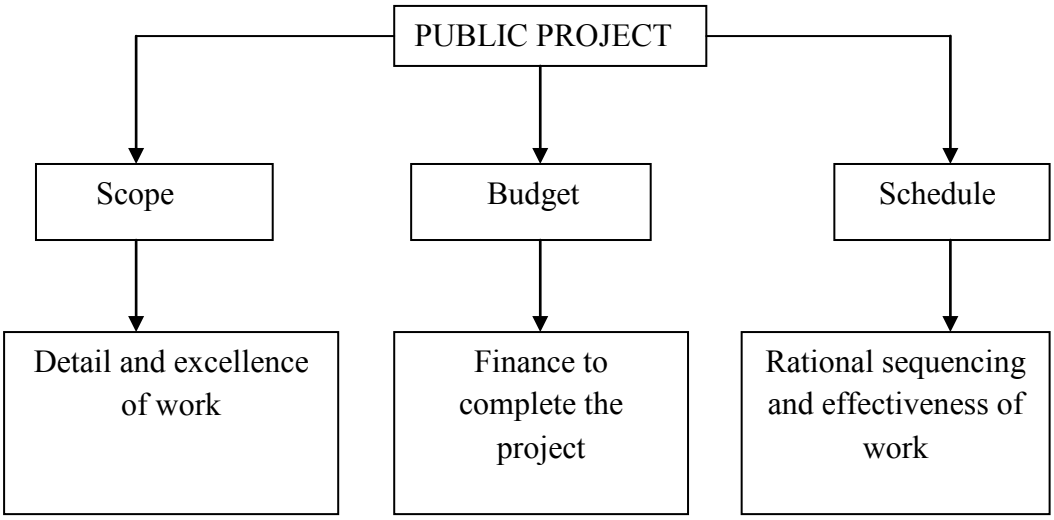

Figure 2-1 Three main elements in public project

Momani (2000) identified that the implementation of sound engineering is required to execute the project within the time period and cost specified in the standard contract document for execution of the project as it is established prior to bidding.

2.2 Types of Delay

Generally the construction project delay can be categorized into three basic types namely, excusable project delay, non-excusable project delay and concurrent delay as shown in Figure 2-2.

2.2.1 Excusable Project Delays

Research carried out by Majid (2006) states that in the construction project, the excusable delays usually do not occur due to the contractor but it usually happens due to an unanticipated occasions. This occurrence is not under the influence of the

contractor. This type of delay can extend the duration of the project and can impact the contractor positively. However the cost overrun may be experienced by the project. The noncritical activities of the project can be hampered with excusable delay and requires close examination.

The excusable delay can be further subcategorized into compensable and no compensable. The compensable excusable delay is usually caused by the client and this can result in time extension and also monetary compensable to the contractor. Majid (2006) further states that the non-compensable excusable delay occur neither due to client or the contractor but it is the result of unavoidable situations like political strikes, unforeseen weather condition, floods, fires etc. The contractor usually exhibits a demonstration that unforeseen situation has affected the critical path of the project activities.

2.2.2 Non-Excusable Project Delays

Majid (2006) also states that this type of delay usually occurs due to inaccuracy in productivity estimate, improper project planning and scheduling, and inadequate site supervision, improper methods of construction and inconsistent supplier and subcontractor. This type of delay does not favor the contractor for the extension of project duration. For instance, this delay can take place when the human resource strength of the project is insufficient and inefficient.

2.2.3 Concurrent Delays

Again Majid (2006) states that the concurrent delay occur when different types of delay overlap at the same time affecting the overall duration of the project. Two or more delays overlap at the same time, the effects are concurrent but may not be identical to each other. The project experience non excusable and excusable delay concurrently, only one time extension can be granted. In a situation when compensable excusable delay and excusable delay without compensation occur concurrently, then the time extension is permitted to the contractor.

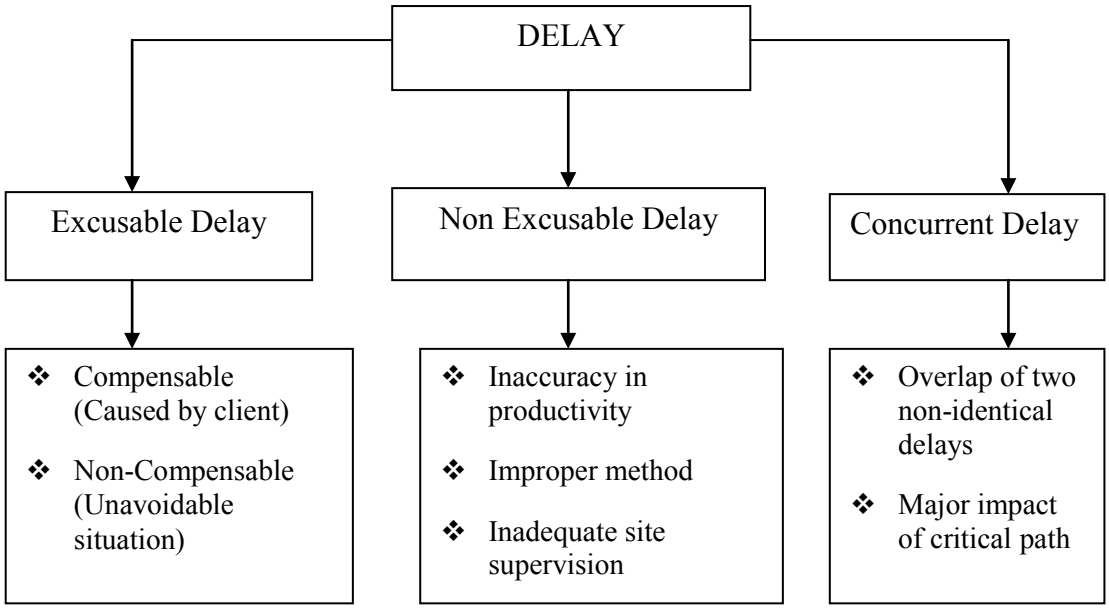

Figure 2-2 Three main types of delay

Furthermore, when two compensable excusable delays arise concurrently, the contractor is eligible for both time extension and damages. This type of delay is usually independent and is not influenced by the delay experienced by other parties. The delay impact is more on the critical path, when employer affects one path and contractor affect the other path of the activities.

2.3 Causes of Delay in Construction

The two main types of causes of construction delay are management factor delay and main site factor delay. These can be described as below.

2.3.1 Management factor Delay

The management factor delay can be attributed to the following factors.

- **Inspection Delay**

The construction inspection is done to ensure whether the construction of the

structure is done as per the approved design. The quality and measurement of each category of construction activity are usually inspected at the site at regular intervals by the client, building inspector, site engineer and even a consultant. However in many cases, the inspection is delayed by the concerned agency which might incur financial loss to the project, resulting in extra payment of interest rate to the bank for the credit borrowed. The inspection delays usually occur when there is shortage of human resource in the organization and when the number of projects to be inspected is in larger number. This increase in the time structure will affect the construction schedule as planned by the contractor.

- **Lack or Shortage of Equipment**

Another research carried out by Sambasivan and Soon (2007) pointed out that many medium and small contractors do not own equipments that are required for the project. They try to manage the equipments by renting with the supplier as and when required. When there are many projects, the equipment is in deficit supply and maintenance of equipment is poor. This can result in the poor performance of the machineries affecting the overall schedule of the project. However poorly maintained equipment also incur higher repair and maintenance cost to the contractor.

- **Stop Work Orders**

In some circumstances, the public construction work get suspended or sometimes terminated without the concern of the contractor. Such interruption of the contract work when happens leads to the delay. The work order gets interrupted sometimes after the work is awarded. There would be also changes in the design which can result in stop work order. Further, the work comes to a standstill if the working environment is in hazardous and unsafe conditions. It also depends on excusable factors of delay.

- **Poor Planning and Scheduling**

Sambasivan and Soon (2007) also states that in a developing country, for instance

the local contractor frequently fails to target the real and feasible “work program” at the stage of planning and scheduling. The finance and payment of completed work can be delayed usually in the public projects. The interference of the government site engineer or the owner causes disruption on the regular schedule. This leads to negotiation and slow decision-making because of the government rules and regulations that need to be adhered. Sometimes impracticable contract time impose on the contractor can affect the project performance.

❖ **Approval of Designs and Drawings**

The final design and approval of drawings consumes time in the preliminary phase of the project. In the process, quality is to be assured and the careful observation be made in each activity to achieve the quality, time has to be compromised. The waiting time for approval of tests and inspection consumes additional time. The other issues like change order adds to, delete from or otherwise alter the work. The types of change order can be change in scope which is the result of agency requesting the design changed as a result of complex ground condition. Moreover, the professional error and omission requested by owner in case the designer has wrongly included the incorrect specifications in the design make the overall work delayed.

❖ **Lack of Communication**

In the construction project, lack of communication within the project performer leads to time overrun and ultimately making the project unsuccessful. From the inception till the final stage of the project, smooth communication improves the motivation levels and processes. In each activity constant flow of information is required for less design error. Poor human resource strength, low quality design, lack of experience of consultant, lack of site assessment and supervision and inappropriate site investigation add delay to project from consultant.

The factors contributing to finance related delay can be listed as the scarcity of fund, high interest rate, inadequate cash flow of contractor and client, delayed

payment to supplier/subcontractors and monthly payment difficulties. Sambasivan and Soon (2007) pointed out contractor related delay as lack of construction experience of contractor, unsuitable construction techniques, unrealistic specification of duration and cost estimate, poor site management and supervision, incomplete project team, unreliable subcontractor and obsolete technology in use.

2.3.2 Main site factors of Delay

Furthermore, Sambasivan and Soon (2007) explained that the contractors in the developing country have less experience to administer the organization in view of the modern management. The administrative and management incapability is thus prevalent in developing countries. In large construction projects, number of sub contract work is under the main contract. If the contractors are capable of handling main site factors, the project succeeds without delay. However, the project get delayed if the subcontractor underperform because of the inadequate experience or capability. The higher the subcontract work, the higher is the chances of delay of project. Some of the factors that contribute to main site factor delay can be stated as below.

- **Material shortage**

Sambasivan and Soon (2007) found that in most of the developing countries, the supply of construction material has to be depended on neighboring countries which are more developed. The shortage of supply of material like sand, cement, stones, bricks, hollow blocks, reinforcement bars etc. can lead to disorder of activities. When the demand for material exceeds the supply, the price of the material is expected to increase. Many times the contractor postpones the purchase of material until the price decrease.

- **Supply of construction labor**

Large number of construction labor supply can have major impact on the project

productivity. For example, in Bhutan most of the construction labors are brought in from India. This leads to dependency in the construction works on foreign labor. Some of the labors are illegal workers and the performance is relatively low as compared to the local labor. The low progress and productivity of the foreign workers have impact on the project progress and efficiency. Sambasivan and Soon (2007) analyzed that the illegal construction labor gets deported by immigration authority resulting in shortage of labor pool. The labor problem in Bhutan from the Bhutanese contractor viewpoint stated that the Indian labor abscond the country without the notice of the authority after taking payments paid in advance by the contractor. Due to this incidences, the contractor most of the time runs under loss and the work gets delayed.

- **Remoteness of the project**

According to Sidawi (2011), the remoteness of the project location is usually one of the critical factors that lack proper transportation facilities, inaccessible without proper communication, human resource and other management problems. The project team also faces several challenges. The modern construction techniques are not applicable and traditional management skills which are usually equipped with lower efficiency and limited technological skills are applied in construction far from being effective add on delay to project.

2.3.3 Literature on past project delay in Bhutan

The time performance of the project executed by the School Planning and Building Section (SPBD), National Housing Development Corporation (NHDC) and some of the District Engineering Sectors from 1998 to 2006 are shown in the Figure 2-3.

As shown, 54% of the school building, 31% of the low income housing and 43% of the office building construction delayed beyond the scheduled date of completion.

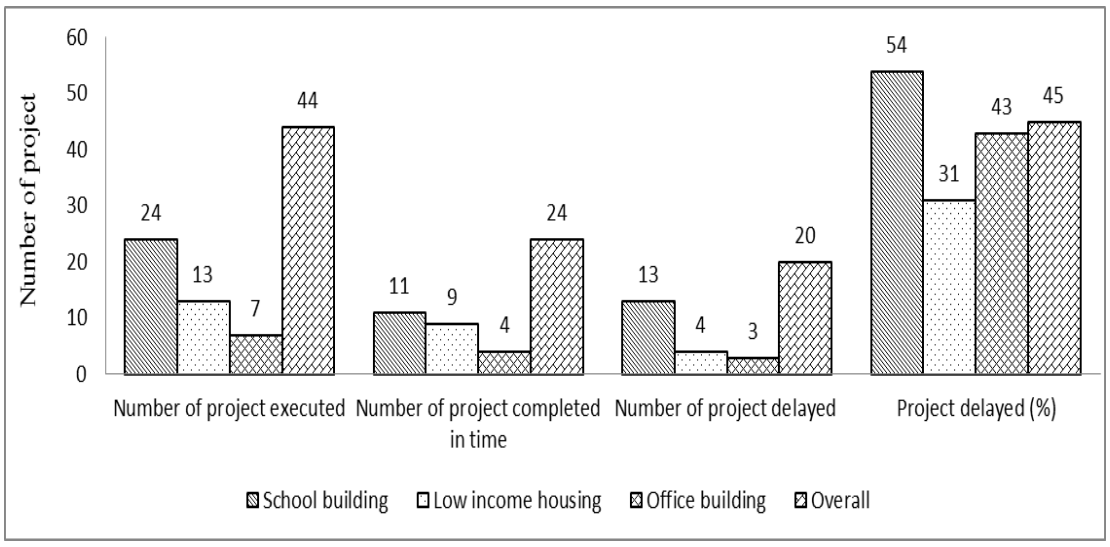

Figure 2-3 Number of project delay in Bhutan, 1998-2006, (source: www.mowhs.bt)

In addition, 71% of school building, 31% of low income housing and 57% of office building construction have undergone cost overrun as shown in Figure 2-4 graphically. The indication of such data as depicted in the figures clearly confirms that project in Bhutan have been experiencing construction delay from earlier period.

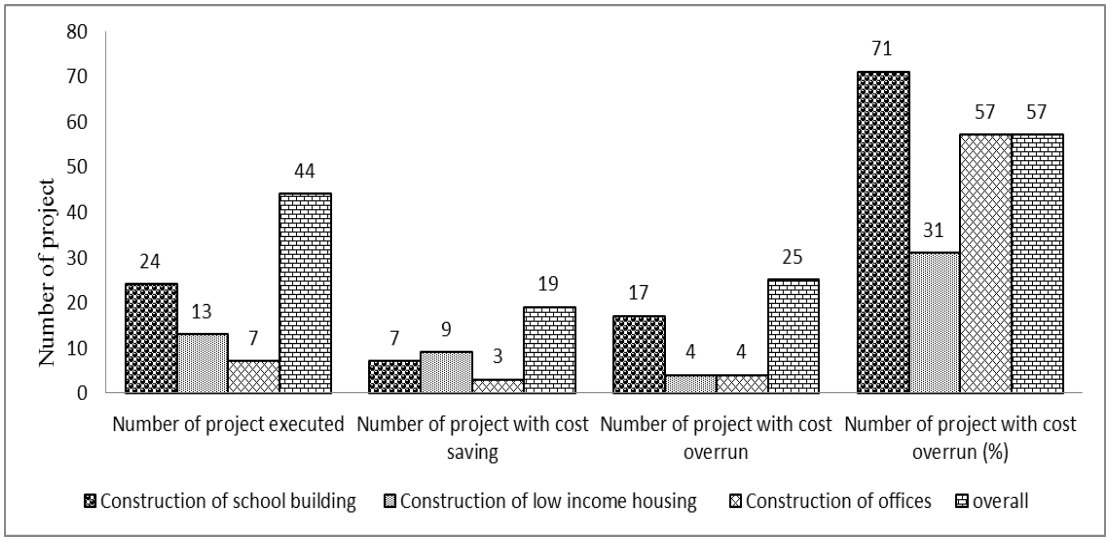

Figure 2-4 Number of project cost overrun, 1998-2006, (source: www.mowhs.gov.bt)

2.3.4 Description of construction industry in Bhutan

The Construction Association of Bhutan (CAB) was first formed in January 25, 2000 and by July 2002, the association established its secretariat in Thimphu, the

capital of Bhutan. The Royal Government of Bhutan established this secretariat to address specific problems and policies of the construction industry at national, regional and international level. The broad objectives of the association are

- To address construction issues and problems in Bhutan
- Track the developmental plan of construction sector and act as a bridge between government and private construction sector.
- Enable need based assessment, identifying the issues and finding solutions
- Promote Bhutanese construction industry for economic development.

The main objective for establishing this organization is to develop and strengthen Bhutanese construction industry. It also performs together with the other concerned construction organization at national and regional level to promote and develop construction standards. CAB is bestowed with the responsibility of representing and advocating for development and up gradation of construction sectors. The participation of the private sector in the public infrastructure projects is essential in order to upgrade the construction industry. However the construction industry in Bhutan is in the developing stage and the construction participants especially the contractors are poorly equipped with technical knowledge and experience. As per the regulations of the CDB and CAB, the contractors are mandated to have certain construction equipment and technical human resource strength, but many of the contractors do not possess these requirements and they even lack proper office setup. These incapable contractors have higher potentials to severely affect the construction performance and result in construction project delay in Bhutan. The enforcement of the rules and regulations is still not stringent that can produce capable and sound contractors. The Royal Government of Bhutan (RGOB) effort in emphasizing the importance of private sector participation has made the contractor even more prominent.

The mega projects like construction of hydro power plant, expressway and suspension bridges are usually taken care by the international agencies and also sometimes by large contractors which aid Bhutan with infrastructure development

project. In rural areas, the construction of irrigation channels and suspension or foot bridges are usually facilitated in the form of community participation with the aid of district authority. The funds for this rural development are usually realized from land taxes, revenues, loan and grants. At district level, most of the public projects are executed by medium and small contractors because of the nature of work.

The CDB, under the Ministry of Works and Human Settlements (MoWHS) is a government agency mainly responsible for issuance of the construction license to contractor. It is a monitoring agency for the registration, classification and categorization of contractors, consultants, engineers and architects. It also performs the track keeping of past contractor's work experience and number of projects executed by each contractor. These databases are applied for promoting the contractor status from small to medium and to large contractor.

Another autonomous agency is the Bhutan Chamber of Commerce and Industry (BCCI) which functions for the private sectors development. The main role and function are policy level intervention, business development facilitation, safeguard and stimulate private sector in Bhutan, institutional capacity building of the private sector, harmonize trade and investment development events, support and facilitate FDI processes and information collection and propagation (www.bcci.org.bt). It also provides forum for discussion, review and exchange of views and ideas for the private sector development. Furthermore, the submission and recommendation are submitted to the government for further necessary actions. BCCI also conducts an induction course for basic construction skills and norms for construction at district and sub district level to improve the quality and performances of the construction workers. The showcase events like construction expo etc. are initiated by this agency as to introduce modern construction materials and also improve the quality of construction.

2.4 Effects of Delay in Construction Project

Every construction project requires completion of task on time within allocated budget along with satisfactory technical performance for safeguarding the quality of

construction. In recent times, however the projects have inclined to time constraint and the capability of delivering project speedily has become a challenge for the contractor in winning over the bid. Disruption and litigations arise when productivity are lost and the third party claims ultimately terminating the contract. Preventive methods for project delays can be identified when the real causes are known to the constructors.

2.4.1 Cost Overrun

Dlakwa and Culpin (2002) concluded in their research that the stage of the construction project can be of two different types, namely the pre-construction stage and the construction stage. The pre-construction stage starts from the conceptual framework to the ratification of the contract document between the contractor and the client. On the other hand, the construction phase continuous from contract up to the construction completion stage. However, the cost overrun is experienced especially when the project is at the final phase of completion.

Mahamid (2012) describes that when the client fails to provide the provisional payments to the contractor, the contractor likely to experience overrun. The numbers of extra items added to the structure which are not within the scope of work, can overrun cost. However proper documentation of the items added needs recording to recover the overrun. Improper estimate also result in cost overrun in the project. The increase in the demand and decrease in supply of construction material make the price inconsistent thereby increasing project cost. However, time overrun occurs if the builder waits until the material price lowers. Sambasivan and Soon (2007) also states that the contract prices generally have a percentage of contingency allowance added to the total direct cost of the project. This allowance is fixed based on the agreement with the contract parties but sometimes disputes occur as to whether the builder is eligible for the extra cost. This situation usually leads to cost overrun in construction.

2.4.2 Conflicts and Disputes

Tazelaar and Snijders (2010) stated that construction industry is often characterized by conflicts and disputes resulting in litigation to resolve the conflict. Behavioral factors such as incompleteness of drawings, poor site communication among the workers, contractual factors like issuing late possession, and delay in the payment at the interim stage due to client and imprecise terms and conditions of contractual documents could delay the construction process resulting in conflict among project party. The inefficiency of the contractor to precede the work and late instruction from the designer and consultants would also result in disputes as pointed out by Jaffar and Tharim (2011). Kathleen (2003) also outlines that lack of resources like labors, materials, equipment and unrealistic project duration can delay project inviting the conflict situation.

In Bhutan, the productivity of the private and public construction project is poor and usually attributed to such problems. There is no proper harmony in the performance of the project despite of awareness on the significance of project productivity and its benefits by the experts. In many situations, the duration of the similar public works is fixed based on the past similar work experience. Many critical factors like project location, availability of resources etc. are not considered during this stage which in turn delays the project, arising conflicts within them.

2.5 Construction industry in developing country

The construction sector is the highest contributor to the socio economic growth especially to Gross Domestic Product (GDP) in many developing countries and concerns always exist for the better productivity in the sector. The problems in all the construction industries are common but are more susceptible in developing country due to general inability to deal with critical issues. The development of construction industry is a deliberate process for improving the efficiency and effectiveness of engineering enabling to promote economic and social development (CIB, 1999). In the developing countries, owing to the magnitude and complication involved in the

projects, many of the major construction work are usually beyond the capability of the existing human resource and technology.

Turin (1973) found that the matrix of construction industries in developing countries are large and complex and can be executed only by foreign consultants and contractors. Edmonds and Miles (1984) also clarified the roles of foreign contractors that they are prominent when the scopes of the construction work are complex in third countries. Drewer (1980) acknowledged that capacities of the local firms are advanced when the developing nation involves domestic contractor in the construction projects.

Another research carried out by Abbott (1985) focusing on construction technology transfer in developing countries investigated and found that the information on the usage of technology by the foreign firms during project execution disappears when the project is completed. This creates a dependency situation for the developing nations even when similar project is to be executed at later stages. The capturing of knowledge items and information requisite an exploration for building a self-sustain construction industry. Conducting proper research to explore and capture the knowledge and screening of knowledge items can make the construction industry independent on long run. Strassman and Wells (1988) stated in their study that many countries like Korea and Japan initiated infrastructure development activities with assistance from the US counterpart in capturing knowledge from the US expert. In subsequent projects, similar knowledge is applied in construction projects finally building their position as an independent and well-developed nation in Asia today. The quality of the work is an essential element for the viability and client contentment. For quality assurance among many quality certifications, ISO 9000 is more certified for construction work and these are implemented by many clients and contractors for quality management and the project to experience the benefits of quality construction. However, in most of the developing countries, qualities of civil works are compromised in view of quality assurance cost consideration.

2.5.1 Occurrence of delay from project participants

Generally construction project participant comprises of three main project teams specifically the owner/government engineer, contractor and consultant. The factors affecting project delay is listed as shown in Table 2-1.

Table 2-1 Occurrence of construction delay from project participants

Rank	Owner	Contractor	Consultant
1	Type of contract award	Late payment by client	Type of contract award
2	Unsuccessful planning and scheduling by contractor.	Slowness in review and sanction of drawings	Lack of man power
3	Inefficient labors	Alteration by owner during work	Unsuccessful planning and scheduling by contractor
4	Unskilled human resource	Delay in material delivery	Late payment my client
5	Changes in order during construction by owner	Changes in documentation	Inefficient labors
6	Unfavorable weather condition during construction	Lack of budget by contractor	Lack of incentives for completed work before contract duration.
7	Insufficient site work force	Suspension of work by owner	Alteration of specification by owner during construction
8	Categories of building agreement (turnkey)	Lack of budget for contractor	Ineffectual fines for time overrun

Table 2-1 Occurrence of construction delay from project participants (continues)

Rank	Owners	Contractors	Consultants
9	Lack of effective site organization by contractor	Delay in approval of drawings by consultant	Hot climate delays construction work
10	Clash on subcontractor planning and scheduling.	Delay in decision by owner	Low technical productivity of workers of contractor.

(Source: Saudi and Sadiq, 2006)

They are the key people who are mainly responsible for the productive performance of the project. As shown in Table 2-2, the engineers from the government sectors are responsible from the stage of contract award till the handing taking over of the project. The consultant is responsible for the proper site investigations and detail designing and drawings of the project and finally the contractor is responsible for the execution of the project from inception till completion. Project delay mostly arises due to the poor performances of the contractor and other factors related to low technical knowledge and improper planning and scheduling. The main weakness of the client resorting to project delay is the frequent change order and the insufficient financial capability. Furthermore, many consultants fail to accomplish proper site investigations including improper detailing in drawing.

In the public construction project, the present practice of the bid evaluation system in Bhutan considers technical and financial capability of the contractor in one part and the bid amount on the other part creating 60% and 40% respectively. The contractor who scores the maximum point during the evaluation wins the contract. The evaluating committee is responsible for the evaluation of every bid with recommendations which are further reviewed and approved by the tender committee. However some drawbacks are observed on this evaluation system as below.

The guideline does not consider the class of contractor specified by the Construction Development Board (CDB). The technical capability is evaluated based

on contractor past similar work experience. This criterion is not applied to new bidder who does not have similar work experience.

The regulation of this evaluation system contains the clauses stating that the contractor requires evidence (certificate) of similar work experience and the financial statement from bank in order to confirm that they have adequate finance and technical human resource to execute the project. However the legitimacy of the documents is not true sometimes. Hence, the submission of uncertified documents at times makes the contractor to win the work. Practically, the contractor generally lacks finance and human resource to execute the project on time causing project delay in Bhutan.

Bhutan still faces deficit of technical manpower at district level where multiple unplanned construction works are carried out like construction of roads, rural water supply, irrigation channel, culverts and suspension bridges. When different works are carried out at one district, in most of the cases one site engineer manages more than two works located moderately at different locations. This develops inefficiency in site engineer supervision towards regular site inspection.

Table 2-2 illustrates the factors identified from the literature review for the past construction project delay in developing countries. In addition, it also illustrates the past public construction project delay occurred from February 2010 to August 2012 from national newspaper of Bhutan.

From this comparison, it is more precise to identify the factors from both the source for this study. After the identification from these two sources, the factors are compared to identify specific and important factors in line with the geographical location of the country which is one important aspect that requires attention which affects construction projects. As Bhutan is a land locked country surrounded by two large world economy namely china and India, the construction project are also affected by excusable delays which requires special solutions to solve.

It is observed that change in material specification during construction, slowness in directives from the government, remoteness of the project location which is not considered as important problem during finalizing project duration. Shortage of foreign currency, for instance the Indian rupee, blockage of access road due to unfavorable weather condition (landslides), lack of basic construction material like cement and brick, abscond of construction labor from the site which results in shortage of foreign labor in the construction project are some of the distinctive factors that influence to construction delay in Bhutan. It is anticipated that there are still more project delay occurring in Bhutan affecting by other specific factors which are not covered by Bhutanese media.

Table 2-2 Comparison of factors influencing project delay from literature review and Bhutan

Factors influencing delay from Literature Review		**Factors influencing delay from Kuensel (national newspaper of Bhutan)**		
Country	**Factors**	**Projects**	**Year**	**Factors**
Nigeria	• Difficult to finance the project by client • Inadequate site inspection	Construction of electric tower in Trashigang	February 2010	• Lack of finance from contractor
Singapore	• Design change by client	Construction of Centenary park in Mongar	August 2010	• Inefficient contractor • Improper planning and scheduling
Zambia	• Lack of finance by client	Construction of Bathpalathang domestic airport in Bumthang	August 2010	• Change of specification during construction

Table 2-2 Comparison of factors influencing project delay from literature review and Bhutan (continues)

Factors influencing delay from Literature Review		**Factors influencing delay from Kuensel (National newspaper of Bhutan)**		
Country	**Factors**	**Projects**	**Year**	**Factors**
Pakistan	• Site staff technically unsound	Renovation of Lingshi Dzong	October 2010	• improper construction material
India	• Late payment of bill • Low labor productivity • Government regulations	Bridge at Amochu River	December 2010	• Improper planning and scheduling by contractor • Inaccessibility to project site
Dubai	• Delay in approval of drawings • Improper planning	Gelephu domestic airport construction	April 2011	• Unfavorable weather • Lack of Indian currency
Saudi Arabia	• Lack of finance • Lack of construction material	Construction of Dungsam cement plant at Nganglam	September 2011	• Shortage of labor • Blockage of access by land slide
Vietnam	• Low technical knowledge	Construction of Tech. park	February 2012	• Delay in labor supply

Table 2-2 Comparison of factors influencing project delay from literature review and Bhutan (continues)

Factors influencing delay from Literature Review		**Factors influencing delay from Kuensel (National newspaper of Bhutan)**		
Country	**Factors**	**Projects**	**Year**	**Factors**
Malaysia	• Lack of construction labor • Contractor improper scheduling	Construction work at Bajothang	March 2012	• shortage of cement supply • Abscond of labor from construction site
Hong Kong	• Site allocation failure • Unforeseen ground condition	Construction of longest bridge in Samtse-Phuentsholing highway	March 2012	• Inaccessibility to site • Shortage of regular construction labor
Jordan	• Frequent revision of design • Climatic condition • Lack of capital of client	Construction of head quarter meeting hall at Shumar and primary school at Khaling	May 2012	• short supply of cement • Shortage of bricks
Thailand	• Shortage of site worker • Change order • Slow permit by government	Construction of Nangar-Ura highway by two years	August 2012	• Lack of material

2.6 Summary and conclusion

The relevant review of literatures is done on the factors influencing the construction project delay from Bhutan and other developing countries which provides the information and guidelines for the study. The subtopics covered in this literature review are as follows.

- The definition of delay from different researcher is stated in order to understand the exact meaning of construction project delay. The delay in the public construction in developing countries are reviewed and observed that different country have unique factors that contribute to construction project delay.

- The concept of types of delay namely, excusable project delay, non-excusable project delay and concurrent delay are important to understand for this research.

- The review on causes of delay like management factor delay and main site factor delay affecting the performance of the construction industry is summarized.

- Literature on past project delay in Bhutan from online newspaper and other available sources have been referred to support this research thereby understand the importance of this study. Further these sources could also provide the data and information about the past project delays of different public projects in Bhutan which have significant problem on the project cost and time overrun. The required description on the Bhutanese construction industry and the agencies involved and their responsibilities explained.

- The factors under each classification like material, construction labor, equipment, contractor, client, consultant and external factors are listed and the review purchased to scope the research for more specific problems in Bhutanese construction industry. Accordingly, the research methodology is designed to identify the factors that influence the public construction delay in Bhutan and to rank them after screening. Comparatives studies are also done from the viewpoint

of contractor and government engineer to compare the factors independently from seven classifications that result in project delay in Bhutan.

CHAPTER III
RESEARCH METHODOLOGY

3.1 General

The detail steps for the research methodology are discussed in this chapter. For the valid and reliable research program, the methodology is designed systematically with proper planning and scheduling. The methodology initially starts with the literature review, data collection and discussion and conclusion. Figure 3.1 represents the framework for the methodology of the research which consists of the following steps and analysis.

3.2 Identification of factors influencing project delay in Bhutan.

The identification of factors for the study of project delay in Bhutan is from the two sources. The first source identifies factors from literature of journals and e-books. The second source identifies factors from survey of seven construction sites and interview with seven government engineers and four contractors.

3.2.1 Literature Review

The review of the literature includes identification of factors influencing construction delay of projects from past studies. The findings of the literature review are gathered from international journal papers, internet, e-books in construction project management, construction websites, online library, national and international conference papers. Furthermore, to develop appropriate questionnaire with specific factors after understanding the internal and factors in context to region and geographical location of the place while inspecting the construction sites and in depth interviews are conducted.

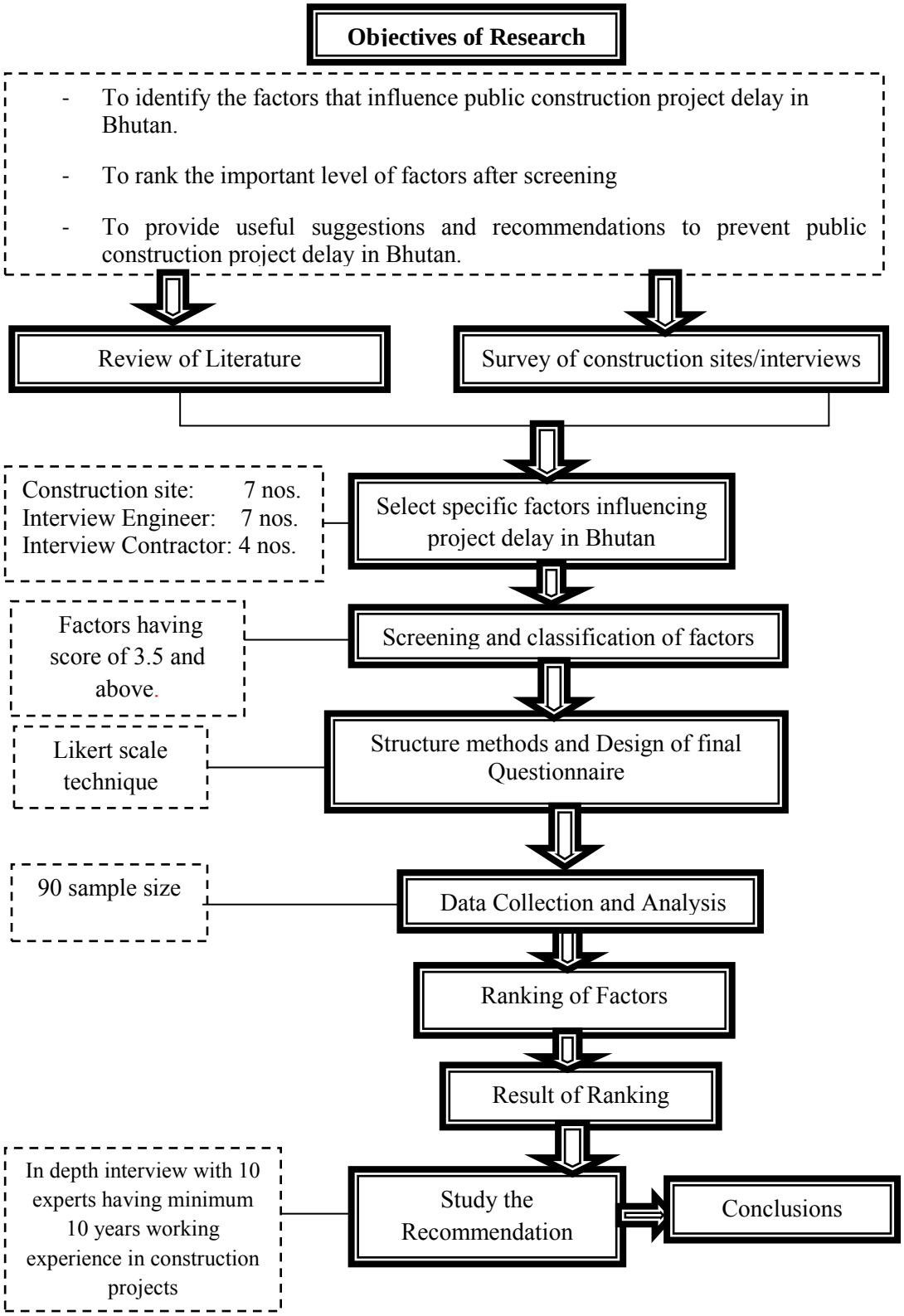

Figure 3-1 A framework for Research Methodology

Table 3-1 Summary of factors influencing construction project delay from the past Research

Country	**Factors influencing construction project delay**	**Country**	**Factors influencing construction project delay**
Nigeria	• Difficult to finance the project by client • Inadequate site inspection	Saudi Arabia	• Lack of finance • Lack of construction material
Singapore	• Design change by client	Vietnam	• Low technical knowledge of project team
Zambia	• Lack of finance by client	Malaysia	Lack of construction labor • Contractor improper planning and scheduling
Pakistan	• Slowness in release of bill and monthly payment difficulties • Site staff technically backward	Hong Kong	• Site allocation failure Unforeseen ground condition
India	• Late payment of bill • Low labor productivity • Government regulations	Jordan	Frequent revision of design • Climatic condition • Lack of capital of client
Dubai	• Delay in design and approval of drawings • Improper planning and scheduling	Thailand	• Shortage of site worker • Change order • Equipment allocation problem in construction

3.2.2 Survey of construction sites and interview

To identify more specific factors influencing project delay in Bhutan, seven construction sites were visited and surveyed from the four districts of Thimphu, Paro, Chukha and Phuentsholing. However, out of seven sites, three sites cover the area within Thimphu and the rest from three other districts. In addition, seven government engineers and four contractors were interviewed to find important and specific factors influencing project delay in Bhutan. During the interviews, it was noticed that the limitation of reserve of foreign currency (e.g., Indian Rupee) is affecting the overall economy of Bhutan. The import of construction material and labor is experiencing delay because of the sudden change for exchange rate of Indian and Bhutanese currencies which had equal value before. Moreover the labor working in Bhutan needed to be paid in rupee, failing to do so made labor to work in another project.

3.3 Questionnaire Design

The format of the questionnaire is designed based on the objectives of this research. The format used is similar for all the respondents namely, government engineer and contractor because the study is focused on factors influencing the public project delay in Bhutan. The questionnaire is designed into two sections consisting of section A and B. Section A describes the background of each respondent and the construction company. These includes the respondent's name, position, number of working experience in construction sector, the type and number of public construction projects executed. This section also gives miscellaneous details like the contact and email address of the respondent. Mention of the company profile describes the number of years for company executing the public projects and types of company like private or public. The position of the respondents from government sectors starts from chief engineer, executive engineer, deputy executive engineer, assistant engineer and even building inspectors. At the district engineering cell, the district engineer manages the overall administration of public construction projects.

Section B comprises a total of fifty eight factors that are grouped under seven classifications namely, material, construction labor, equipment, contractor, client (government engineer), consultant and external factors that influence the public construction delay from the viewpoint of government engineer and contractor.

The section requires the respondent's to indicate the level of agreement for the listed factors associated with the public construction projects. The degree of agreement of each factors are scaled using Likert scaling techniques. Out of five scales, each scale represents the level of influence, frequency of occurrence and importance of factors on construction project delay and are denoted by 1-very weakly agree 2-weakly agree, 3-moderately agree, 4-strongly agree and finally 5-very strongly agree. Each scale represents the level of influence as shown in Table 3-2.

Table 3-2 Likert scale table to identify the level of agreement for factors influencing construction project delay in Bhutan

Level of Influence	Scale
Very Strongly Agree	5
Strongly Agree	4
Moderately Agree	3
Weakly Agree	2
Very Weakly Agree	1

3.4 Data Collection

For the collection of data, one of the most reliable techniques is the questionnaire survey as primary source applied in this research. The framework of questionnaire is developed from related literature review and survey of construction site along with face to face interviews with construction participants in Bhutan. The format of the questionnaire is designed in line with the objective of the research. The questions are framed in the form of open- end question and close end question. Multiple strategy with check boxes are designed for respondent and expert to answers as shown in appendix B. The distribution of questionnaire to the two key project participants i.e.

contractor and government engineer including project managers from four districts of Bhutan were employed.

The construction site investigations, meetings and interviewing the construction participants both from public departments and private company are done for the data collection exercise. The collected data and information from sample size of 90 project participants from the questionnaire survey and interview technique are analyzed in order to rank the most influencing factors influencing construction project delay in Bhutan. The ranking is done in this study to identify and segregate the factors having higher influence to project delay. In addition, useful suggestions and recommendations are provided for the higher influencing factors for resolving and reducing problems related to delay in Bhutanese construction industry.

The factors are screened having scored of 3.50 and above as this value determines the level of agreement for the response of respondents. Subsequently, in-depth interviews along with the questionnaire for the useful recommendations are conducted only to the experts who play an important role in the project and have working experiences at least of ten years or more. The pilot area chosen for the data collection will have more scope to Thimphu, capital city of Bhutan since the construction activities are of higher frequency within the region. The data collection is divided into two categories of respondents as shown in Figure 3-2:

1. The data from the questionnaire and interview with the contractors working for the public project.

2. The data from the questionnaire and interview with the government engineer involve in the executing the public project.

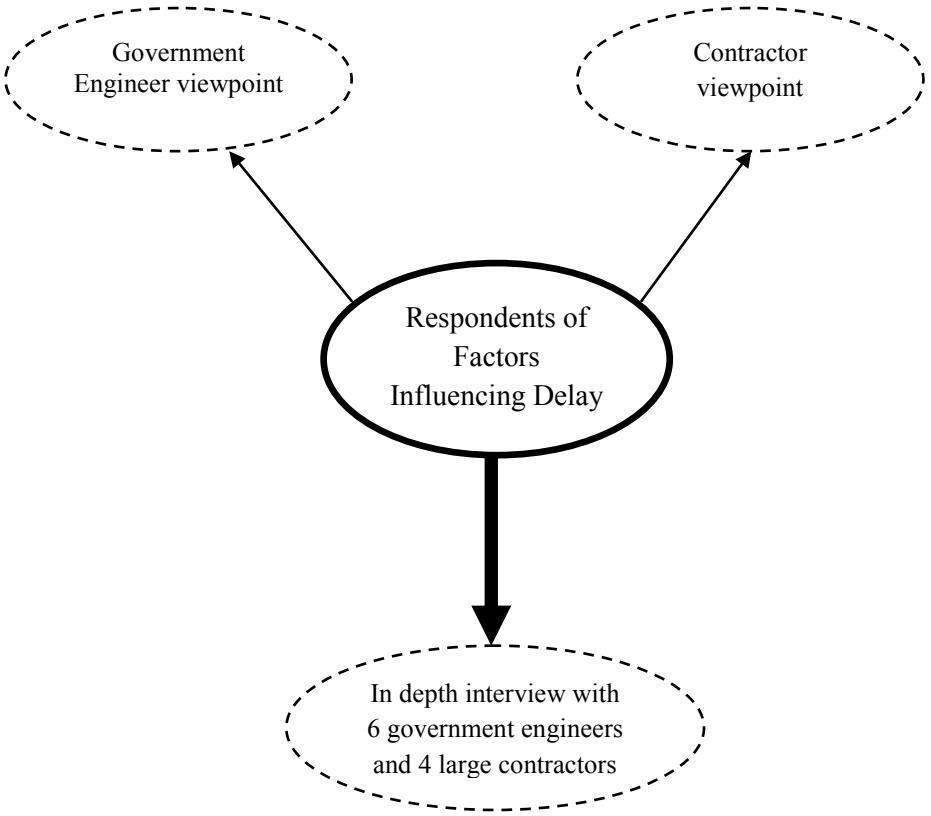

Figure 3-2 Scope of interview (project participants)

3.4.1 Method for analysis

The data analysis method applied for analyzing data sets for screening the factors influencing construction project delays comprises of descriptive statistics. The descriptive statistics include mean, standard deviation, coefficient of variation, frequency index; relative importance index and t- test using Statistical Packages for Social Science (SPSS). However for the final screening, mean value is used to rank and identify the critical factors for final recommendation. These tools are applied to analyze the data obtained from the respondents.

Table 3-3 Sample design for preliminary ranking of factors

Factors influencing public construction project delay in Bhutan	Scale					Mean	Rank
	Very Weakly Agree				Very Strongly Agree		
	1	2	3	4	5		

.

Table 3-4 Sample design for preliminary ranking of factors from two project participants

No.	Factors influencing public construction project delay in Bhutan	Government Engineer		Contractor	
		Mean	Rank	Mean	Rank

3.4 Data Analysis

Based on the literature review, data were analyzed by mean, standard deviation and relative importance index. Raz and Micheal (2001) use the overall average of mean to analyze the importance index of benefits and uses of tools for the risk management. Aiyetan (2010) uses the mean and standard deviation for analysis of data to study the project delivery time in South Africa. Assaf and Hejji (2006) have also applied RII for the analysis of data to study the causes of delay in large construction projects.

❖ **Mean**

For the analysis, the raw data collected from the research questionnaire are subjected to statistical analysis by means of computer software called Microsoft Excel 2010. The lists of factors are evaluated by the respondents by rating the Likert scale and this requires the calculation of mean and standard deviation for the data analysis. The mean value is computed by the summation of scores of each respondent divided by the number of respondent. However the responses of the questionnaire from the

respondents are subject to finding of the average value and standard deviations through the use of the following mathematical equations for each category as shown in Equation 3.1.

$$\bar{X} = \frac{\sum x_i}{N} \quad \text{.....3-1}$$

Where $\bar{X}$ is the average value of dimensions, x_i is the each score of the dimension and N is the total number of respondents score.

The rating for the mean scale to identify the level of influence is used to analyze the data from the survey questionnaire. The classification of factors based on the level of influence to construction project delay in Bhutan is ranked using the five expressions defined in significance intervals 1.0 (SPSS, AMOS, 2012) as shown Table 3-5.

Table 3-5 Expressions for mean value

Mean Score Interval
1.00≤ 'very weakly agree'≤1.49
1.50< 'weakly agree' ≤2.49
2.50< 'moderately agree'≤3.49
3.50< 'strongly agree'≤4.49
4.50< 'very strongly agree'≤5.00

❖ **Standard Deviation**

Another method used to analyze the data and compute for each to check nearness of sets of data from the mean of all the sets is standard deviation as shown in Equation 3-2. It shows the relationship with the mean of each data set. The closeness of data to

the mean represents uniformity of data with smaller value of standard deviation. The far-off of data scores from the mean represents the variance in the score with higher value of standard deviation. In other words, if the scores of every data are equal, then the value of standard deviation is zero.

$$\sigma = \frac{\sum (x_i - x)^2}{n - 1} \quad \text{.....3-2}$$

where x_i is the score of each respondent, x is the mean, N is the total number of respondents and i is 1,2,3,4,5,6……

❖ Coefficient of Variation

The coefficient of variation is also calculated to measure the dispersion of data points. The coefficient of variation is denoted by the ratio of standard deviation to the mean. The coefficient of variation was found to be useful for comparing the degree of variation from one data set to another. The Coefficient of Variation (CV) is denoted by the formula as illustrated in Equation 3-3.

$$CV = SD/M \quad \text{.....3-3}$$

Where SD is the standard deviation and M is the mean of the each data set. The value of the coefficient of variation ranges between 0 - 1. If the coefficient of variation is closer to 0, the greater is the uniformity of data. Similarly, if the value of coefficient of variation is closer to 1, the variability of data is greater.

❖ Frequency Index

The data collected is also analyzed by statistical techniques like frequency index. The data analysis by frequency index is used to rank the factors of delay based on the

frequency of occurrence as cited by the participants. It is calculated as shown in Equation 3-4.

$$\text{Frequency Index (F.I.) (\%)} = \sum a\,(n/N)*100/5 \quad \text{.....3-4}$$

Where "a" is the constant expressing weighting given to each response (range from 1 for very weakly to 5 for very strongly), "n" is the frequency of the responses and N is the total number of responses.

The rating for the FI scale to identify the level of influence is used to analyze the data from the survey questionnaire. The classification of factors based on the level of influence to construction project delay in Bhutan is ranked using the five expressions defined in significance intervals of 0.8 (Kazaz and Ulubeyli, 2007) as follows.

Table 3-6 Expressions for FI value

FI Score Interval
1.00≤ 'very weakly agree'≤1.49
1.50< 'weakly agree' ≤2.49
2.50< 'moderately agree'≤3.49
3.50< 'strongly agree'≤4.49
4.50< 'very strongly agree'≤5.00

❖ **Relative Importance Index**

The computation of Relative Importance Index (RII) includes allocation of numerical scale to represent the level of importance of factors applying Likert scaling technique with a five scale range of 5 (very strongly agree) to 1 (very weakly agree) as indicated in the Likert scale table above. The Relative Importance Index (RII) is the ratio of average of scores to the maximum score. Relative Importance Index

expresses the relationship between different factors in terms of percentage. It is calculated using the formula as shown in Equation 3-5.

$$RII = \frac{\sum^{5}_{i=1} W_i * X_i}{\sum^{5}_{i=1} X_i}, (1 \leq RII \leq 5) \quad \text{.....3-5}$$

Where RII: Relative Importance Index

W_i: is the score given to each factor ranging from 1 very weakly agree to 5 very strongly agree.

X_i: represents the percentage of respondents scoring; and

i: represents the order for number of respondents.

The attribute is arranged in the ascending order of ranks, the attribute with highest RII or scale 5 indicates that it has the maximum impact on the project delay while the attribute with the lowest rank or scale 1 represents that it has least impact on project delay. The rating for the RII scale to identify the level of influence is used to analyze the data from the survey questionnaire. The classification of factors based on the level of influence to construction project delay in Bhutan is ranked using the five expressions defined in significance intervals of 0.8 (Kazaz and Ulubeyli, 2007) as illustrated in the Table 3-7.

Table 3-7 Expressions for RII value

RII Score Interval
1.00≤ ‘very weakly agree’≤1.49
1.50< ‘weakly agree’ ≤2.49
2.50< ‘moderately agree’≤3.49
3.50< ‘strongly agree’≤4.49
4.50< ‘very strongly agree’≤5.00

3.6 Reliability Test

A test to check the internal consistency of data is required using reliability test which is calculated using the formula shown in Equation 3-6. Cronbach's alpha is the test to investigate the internal consistency of the data. This face validity discuss to the statement that the validity of the data can be observed.

$$\alpha = k/k\text{-}1[1- (\sum\sigma^2_i/\sigma^2_i)] \quad \text{.....3-6}$$

Where k: number of factors or components

σ^2: variance of scores of each component

$\sum\sigma^2_i$: total variance

As tabulated in Table 3-8, Nunaly (1978) explains the Cronbach's alpha test for reliability to expose an interpretation of the test results.

Table 3-8 Interpretation of Cronbach's alpha values (Nunaly, 1978)

Values	Reliability
< 0.5	Poor
0.5 to 0.7	Sufficient
> 0.7	Good

3.7 Sample size

In order to obtain the required size of the sample for the data collection, the simplified formula provided by Yamane (1973) is used as shown in Equation 3-7. This formula is computed to calculate the sample size for 85% confidence level because the data obtained from the government engineer and contractor was based on the opinion and perceptions.

$$n = \frac{N}{1+ N (e)^2} \quad \text{.....3-7}$$

where n: Sample size (Government engineer and contractor)

N: Population size (the whole of contractor and government engineer)

e: The error of sampling (10%)

As shown in the Table 3-9, the number of population that studied are more than 100000 as mentioned in order to get the quantity of sample that represented all the population with maximum of 5% error, a total of 400 surveys had to be carried out.

Table 3-9 Yamane table to select the sample size

Size of Population	**Sample Size (n) for Precisions (e) of:**			
	±3%	**±5%**	**±7%**	**±10%**
500	-	222	145	83
600	-	240	152	86
700	-	255	158	88
800	-	267	163	89
900	-	277	166	90
1,000	-	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100

Table 3-9 Yamane table to select the sample size (continues)

Size of Population	Sample Size (n) for Precisions (e) of:			
	±3%	**±5%**	**±7%**	**±10%**
100,000	1,099	398	204	100
>100,000	1,111	400	204	100

However, in this research due to time and budget constraints, it was decided that for the sample size calculation, a precision of no more than 10% will be use. As a result, the sample size for this research came out to be at least 90 from both contractor and government engineer as shown in the Table 3-10.

Table 3-10 Sample size for government engineer and contractor in Bhutan

Total number of Government Engineer	**Total number of private contractor**	**Grand total**	**Estimated sample size**	**Responded Sample Size**
2478	2656	5134	115	90

3.7 Independent sample T- test analysis

The independent sample t- test is used to compare the mean score in a statistics test between two groups of sample set. The independent sample t- test and paired sample t- test are the two different kinds of t- test. The paired sample t- test is determined by comparing in the same sample of respondent with value of mean in two different events.

Since the data is collected from two respondents in this study namely the government engineer and the contractor, independent sample t- test is an appropriate method to compare the different mean score of both the respondents.

The two dependent variables groups in this study are the government engineer and the contractor. In addition, the dependent variable consists of 58 derived from factors influencing the construction project delay in Bhutan. Applying Statistical Package for

Social Sciences (SPSS) programming for calculating independent t- test, we can assume the hypothesis of samples in the following manner.

Ho: m1 = m2 denotes there is no significant difference in the response of contractor and government engineer on main factors influencing public construction project delay in Bhutan.

H1: m1 ≠ m2 denotes there is significant difference in the response of contractor and government engineer on main factors influencing public construction project delay in Bhutan.

However, before the analysis of data set, it is important to check the homogeneity of variance assumption. This assumption states that value of variance of dependent variable should be the same with other group being compared. It is important to note that this homogeneity assumption is checked by Levene's' test. The assumptions is not violated if the significant score is higher than 0.05 and we use the value of equal variance assumed. Likewise, the assumption is violated if the significant level is equal to or lowers than 0.05. Still, the SPSS provides an alternative t – value of Equal Variance not assumed.

Therefore, the perception difference between the government engineer group and contractor group are retrieved by observing Sig. (2 -tailed) column under the t- test for equality of means. The result concludes that if the significant value (2- tailed) is equal or less than 0.05, it confirms that there exist a difference in mean scores of two group perceptions. In contrary, if the score is higher than 0.05, it confirms that there exist no significant difference between the perception of the two group of respondents.

3.8 Technique for study recommendation

In order to draw recommendation for the critical factors responses are provided by ten experts comprised 6 from government sector and 4 from the private sector. Further after the ranking, top three factors from each of seven classifications are segregated.

Each of these factors is discussed with the expert in the form of in-depth interview. The option is also provided in the form of recommendation sheet for the respondent who wishes to provide in writing. The similar recommendation from each expert is segregated by frequency as shown in Table 3-11. The suggestions having the frequency of three and above are used for the final recommendation which would be useful to minimize and prevent the construction project delay in Bhutan.

Table 3-11 Technique for final recommendation to prevent construction project delay

Classification	Critical Factors	Recommendation	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency

3-10 Conclusions

This chapter outlines the details of the methodology applied for the research. In order to achieve the objectives of this research, the study has two main portions. First, the identification of the important factors that influence construction project delay from literature review and expert interview. The interviews were carried out in order to add specific and important factors in context to the topography, region and culture of Bhutan. All the factors are identified prior to framing the final questionnaire for the data collection. For the data analysis, methods related to descriptive statistics like mean, standard deviation and relative importance index are used to rank the factors and interpret the result. The t -test is computed using SPSS to find the factors having similar and significant difference in the perception of responses from the government engineer and contractor. The factors with mean value of 3.50 and above are used for ranking.

CHAPTER IV
DATA COLLECTION FOR CONSTRUCTION PROJECT DELAY IN BHUTAN

4.1 Background of construction industry of Bhutan.

Bhutan is a developing and mountainous country and about 72% of the country is covered by mountains. It is a small landlocked country with an area of 38,394 sq. km and a population of 700,000 approximately. Bhutan is surrounded by China in the north and India in the south west as shown in Figure 4-1. The construction industry in Bhutan has a major contribution to Bhutan Gross Domestic Product (GDP) and it plays a major role in economic development of the country. The infrastructure projects have increased rapidly in Bhutan including construction of Mega hydroelectric projects which is the one of main source of economy. Presently Bhutan has diplomatic relationship with 53 countries in the world and many international funding agencies like World Bank (WB), Asian Development Bank (ADB) and Japan International Cooperation Agency (JICA) assist the construction projects in Bhutan.

Figure 4-1 Map of Bhutan and its neighboring countries.

The frequency of public construction projects are at greater number in Thimphu as shown in Figure 4-2. As shown, the construction of the major public buildings still practices age old traditional methods of using bamboo planks for scaffoldings activities which requires longer time for joining and fixing to the structures. In addition, due to narrower road width, the traffic congestions affects the timely delivery of materials at the construction sites.

A brief description on the nature of construction industry in Bhutan in terms of its characteristic of construction, rules and regulations of the public sectors and issuance of construction license and registration process is expressed as below.

Figure 4-2 The construction in capital city

As of now, Bhutan does not have an internationally accepted standard form of construction industry. Technically, the construction industry in Bhutan features local construction materials that are safe for the local use but however local supplier imports the construction materials. The construction of the major public projects like highway, hydro power project, bridges, hospitals, colleges, ministries and other infrastructures need all time assistant from India from where the import of heavy

machineries, materials, labor, designers and other construction related services including logistics support are sought and delivered.

In Bhutan, the engineering services provided at the district level are usually the construction of irrigation channels, rural water supply, feeder road, mini hydro power and industrial plants, telecommunication facilities and construction of community schools and other basic public utilities. As explained earlier, the CDB categories the contractor into large, medium and small classes and at the district works are executed mostly by local contractors. As shown in Figure 4-3, CAB intervenes in the construction issues and problems related to contractors and address the issues to government for solutions.

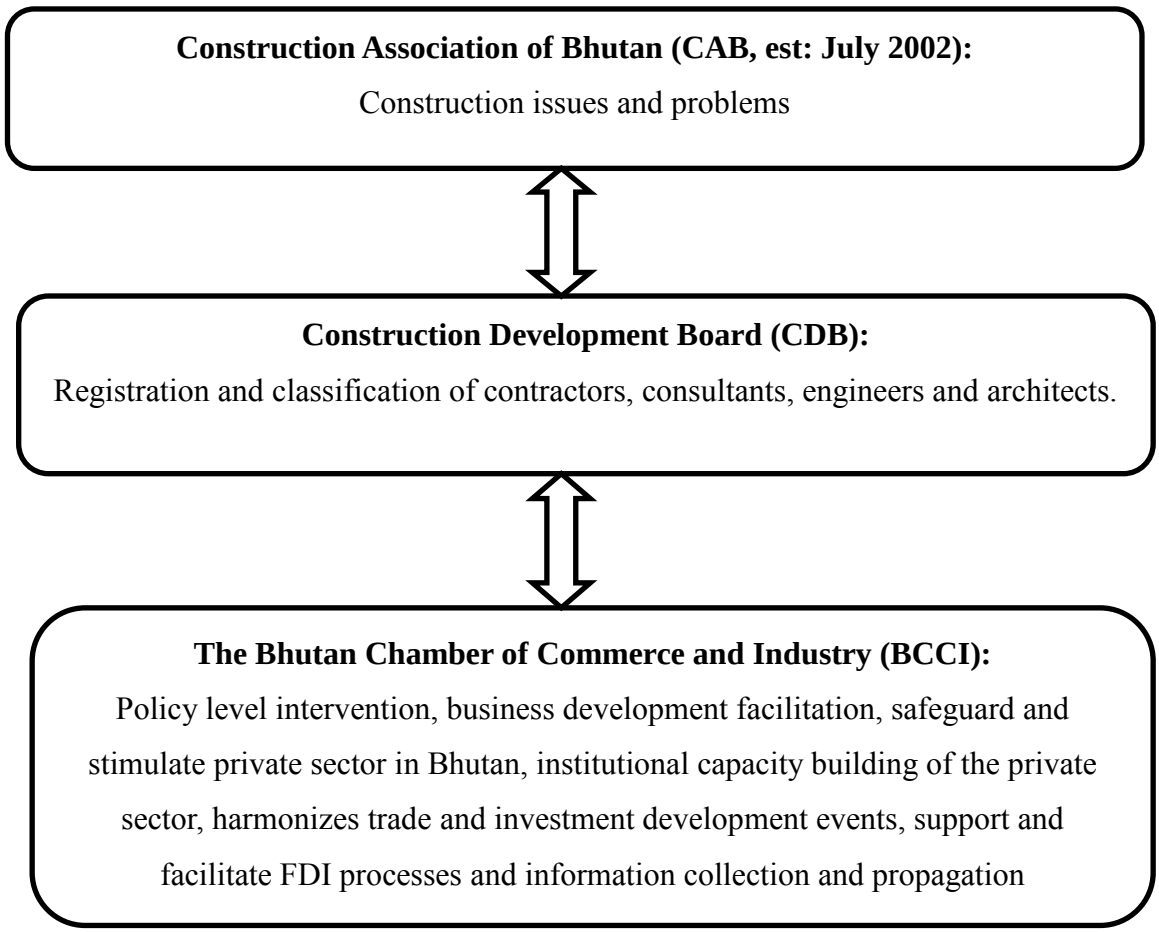

Figure 4-3 Three main regulators of construction industry in Bhutan

The main source of finance for all the above public utility works are managed from the revenue generated from taxes, soft loans and grants received from the bilateral arrangement with several countries.

In the past, the Public Works Department (PWD) was responsible for facilitating the engineering services all over Bhutan. Due to increasing volume of works to be executed over the years, every district establishes an engineering service division headed by the district engineer. Bhutan still faces shortages of technical manpower due to which one engineer has to supervise two or more projects at different rural sites.

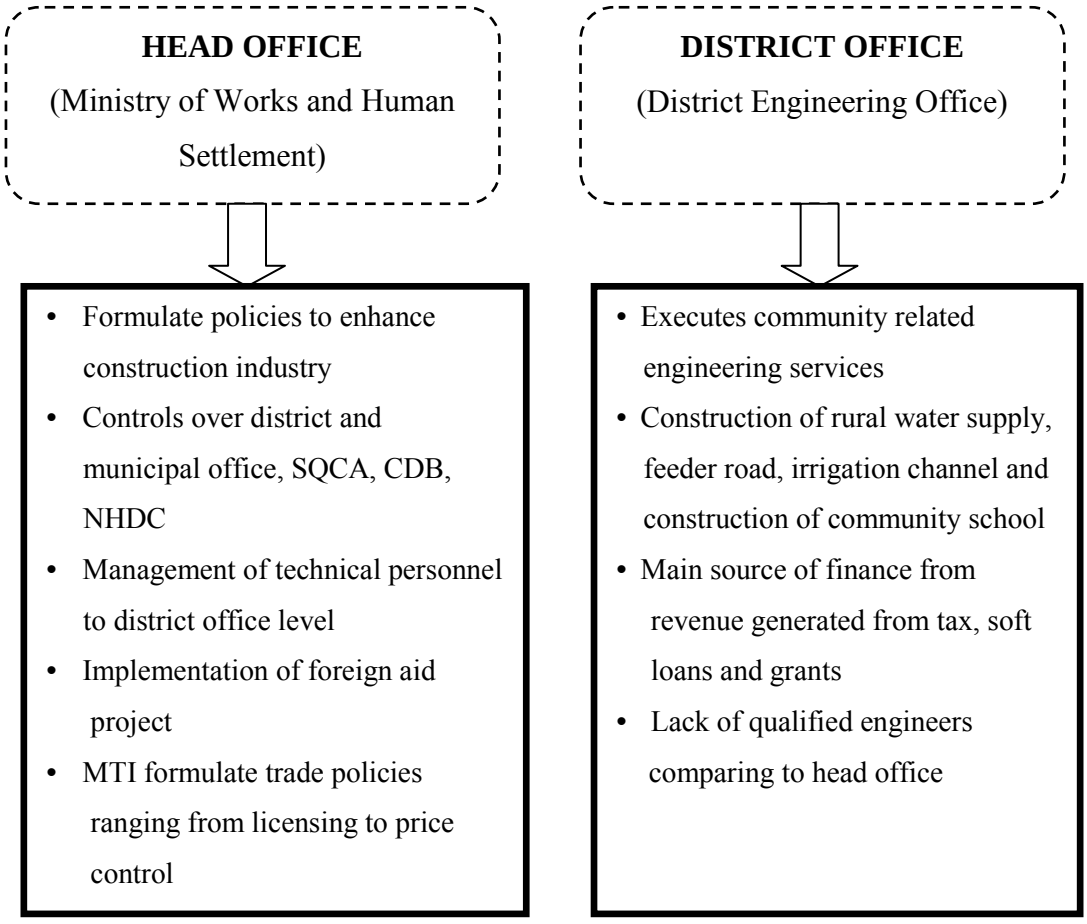

Figure 4-4 Existing working culture of public sector in Bhutan

The Figure 4-4 represents the present working culture of public sectors and its main functions which are governed by two main regulators at the head office and

district office level. Interestingly, the Bhutanese contractors have no other means of participating in other construction work except bidding for public construction projects. The award of work by the private individual to the local contractor rarely exists. The team leader from group of foreign labor is normally acts as engineer for the execution of private buildings. The dependence of Bhutanese construction industry on India who has its volatile political situation in getting the intact assistance and availability of limited Indian rupee are one of the major factors that influence construction delay in Bhutan.

4.2 Pilot study to identify specific factors influencing public construction project delay in Bhutan

The pilot area selected for the survey is Thimphu, the capital city of Bhutan where it is observed that many public construction projects are under construction.

Figure 4-5 Pilot area study to identify important factors in Bhutan

As shown in Figure 4-5, the pilot area survey is carried out to identify important and distinct factors that influence construction delay in Bhutan. Some distinct factors are identified after interviewing 7 government engineers, 4 large contractors and site observation of 7 public project construction sites in Thimphu. Table 4-1 illustrates some of the specific factors that influence project delay in Bhutan. Several public construction project site visits were carried out including construction of United Nation house, Supreme Court, double lane of highway between Thimphu and Phuentsholing, Education city, Thimphu Tech Park and Infrastructure development project funded by the Asian Development Bank.

Table 4-1 Factors from pilot area survey and interview

Construction sites (7 nos.)	**Interview with Government Engineers (7 nos.)**	**Interview with Contractors (4 nos.)**
Unavailability of basic construction material in market	Limitation of exchange rate	Frequent festivals in Bhutan and neighboring countries especially India
Frequent road block by landslides and heavy snowfall	Shortage of national construction labor	Over project number in hand
Cold climatic condition	Application of obsolete equipment	Insufficient contract duration for remoteness of project
Lack modern construction technologies	Lack of foreign labor	Insufficient contract duration for scope (volume) of project
Equipment allocation problem at site	Audit objection especially in construction sector is a major concern for decision maker in public sector	Different culture of labor

Finally a total of fifty eight factors from the two sources of literature review and pilot area study are grouped under seven categories namely material, construction labor, equipment, contractor, client, consultant and external factors. The final questionnaire designed after grouping these factors and the data collection was made possible from two project participants namely, the contractor and government engineer.

4.3 Data collection in Bhutan

The relevant data collection is the most essential part for any research and the precision of data will decide the success or failure of the intended research. The data collection in Bhutan covers four main districts namely Thimphu, Chhukha, Paro and Phuentsholing (sub district). These four districts are located along western and southern regions. The data collection was focused on these four districts because they are the main area where the higher magnitudes of public construction projects are executed especially in Thimphu, the capital city of Bhutan. Some large projects like construction of Supreme Court, UN house and embassies are ongoing projects in Thimphu. Figure 4-6 illustrates the construction of Supreme Court and other government departments in the capital city, Thimphu.

Figure 4-6 Contemporary public construction projects in Thimphu and Paro.

During data collection, the questionnaire was distributed and face to face interviews conducted separately for two main project participants namely the government engineer and contractor. During the questionnaire survey, several construction site observations and interviews conducted to obtain the applied process and progress of construction.

4.3.1 Data collection for ranking important level factors.

There is comprehensive ascending of public project construction in the country and many public projects are funded by Government of India (GoI) under soft loan scheme. The data from the contractor and government engineer collected through survey of construction sites, construction companies and also face to face interviews with the two project participants. The data was collected from three districts and one sub district of Bhutan. However it was observed that at district administration level, the medium construction work like construction of irrigation canal, feeder road and rural water supply schemes exclusive of other projects are found to be similar that they are responsible for facilitation of rural development. Time management and making appointments with the contractors and engineers are the difficult part experienced during the data collection period since many of the respondents especially the contractors were mostly at rural construction sites. Nevertheless, most of the respondents fully cooperated as they felt the research was important to be carried out. Individual respondent are explained the methods of filling the questionnaire and the importance of the data in the process.

As shown in Table 4-2, the data updated as of August 2011 reflects that Bhutan has 83 large contractors, 347 medium contractors and 2223 small contractors making a grand total of 2656 contractors. However there are many of the construction projects executed at the capital city of Bhutan, Thimphu, which also has maximum number of registered contractors. A common practice that the medium and small contractors usually participate in the construction of buildings, retaining wall, roads, culvert, schools, Basic Health Units (BHU) and irrigation canal at the district level in which cases the construction is not very complex and the bid amount is fairly moderate.

Table 4-2 Numbers of contractor in 20 districts in Bhutan (last update 22- August 2011)

District	Class of contractor			Total in each district
	Large class	Medium class	Small class	
Bumthang	1	9	80	90
Chukha	10	24	145	179
Dagana	0	4	59	63
Gasa	0	0	14	14
Haa	1	15	89	105
Lhuntse	0	14	62	76
Mongar	2	19	124	145
Paro	7	24	167	198
Pemagatshel	0	12	86	98
Punakha	1	9	52	62
Samdrup Jongkhar	2	12	67	81
Samtse	0	12	108	120
Sarpang	4	16	149	169
Thimphu	48	107	491	648
Trashi Yangtse	2	6	99	107
Trashigang	3	26	154	184
Tsirang	0	5	60	65
Trongsa	1	11	66	78
Wangdue	1	13	100	114
Zhemgang	0	9	51	60
Grand Total	**83**	**347**	**2223**	**2656**

(Source: www.cab.org.bt)

As shown in Table 4-3, a total of 115 sets of questionnaire distributed, out of which 70 distributed to government engineer of various ministries, departments and

agencies and 45 sets distributed to contractors belonging to large, medium and small construction firms.

Table 4-3 Number of questionnaire distribution

Description	Number distributed	Number of respondents	% of number distributed	% of number responses
Government Engineer	70	61	87	68
Contractor	45	29	64	32
Total	**115**	**90**	**78**	**100**

From a total of 70 questionnaires set distributed to the government engineer, 61 respondents have returned back positively. However, the rest 19 sets of questionnaire were not returned. Similarly, a total of 45 questionnaires distributed to contractor, only 29 respondents returned to questionnaire. However, the balance 16 sets fail to respond despite several follow up. This is because of the reason that most of the contractor participating in the bidding for tender at different districts of Bhutan could hardly spare time. The Table 4-4 represents the name of the public offices and the number of respondents who were interviewed for collecting the data. A total of 10 public ministries and departments were covered from four districts during the questionnaire survey.

Table 4-4 Number of respondent from government sectors

Name of Ministry/ Department	Number of Respondent
Ministry of Agriculture	5
Ministry of Labor and Human Resources	5
Ministry of Works and Human Settlement	8
Ministry of home and Cultural Affairs	2
Thimphu District Administration	6
Thimphu Thromde (municipal office)	18

Table 4-4 Number of respondent from government sectors (continues)

Name of Ministry/ Department	Number of Respondent
Construction Development Board	1
Chhukha District Administration	7
Phuentsholing Thromde(municipal office)	4
Paro District Administration	5
Total	**61**

The number of large, medium and small contractors who were interviewed with the questionnaire is as shown in Table 4-5.

Table 4- 5 Number of respondent from private sectors

Types of Company	Number of Respondent
Large Contractor	9
Medium Contractor	12
Small Contractor	8
Total	**29**

4.4 Description of data for contractor

From the total of forty five questionnaire sets that was distributed to the large, medium and small Bhutanese contractors, twenty nine of them responded the questionnaire survey. Section A of the questionnaire is analyzed and illustrated graphically in the form of pie chart diagrams.

The working experience for the contractor represented in the pie chart in Figure 4-7 illustrates that 17% of the respondents have at least 5 years of working experiences, 24% of the respondents had between 6 to 10 years of working experience, 45% of the respondents had between 11 to 15 years of working experience and 14% of the respondents had more than 15 years of working experience in public construction

projects. This statistics also confirms that the respondent contractors have good experience in public construction projects.

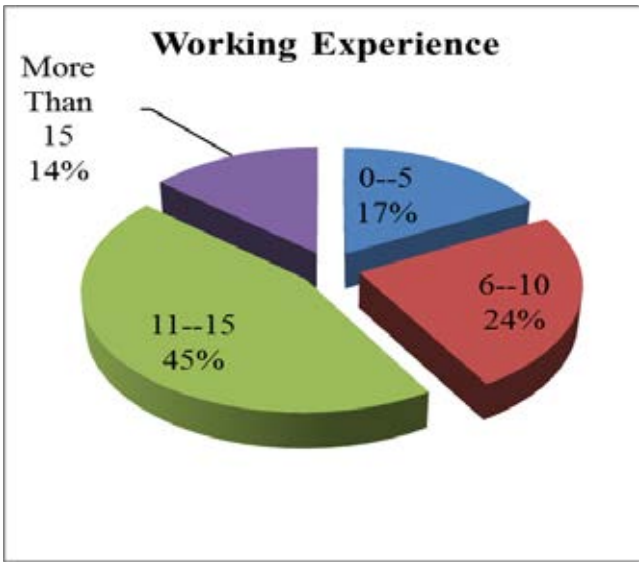

Figure 4-7 Contractor working experience

The analysis of data for the number of projects executed by the contractor is found important because more the number of project executed by the contactor, the validation of response is more accurate.

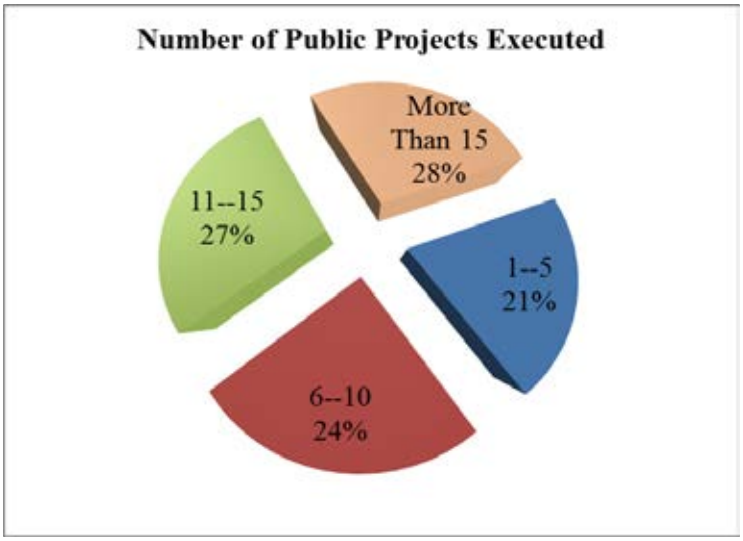

Figure 4-8 Number of projects by contractor

Figure 4-8 provides the number of public projects executed by the contractor and is described as follow. 21% of the respondents had executed a minimum of one and a maximum of five public projects. 24% of the respondent of contractors had executed between six to ten projects. 27% had completed between eleven to fifteen projects and finally 28% of twenty nine respondents had completed more than fifteen public construction projects.

It is also important that the data for the types of projects executed by the contractor need to be represented since it has larger scale of influence on the construction project delay. Therefore as represented in Figure 4-9, it is observed that 9% of the respondents had constructed low income government housing projects, 19% of the respondents had experience in road and domestic runway construction, 16% of them had constructed bridges and culverts, 16% had constructed schools, 7% of them had constructed substations, 10% had constructed hospital and basic health units, 16% of the respondents had constructed government offices and finally 7% of the respondents had executed other public construction projects like construction of irrigation canals, heritage structures, community centers, river training works, water supply and reservoirs, sewerage networks and sewerage treatment plants, land fill site construction and other miscellaneous projects.

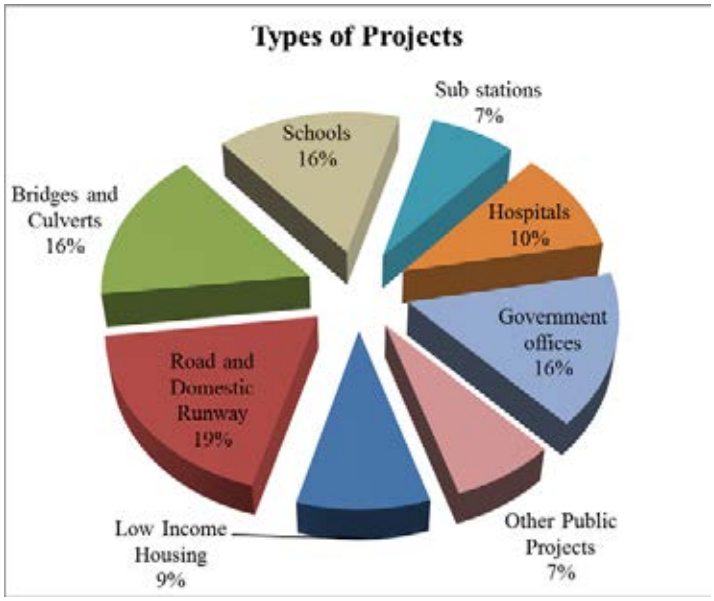

Figure 4-9 Types of project

The analysis of the data from section B of the questionnaire which includes fifty eight factors influencing construction delay grouped under seven classifications from twenty nine contractors' responses.

The factors listed are identified from the literature review and from the site investigations and face to face interview with the two major project participants namely contractor and the government engineer. The overall analysis of the factors influencing construction delay is explained in the chapter five of this research.

4.5 Description of data for Government Engineer

From the total of seventy questionnaire set that are distributed to the government engineers of various ministries and departments in Bhutan, sixty one of them responded the questionnaire survey. The section A of the questionnaires are analyzed and illustrated graphically in the form of pie chart diagrams.

The number of years of working experience of government engineer who have responded to the survey questionnaire represented in the pie chart in Figure 4-10.

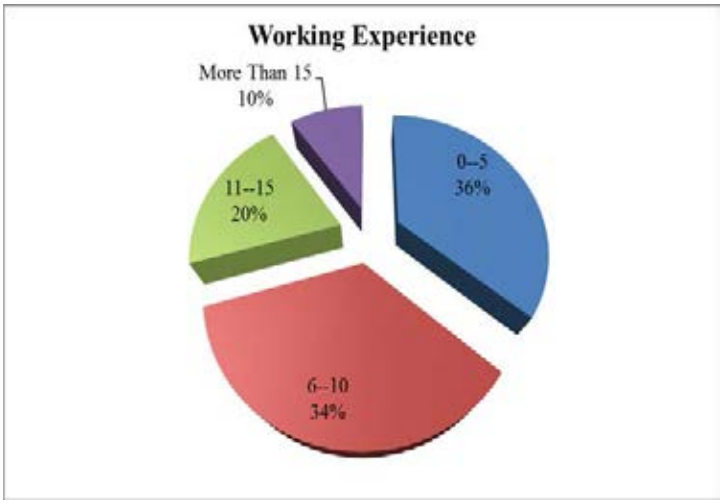

Figure 4-10 Government engineer working experience

. It illustrates that 36% of the respondents from government sectors had at least 5 years of working experiences, 34% of the respondents had between 6 to 10 years of

working experience, 20% of the respondents had between 11 to 15 years of working experience and 10% of the respondents had more than 15 years of working experience in public construction projects. This statistics also confirms that the responding government engineer had good experience in public construction projects.

The analysis of data for the number of construction projects executed by the engineer is found important because the more the number of project executed by them, the more the responses to the questionnaire to validate the most influencing factors that could be depicted during the evaluation process.

Figure 4-11 illustrates the number of public projects executed by the contractor and is described as below. As shown, 18% of the respondents from government sectors had executed a minimum of one and a maximum of five public projects. 8% of the respondent of contractors had executed between six to ten projects. 25% had completed between eleven to fifteen projects and finally 49% of sixty one respondents had supervised and implemented more than fifteen public construction projects in Bhutan.

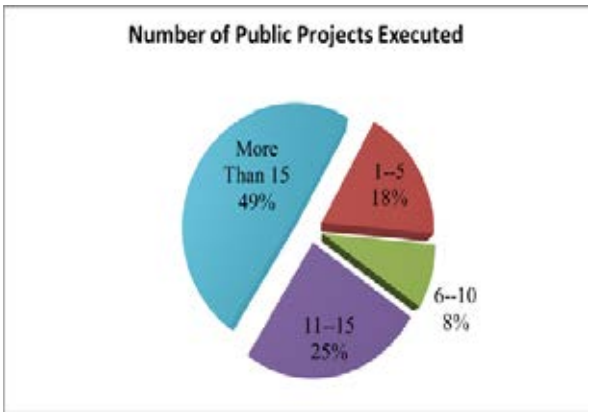

Figure 4-11 Number of projects by government engineer

Importantly it is found that the data for the different types of projects executed by the government engineer need to be represented since it is expected that the response to the questionnaire will be more appropriate with broader perceptions that the engineer has the experience with different type and scope of projects.

As represented in Figure 4-12, the following observations were therefore obtained from the data. It is observed that 11% of the respondents had constructed low income government housing projects, 20% of the respondents had experience in road and domestic runway construction, 14% of them had constructed bridges and culverts, 16% had constructed schools, 2% of them had constructed substations, 7% had constructed hospital and basic health units, 18% of the respondents had constructed government offices and finally 12% of the respondents had executed other public construction projects like construction of irrigation canals, heritage structures, community centers, river training works, water supply and reservoirs, sewerage networks and sewerage treatment plants, land fill site construction and other miscellaneous projects.

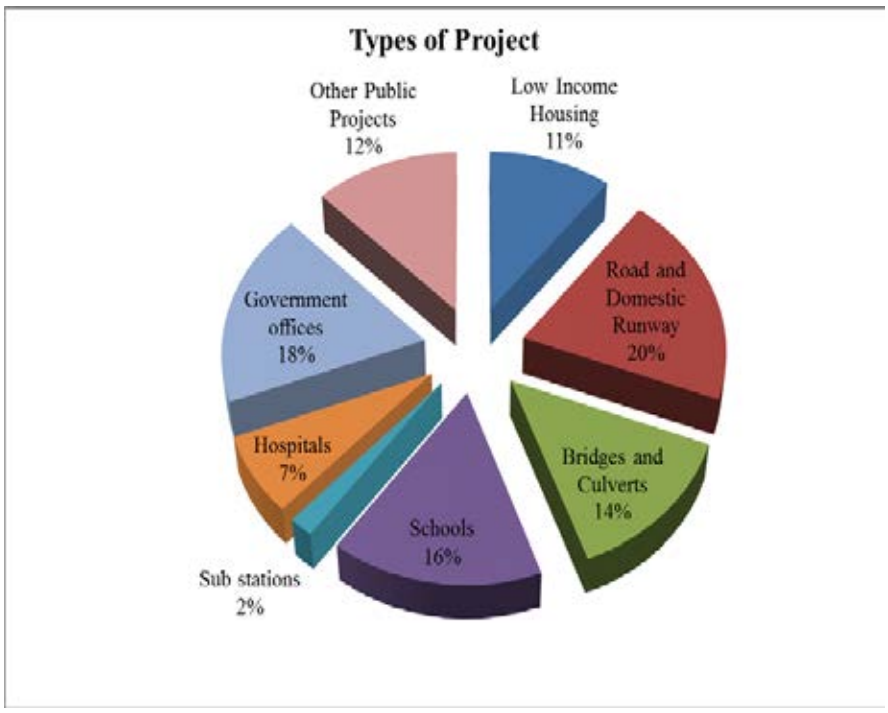

Figure 4-12 Types of project

4.6 Method of ranking of factor

After the analysis of the first phase of the data collection is completed, the analyses of data from the questionnaire obtained from the respondents are computed using statistical tools. However for the ranking of factors, as shown in Table 3.5 the

set of factors with a value of 3.50 and above are used. The critical factors with this value and above represent the stronger level of agreement influencing public construction project delay in Bhutan from the overall viewpoint, viewpoint of contractor as well as viewpoint of government engineer.

4.7 Method of recommendation study

After the ranking of each factor from seven classifications, the top two factors from each classification are extracted to list down the critical factors influencing public construction project delay in Bhutan. The questionnaire sheet for recommendation is also designed for the experts who wish to provide suggestions in writing forms the next phase of data collection.

As shown in appendix E, for the recommendation phase, ten construction experts from different ministries and private companies who have at least ten years of working experience in construction industries are identified. Out of ten experts, six of them represent government departments and the other four represent large contractors from private construction firms. This phase of the questionnaire for the in depth interview is divided into two sections. Section A provides the profile of the respondents like name, designation, name of company working under, number of years of experience and other miscellaneous details like contact number and emails address. In addition, section B of the sheet lists the top two critical factors each from the viewpoint of government engineer and contractor. These are selected for the useful recommendations with an aim of fulfilling the objective of this study to prevent public construction project delay in Bhutan.

4.8 Conclusion

The analysis of the research focusing factors influencing public construction project delay in Bhutan have two techniques namely face to face interview and questionnaire survey that are used to gather the data and information from the Bhutanese construction industries. In this research, the data analysis is carried out

separately from the viewpoint of government engineers and contractors while comparisons of factors from both the sources are studied. After the analysis and ranking of factors, useful guidelines and recommendations are provided after conducting an in depth interview using questionnaire techniques with construction experts. The ranking of factors is done based on overall ranking, ranking from the viewpoint of contactor and government engineer and ranking of factors from each of seven classifications. For the ranking, the factors with value of 3.5 and above are used as it determines the level of agreement based on the perception of the respondents.

The statistical techniques like mean, standard deviation, variance, relative importance index and frequency index are applied to analyze the data. A test to check the internal consistency of data using reliability test is carried out. For example, Cronbach's alpha is the test to investigate the internal consistency of the data. The significance of the factors from the perceptions of government engineer and contractor are also tested applying t- test from Statistical Package for Social Science (SPSS) in this study.

CHAPTER V
ANALYSIS, RESULT AND DISCUSSION

5.1 General

This chapter highlights the analysis, result and discussion from the questionnaire survey concerning the construction project delay from contractor and government engineer viewpoint in Bhutan. The findings for the public construction project delay in Bhutan is ranked as overall factors, rank of factors from viewpoint of contractors, government engineers and finally the ranking from each of seven categories namely, material, labor, equipment, contractor, client, consultant and external factor from both the respondents and discussed accordingly. The result of the analysis is discussed separately along with the comparisons for each of two groups namely, contractor and government engineer.

5.2 Ranking of factors

Based on the result from analysis of each factor as discussed above, the overall ranking, ranking of factors separately from the viewpoint of contractor and government engineer are tabulated to find the critical factors. To find the critical factors, screenings of factors are done which have the value of 3.50 and above as this group of factors have stronger level of agreement from the perception of government engineer and contractor. The overall mean of the factors are tabulated from the respondent score. From the analysis of general score, it is possible to identify the critical factors on project delay in Bhutan. The details of ranking of fifty eight factors are presented in appendix C.

5.2.1 Overall ranking of factors influence project delay from 58 respondents.

This research compares the factors influencing public construction project delay

from the viewpoint of two groups of respondents, comprising of 58 and 90 respondents. The number of respondent for government engineers are 61 numbers and the number of respondent for contractors are 29 numbers. Therefore the ratio of the two respondents is not comparable. However keeping equal size of samples from both the group of respondents is important to achieve statistically significant results and ensuring research resources efficiency (Burmeister and Aitken, 2012).

Therefore, for the overall ranking of data, the numbers of respondents for government engineer are minimized from 61 to 29 in order to reduce biasing of the results and keep the respondent rate equal to that of contractor. From the total of 61 governments engineer who have responded to the questionnaire survey, 32 of them were identified whose response is not consistent.

Table 5-1 Overall ranking of factors influence project delay from 58 respondents

Overall Ranking from 58 respondents			
Factors influencing public construction project delay in Bhutan	**Catagory**	**Mean**	**Rank**
Unqualified workforce at site	Contractor	4.38	1
Delay in obtaining construction permit from municipality	External Factor	4.10	2
Different culture of labor	Construction Labor	4.07	3
Conflict within project participants	External Factor	4.05	4
Low labor productivity at site	Construction Labor	3.97	5
Shortage of national construction labor	Construction Labor	3.95	6
Lack of foreign labor	Construction Labor	3.91	7
Lack of modern equipment hiring agency	Equipment	3.91	8
Use of obsolete equipment with low working efficiency	Equipment	3.86	9
Equipment allocation problem at site	Equipment	3.83	10

Table 5-1 Overall ranking of factors influence project delay from 58 respondents (Continues)

Overall Ranking from 58 respondents			
Factors influencing public construction project delay in Bhutan	**Catagory**	**Mean**	**Rank**
Rework due to error during construction	Contractor	3.79	11
Delay in material delivery at site	Material	3.74	12
Shortage of construction material in market	Material	3.71	13
Lack of safety management	External Factor	3.71	14
Over project number in hand	Contractor	3.69	15
Delay in progress payment of running bills and other overheads	Client	3.67	16
Emphasis on specification of the design	Client	3.67	17
Poor and irregular site inspection	Consultant	3.66	18
Unreliable supplier of construction material	Material	3.62	19
Improper planning and scheduling	Contractor	3.62	20
Inexperience sub-contractor	Contractor	3.62	21
Delay in import of construction material	Material	3.60	22
Lack of basic technical knowledge	Contractor	3.60	23
Unavailability of basic construction material in the market	Material	3.59	24
Limitation of exchange rate	External Factor	3.59	25
Unavailability of equipment parts in the market	Equipment	3.57	26
Inadequate design	Consultant	3.57	27
Lack of experience in construction	Contractor	3.53	28
Inadequate technical staff	Contractor	3.52	29
Lack of environmental clearance	External Factor	3.50	30

As illustrated in the Table 5-1, it shows the ranking of 58 factors from the response of 29 contractors and 29 government engineers. A total of 30 factors identified have the value of mean 3.50 and above. While 58 respondents have strong

level of perception over these 30 factors for influencing project delay in Bhutan. The graph in Figure 5-1 also represents the top 10 factors that influence project delay from the viewpoint of 29 each contractors and government engineers.

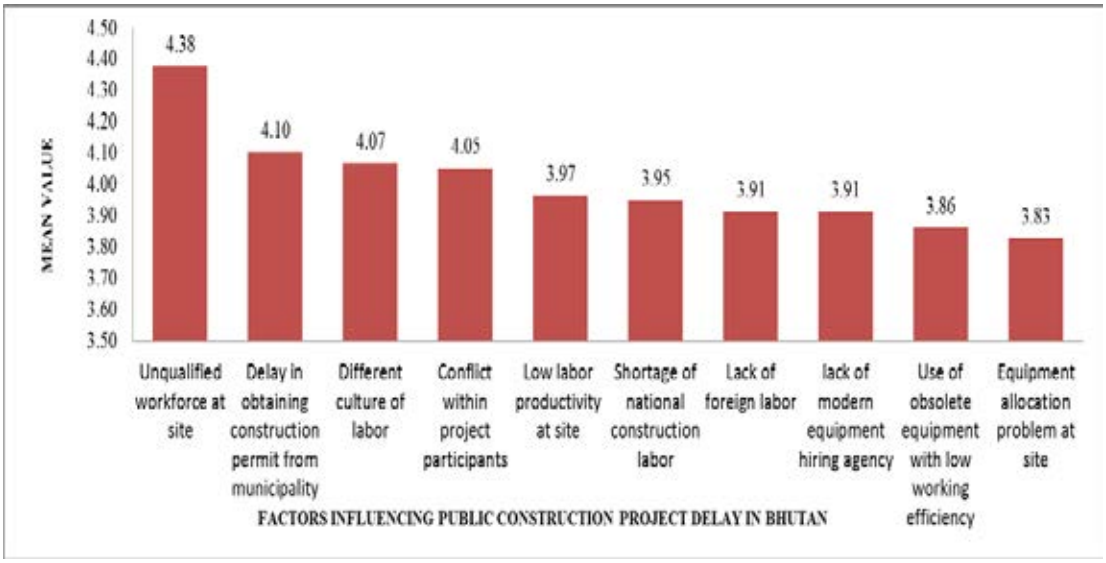

Figure 5-1 Top ten overall mean rank from 29 Contractors and 29 Government Engineers

The first rank is unqualified workforce at site (mean = 4.38). At the project execution level, it is the unqualified workers and labors especially the labors brought from border area of India who do not possess good construction knowledge and skills. They require regular guidance from the site engineer and supervisor to organize and execute every activity. These workers by profession are the villagers who migrate to Bhutan in search of jobs. Therefore, the unqualified workforce at site ranks first from over all viewpoints which influence to project delay in Bhutan.

The second rank is the delay in obtaining construction permit from the municipality (mean = 4.10). In Bhutan, the municipal office usually takes longer time to scrutinize and approve the designs. The number of construction is more in municipal area as compare to area under district jurisdiction because the district area usually covers the rural area where the population and frequency of construction works are less. The municipal offices require approving the drawings of both private

and public owner with a limited number of human resource. The regular meetings with different stakeholders on various issues and site visits and verifications before the approval are some of the activities which consumes more time for government engineer and finally it impacts the on time delivery of approved drawings.

Different culture of labor (mean = 4.07) is rank third from the overall ranking from 58 respondents. The foreign labors usually have their own culture of working which is not similar in context to Bhutanese construction industry. In order to complete the work within the deadline, Indian labors are sometime enforcing to work till midnight which is unacceptable to them. There is no proper management of safety culture and promotion for the foreign construction labor because of which the incidence of accidents at construction sites are increasing. The Bhutanese construction industry can be revitalize if there is trust developed between the Bhutanese contractor and the foreign labors especially the labor who migrate from India. Some contractors are dishonest with the foreign labors and they create false believe that the site is safe and facilitated with all the basic needs which may not be true at actual site location. The occurrence of such problem encourages especially the Indian labor to return to their native places without any notice from the management and this creates a broader gap between the actual and required number of labor which finally affects project completion on time.

Conflict within project participants is rank fourth (mean = 4.05). In Bhutan, conflict occurs more in the construction phase of the project. The government engineer administers the contractor to follow the detailed design as approved which is at times difficult to implement in many cases. Usually the site locations are not feasible as per the requirement of the design and the specified materials are not readily available in the market. The procurement of such specified material requires supplier from other countries to import to Bhutan which takes longer time. In order to build as specified requires longer time especially in site development works. In the process, the project is time bound, the government engineer enforces the contractor without realizing the real situations. Such state of affair creates antagonism and

frustration between them which sometime results in construction conflict and project delay.

Low labor productivity at site is rank fifth (mean = 3.97). The foreign construction labor migrated especially from border area of India retain low construction productivity at site. The ratio of skilled labor is low as compare to that of unskilled group and this unequal ratio require overtime, second shift work, rework and additional work, additional crafts and many other impacts to original plan and estimate. The cold weather of Bhutan comparing to the border states of India which have subtropical climatic conditions is also one reason for low labor productivity. Such changes cause manpower increase and work site to be overcrowded, thus adding positive impacts towards low labor productivity. The Indian labor usually do not show enough spirit of willingness, confidence, discipline and cheerfulness to work due to these issues ultimately causing construction delay in Bhutan.

The shortage of national construction labor (mean = 3.95) is rank sixth. The workforce participation of national labor in the Bhutanese construction industry is very low at 1.4% (National Statistics Bureau of Bhutan, 2010) due to lack of construction skills. There is also lack of basic and essential vocational trainings despite the initiative taken by the government sector in enhancing and encouraging Bhutanese to build skill in construction. The working environments at construction sites are not planned and appropriate which discourages them in developing interest to participate in construction sector. These results in foreign labor dependency working situation in Bhutan compromising for unskilled, inexperience and uneducated workers finally influence project delay in Bhutan.

Lack of foreign labor is rank seventh (mean = 3.91). In Bhutan, the contractors are required to submit the work order for the particular public project to the Department of Labor in order to recruit for foreign labor. The Department of Labor then issues the labor permit to the contractor with which the contractor qualifies to bring in foreign labor. Every foreign construction labor is issued labor identity card which specifies the details of the project type and duration. Therefore, if the project is

not completed within the specified duration, the labor has to reprieve to their home country. In addition, the labor has to register again for new project in order to work continue in Bhutan. These processes are lengthy and require a lot of time finally affect to project completion time in Bhutan.

The eighth, ninth and tenth factors are lack of modern equipment hiring agency (mean = 3.91), use of obsolete equipment with low working efficiency (mean = 3.86) and equipment allocation problem at site (mean = 3.83) respectively.

5.2.2 Overall ranking of factors influence project delay from 90 respondents.

The overall ranking of factors from the viewpoint of 90 project participants comprising of 61 government engineers and 29 contractors is represented in Table 5-2 and Figure 5-2. The ranking is based on the value of 3.50 and above, which represents the strong level of agreement of the respondents for the factors influencing public construction project delay in Bhutan. It is found that shortage of national construction labor is the top factor (mean = 4.08).

Table 5-2 Overall ranking of factors influence project delay from 90 respondents.

Factors Influencing Construction project delay in Bhutan	Category	Mean	Rank
Shortage of national construction labors	Construction Labor	4.08	1
Different culture of labor	Construction Labor	3.77	2
Unqualified workforce at site	Construction Labor	3.74	3
Lack of foreign labor	Construction Labor	3.74	4
Limitation of exchange rate	External Factor	3.73	5
Lack of modern equipment in construction sector	Equipment	3.68	6
Low labor productivity at site	Construction Labor	3.64	7
Improper planning and scheduling	Contractor	3.61	8

Table 5-2 Overall ranking of factors influence project delay from 90 respondents. (continues)

Factors Influencing Construction project delay in Bhutan	Category	Mean	Rank
Improper preliminary study of project location	External Factor	3.61	9
Delay in material delivery on site	Material	3.60	10
Poor site management and communication	Contractor	3.60	11
Inadequate technical staff	Contractor	3.60	12
Lack of knowledge and training on modern construction technologies	External Factor	3.56	13
Over project number in hand	Contractor	3.54	14
Shortage of construction material in market	Material	3.53	15

This indicates that from the viewpoint of 90 respondents, shortage of national labor is identified as one of the most severe factor for construction delay.

Moreover, there is a huge scarcity of national labor who do not participate to support the demand of the construction industry. Shortage of national labor is the main concern even for private firms. Till date, the demand of construction labor is suppressed by the Indian labor. One of the reasons cited is there is no communication barrier in the working environment of Bhutanese contractor and Indian workers. The different culture of labor is rank second (mean = 3.77). In general, significant valuing of the cultural and traditional issues in performing any construction activities is essential. For any project success, understanding the culture of the region is important and if the cultural difference is managed properly, it can provide several advantages to the project. The Indian labor are characterized by different culture, do not render importance to understand the Bhutanese working culture. In Bhutan, the construction operations follow certain cultural norms of contracting, procurement and execution of project. Many of the Indian labor are ineffective with regards to successful management of cultural differences which have risen to project conflict and delay. As stated earlier, the communication is not a barrier but the cultural difference due religious aspects as both the country follows different religion, there is minimum trust

inbuilt between the Indian labor and Bhutanese contractor in construction projects. Furthermore, the lack of trust is a barrier in Bhutanese construction industry for knowledge sharing in management practices like human resource management, knowledge management, communication management; safety management and time management. All these issues pertaining cultural differences influence construction project delay in Bhutan.

The unqualified woke force at site (mean = 3.74) is rank third from the overall viewpoint of 90 respondents. The unqualified workers possess little knowledge and experience in construction and the Indian labor are initially engaged with construction work. Constant guidance of the site supervisor is required over every project activity during execution. This consumes more time than to complete every single activity resulting in project delay.

Lack of foreign labor is rank fourth (mean = 3.74). In Bhutan, the project location within urban or sub urban area does not requires to manage the worker because of adjustable living environment with basic amenities. However, when the project located at isolated regions, contractor faces a lot of problem to manage the construction worker.

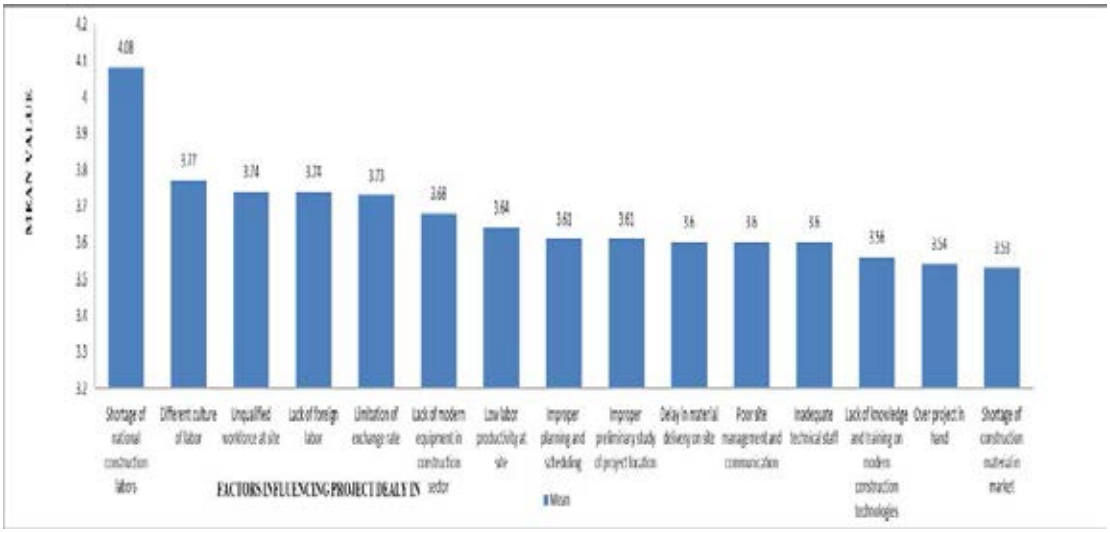

Figure 5-2 Overall mean rank from 29 Contractors and 61 Government Engineers

The site workers express least interest to work under these environments due to inadequate basic facilities like potable water, access road, health facilities and other basic amenities at construction site and sometimes in the entire region. Sometimes, the inferior health status of the worker requires them to make days of journey to acquire proper health and clinical facilities because of the isolation of construction sites. This unsuitable environment compels them to leave the construction site creating deficit of foreign labor. In some cases, the workers demand high wages than normal because of project isolation. However, many of the contractors do not comply with their demand on the pretext that it is not equivalent to their construction skills.

Finally, the foreign labor abscond from the uneven construction site after claiming settlement allowance from the contractor. These foreign labor informally leaves the country without the notice of the management and thereby betrayal of trust between contractor and worker. This creates a deficiency of labor which affects the project delay in Bhutan.

The limitation of exchange rate is rank fifth (mean = 3.73). The Bhutanese economy and construction industries are extensively dependent on India. Most of the construction materials including the interior and exterior design items are imported from India. When these items are procured from India, the Bhutanese constructor while importing these items require to do payment in Indian currency. Deficit of Indian currency in Bhutanese construction market halts the import of construction material and other items which ultimately contribute to the construction project delay in public and even private projects in Bhutan.

The lack of modern equipment in construction sector is rank sixth (mean = 3.68). In the present scenario, Bhutan is executing over a larger scale public project like the construction of hydro power projects, education city and information and communication technology parks, embassies, United Nation House etc. The execution of such projects requires application of modern equipment in construction activities in order to overcome complexity of the project. However the construction methods do not possess such modern equipment having higher efficiency. Instead, many of them

use outdated equipment during construction process. Aggravated by unavailability of equipment hiring agency, the project lacks application of modern technologies which have repercussion on the construction contract duration causing delay in public sector.

The low labor productivity at site is rank seventh (mean = 3.64) from the overall mean. The lack of regular supervision by the site engineer and late inspection from the district and head office has higher impact on the low labor productivity in Bhutan. Sometimes the labor takes individual decision over project execution during the absence of site supervisor. This bring in error in construction resulting in revisiting the same thereby delaying the project.

The improper planning and scheduling by the contractor is rank eighth (Mean = 3.61). In construction projects, proper planning and scheduling is the main assignment for the contractor for effective execution of project activities within the specified contract duration. However in Bhutan, the requirement of qualification for the contractor is still not yet established. Many of the contractors belong to low level qualified human resource strength. These non-technical contractors do not possess capability to plan and schedule the project in a workable fashion. Failing to make practical work program by the inexperience contractor subsequently delays the overall site management making the one activity overlap the other. The local contractor usually lack proper site planning and control. This inefficiency in proper planning and management contributes to project delay in Bhutan.

The improper preliminary study of project location (mean = 3.61) and delay in material delivery on site (Mean = 3.60) is ranked ninth and tenth respectively from the overall ranking. Bhutan is a hilly and mountainous country with a forest cover of around 72%. This makes one of the most difficult tasks of making decision over the project location. Many isolated districts where there exist human settlements; the project areas do not have proper access road which makes the contractor difficult to deliver the construction material and equipment on time. Such situation usually confronts manual transportation of construction materials as practiced by the

contractors in order to execute public project. Proper study of project location and its periphery area before initiating project can minimize project delay.

As regard to the general perception, the poor site management and communication (mean = 3.60), Inadequate technical staff (mean = 3.60), lack of knowledge and training on modern construction technologies (mean = 3.56), over project in hand for contractor (mean = 3.54) and shortage of construction material in the market (mean = 3.53) influence to project delay in Bhutan with lower magnitudes. However in areas where the design of the structure is complex, approval usually require more time further delay the progress of other activities.

5.2.3 Ranking of factors from 29 contractors view point

The top factors from each category from contractor viewpoint are represented in Table5-3 and Figure 5-3. The factors with the mean value of 3.50 and above are ranked for discussion as the perception level is strongest for these factors from the contractor's viewpoint.

The unqualified woke force at site (mean = 4.03) is rank first from the viewpoint of 29 respondents. The unqualified workers possess least knowledge and experience in construction and the Indian labor are initially engaged with construction work. Constant guidance of the site supervisor is required over every project activity during execution. This consumes more time than required to complete every single activities resulting in project delay in Bhutan.

The difference in culture (mean = 3.97) is rank second from the view point of contractor. The delay factor related to culture can be mitigated when Bhutanese construction industry employs national construction labor to optimum level.

Table 5- 3 Rank of critical factors from 29 Contractors view point

Factors Influencing Public construction Project delay in Bhutan	Catagory	Mean	Rank
Unqualified workforce at site	Contractor	4.03	1
Different culture of labor	Construction Labor	3.97	2
Conflict within project participants	External Factor	3.93	3
Delay in obtaining construction permit from municipality	External Factor	3.79	4
Lack of foreign labor	Construction Labor	3.72	5
Low labor productivity at site	Construction Labor	3.62	6
Use of obsolete equipment with low working efficiency	Equipment	3.59	7
Lack of safety management	External Factor	3.59	8

The conflict within the project participants (mean = 3.93) is rank third. The conflict in the Bhutanese construction industry is increasing over time resulting into legal harassment. The conflict usually occurs when the standard bidding documents specifies the materials which are not available in the market. In addition the public sectors enforces the contractor to use the same material as specified which are not readily available in the Bhutanese market and needs longer time for import from other countries. Sometimes, the public sector disallows the use of alternative material with same quality standard. This makes the contractor resent with frustration and antagonism which results in conflict between the government engineer and contractor, thus delaying the project.

Delay in obtaining construction permit from the municipality (mean = 3.79) is ranked fourth. Lack of foreign labor (mean = 3.72) is rank fifth. Irrespective of public or private construction, the majority of the construction activities are carried out by the Indian labors in Bhutan. The climatic condition and other unfavorable aspects together cause the labor to abscond the workplace. Some aspects that can be anticipated are the difference in life style. Nevertheless, the labor prefers working for

projects that provide better and higher wages or failing to achieve this induces foreign labor with the situation of resigning from workplace.

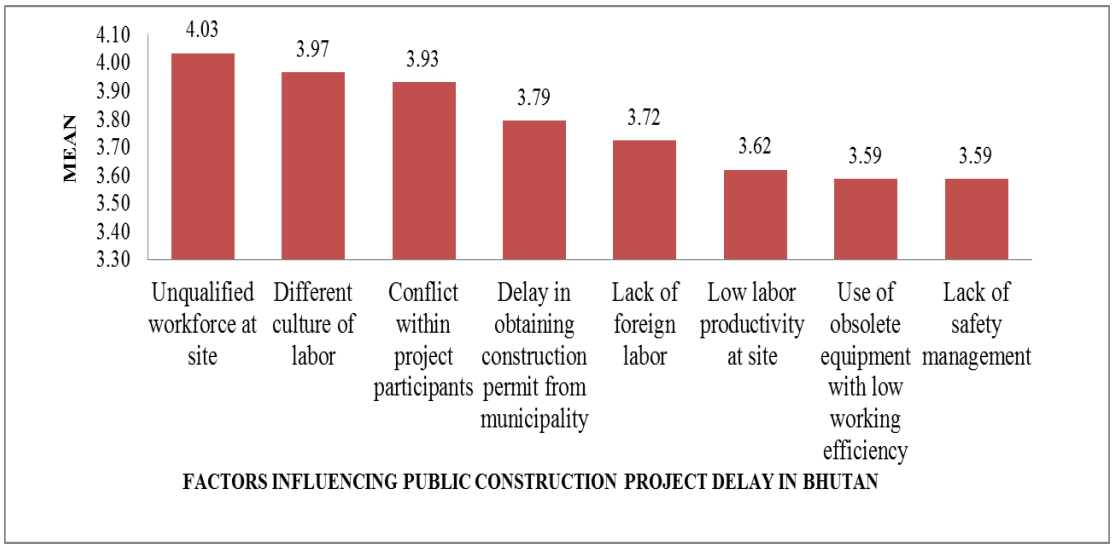

Figure 5-3 The top factor from each classification from Contractors viewpoint

In some situation, the foreign labors reject the existing project which offers them with low wage and hence it causes deficit of labor. Further there is no general practice of entering into legitimate agreement between the contractor and the foreign labor while the absence of legal binding encourages the Indian labor to liberally move from one project to other without any hindrance. Moreover, there is no proper labor agent and stringent labor law which can provide some guidelines that can facilitate the construction labor towards conducive working environment. This situation finally rises to public project delay in Bhutan.

The low labor productivity at site (mean = 3.62) is rank sixth from the viewpoint of contractor. The public projects executed at district level usually have isolated project location with no proper transportation and electricity facilities. The productivity is affected when there is no work progress without electricity at night. Transportation of materials require enough time to deliver at site and this arises idle time for site labor because of temporary halt of activity. Thus lowers the labor productivity and extension of contract duration. Labor productivity is also affected by the isolation and hilly terrain of project location at district level which is a major

cause of accidents, occupational injuries and illness. Hence this should be the primary concern for the employer to complete the project within the stipulated contract period.

The use of obsolete construction equipment (mean = 3.59) is rank as seventh factor and the modern equipment parts are not readily available in Bhutanese market. Hydro power supply is the main stay of economy. The major construction projects for example, the execution of hydro power plant necessitates the application of modern equipment during entire execution. Many of the large contractors do not keep this modern equipment and instead they use obsolete equipment because the spare parts of modern equipment are not readily available. There is no agent based system to supply modern equipment. The technical personnel experience in operation and maintenance of modern equipment is also scarce in the country. There is no initiatives from public sector to encourage distributor that can maintain ready stocks of essential spare parts at all the time. In addition, there is no registered dealership of license for such facilities and making availability of equipment in stock. This creates a situation for the contractors to use old equipment with lower output causing project delay.

Lack of safety management (mean = 3.59) is rank eighth from the viewpoint of contractor. The project design for the better health and safety before, during and after the construction phase does not exist in many construction projects in Bhutan. There is no collective measure to project the labor and combat the risk of site accident. The most common site accidents that occur in Bhutan are falling from a height, involved in vehicle accident, getting electric shock and being stuck by falling material. There is no proper enforcement of safety precaution from the policy makers and hence the safety management is absent in most of the construction sites in Bhutan.

5.2.3 Ranking of factors from 61 Government Engineers view point

The ranking of critical factors from the viewpoint of government engineer is represented in Table 5-4 and Figure 5-4. The unqualified workforce at site (mean = 4.10) is rank first. The second rank is lack of modern equipment hiring agency (mean = 3.90). The dealership for modern equipment hiring agency do not exist in Bhutan.

The tax for the import of the heavy machineries is very high which discourages the people in participating as equipment dealer.

Improper planning and scheduling (mean = 3.90) is rank third. The contractor does not use planning techniques such as Critical Path Method (CPM) and Program Evaluation and Review Techniques (PERT) to schedule the project. The fixing of project duration is based on negotiation between the government engineer and the contractor. There is no stringent rule for the submission of the work plan and schedule of project activities during the execution of project. Hence the project experiences delay.

Table 5-4 Rank of critical factors from 61 Government Engineers view point

Factors Influencing Public construction Project delay in Bhutan	**Catagory**	**Mean**	**Rank**
Unqualified workforce at site	Contractor	4.10	1
Lack of modern equipment hiring agency	Equipment	3.90	2
Improper planning and scheduling	Contractor	3.90	3
Inexperience sub-contractor	Contractor	3.90	4
Shortage of national construction labor	Construction Labor	3.89	5
Low labor productivity at site	Construction Labor	3.84	6
Lack of basic technical knowledge	Contractor	3.79	7
Over project number in hand	Contractor	3.77	8
Audit objection is the main concern for decision maker	External Factor	3.77	9
Inadequate technical staff	Contractor	3.75	10
Delay in material delivery at site	Material	3.74	11
Unreliable sub-contractor	Contractor	3.70	12
Different culture of labor	Construction Labor	3.64	13
Conflict within project participants	External Factor	3.64	14
Lack of foreign labor	Construction Labor	3.61	15
Equipment allocation problem at site	Equipment	3.61	16
Shortage of construction material in market	Material	3.57	17

Table 5-4 Rank of critical factors from 61 Government Engineers view point (Continues)

Factors Influencing Public construction Project delay in Bhutan	Catagory	Mean	Rank
Delay in obtaining construction permit from municipality	External Factor	3.52	18
Late procurement of high quality material	Material	3.51	19
Use of obsolete equipment with low working efficiency	Equipment	3.51	20
Delay in progress payment of running bills and other overheads	Client	3.51	21

Inexperience subcontractor (mean = 3.90) is ranked fourth from the viewpoint of 61 government engineer. The contractor most of the time rely on site engineer who are usually diploma holder by qualification. There are abundant of small contractors in Bhutan who are unqualified and inexperience in the construction project. To acquire the reliable and good sub-contractor for the main contractor usually takes longer duration because they usually do not rely too optimum for the work progress of the sub-contractor.

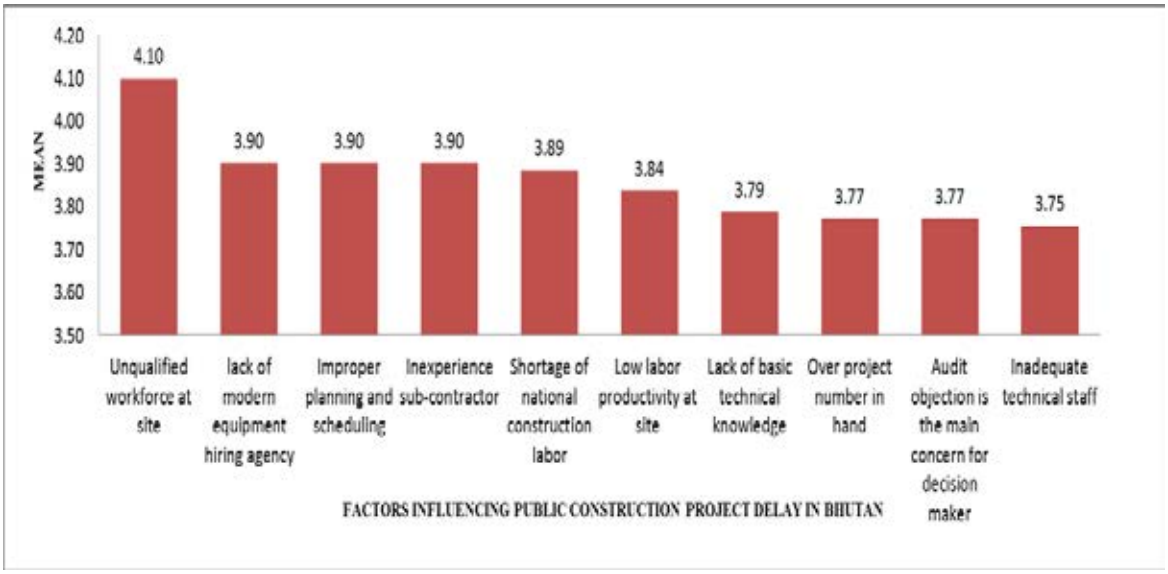

Figure 5-4 The ten critical factors from the viewpoint of 61 Government Engineers.

From the government engineer's viewpoint, shortage of national construction labor (mean = 3.89) is the fifth factor influencing project delay in Bhutan. The construction industry in Bhutan is expatriate labor dependent because of shortage of national labor in construction firms. The contractor depends on Indian labor from across border areas that are easier to explore. There are no proper incentives to attract national construction labor. In addition, lack of proper training institutes for supplementing the problem of quality national labor aggravates more external labor dependent construction industry. The younger and unemployed youth are hesitant to join as blue collar employee for the reason that dignity of labor is not recognized to encourage national labor. The policies bear deficiencies over proper plans and initiatives from the government to replace the Indian labor by Bhutanese nationals at its optimum level.

5.3 Comparison in perceptions of the contractors and government engineers under each classification.

The perception and viewpoint of twenty nine contractor and sixty one government engineer for the factors influencing project delay are compared from each classification. The factors are categorized under seven classifications namely material, construction labor, equipment, contractor, government engineer, consultant and external factors. Each factor is ranked based on the perceptions of government engineer and contractor of Bhutan. The public sector normally execute the project at two different segments at head office and at district engineering cell at district level. The construction work at the head office level are usually executed by the larger contractor who have better technical and financial background comparing to the medium and small contractors executing the work at district level who are usually technically unsound and financially unstable. In other words, there are substantial differences within these two levels of organizations. The head office usually have qualified and experienced engineers to supervise and monitor the public projects where as at the district level, the engineers usually possess mostly diploma level qualifications to supervise the projects and usually experience shortages of engineers. The technical capability and skills of contractor and engineers working at head office

and district level have significant effects on public construction project delay in Bhutan.

5.3.1 Comparison of viewpoint for Material related delay

The Figure 5-5 and Table 5-5 compare the perceptions of contractor and government engineer under material classification. The level of perception is compared for the factors with the mean value of 3.50 and above. All the factors leveled to material related delay from the viewpoint of the 29 contractors are below 3.50 which is the cut off value for the level of agreement and therefore the factors from their perceptions are screened out. However from the viewpoint of 61 government engineers, three factors have value more than 3.50 and are discussed as below.

Table 5-5 Critical factors for material category

Government Engineers			
Catagory	Factors influencing construction project delay in Bhutan	Mean	Rank
Material	Delay in material delivery at site	3.74	1
	Shortage of construction material in the market	3.57	2
	Late procurement of high quality material	3.51	3

Delay in material delivery at site (Mean = 3.74) is rank first from the government engineer viewpoint. The geographical sites of most of the districts in Bhutan are hilly and mountainous in relief which sometimes hinder the proposal of access road to the construction sites. This hindrance delays the materials to get delivered at site on time, causing the suspension of scheduled activities of the project. In addition, the frequent road blockage due to heavy snowfall and landslides hinder the timely delivery of material at the construction site.

From the viewpoint of government engineer under material category, shortage of construction material in the market is rank first (Mean = 3.57). In Bhutan, when the construction materials are in short supply in the market, the price rise from the normal value. During such state, some of the Bhutanese contractors suspend both the work and purchase of material until the price falls to normal and this creates repercussion negatively on project duration and performance. As evident that the geographical sites of most of the districts in Bhutan are hilly and mountainous in character which sometimes hinders the proposal of access road to the construction sites. This hindrance delays the materials to get delivered at site on time leading to the suspension of scheduled activities of the project.

Late procurement of high quality material (mean = 3.51) is third rank that is strongly affecting construction project delay in Bhutan. In the quite recent practice that the interior design and finishing of many public building incorporates imported material from India, Singapore, China and Thailand. The material requires long delivery time to reach Bhutan and then to the construction sites. The supply is also being delayed sometimes because of the discontent political situation of the supplier's country.

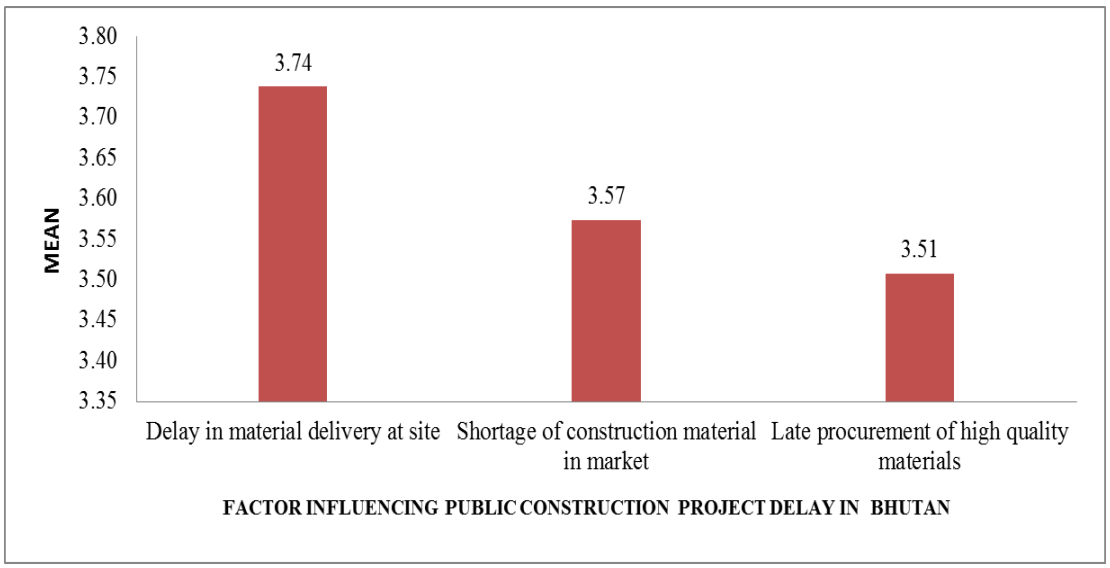

Figure 5-5 Critical factors of material catagory

5.3.2 Comparison of viewpoint for Construction Labor related delay

The graph in the Figure 5-6 and Table 5-6 compare the perceptions of contractor and government engineer under construction labor category. The level of perception is compared for the factors with the mean value of 3.50 and above.

As illustrated, shortage of national construction labor (mean = 4.03) is rank first from 29 contractors viewpoint. On the other hand, different culture of labor (mean = 3.62) is lower influence to project duration from his perceptions which is rank fourth. Similarly, from the viewpoint of government engineer, the shortage of national construction labor is the most important (mean = 4.10) factor influencing construction delay. The low labor productivity at site (mean = 3.61) is one of the least important factor rank fifth from the viewpoint of contractor impacting minimum to project delay.

However it is interesting to note that from the viewpoint of both the contractor and client, shortage of construction labor is rank first. This indicates that lack of national construction labor is one of the main concerns to both the respondents. This is closely linked with the least importance attach by the Bhutanese despite accepting the problem for labor demand in Bhutanese construction industry. There is no proper system to calculate the relationship between volume of work and the requirement of labor. The immigrations rules are not applied moderately especially to the foreign construction labor and no new markets for labor are explored from other neighboring countries like Bangladesh and China as an alternative measure.

The unqualified workforce at construction sites (mean = 3.89) is ranked the second from government engineer viewpoint. In any construction industry, it is prerequisite to have an experience and technically sound workforce who can contribute with higher efficiency towards the progress of every site activity. In contrast to other developing countries, Bhutan does not have authorized distributor of quality labor agent and further there is no system to evaluate the volume of work and

to provide short term basic technical education to the low skilled labor to enable improvement of construction skills.

The second significant factor from contractor viewpoint is lack of foreign labor (mean = 3.96). There are no stringent labor laws, for instance, the list of basic facility even in terms of safety gear that need to be provides to the foreign labor and which can impact positively to the workforce. Bhutan possesses very stringent immigration rules and regulations on immigration of foreign labor. Furthermore, the labor ministry permits very less number of foreign construction labor to work in the country.

Table 5-6 Comparison of perceptions from Contractors and Government Engineers for construction labor category

Contractors			
Catagory	Factors influencing construction project delay in Bhutan	Mean	Rank
Construction Labor	Shortage of national construction labor	4.03	1
	Lack of foreign labor	3.96	2
	Low labor productivity at site	3.72	3
	Different culture of labor	3.62	4
Government Engineers			
Construction Labor	Shortage of national construction labor	4.10	1
	Unqualified workforce at site	3.89	2
	Lack of foreign labor	3.84	3
	Different culture of labor	3.64	4
	Low labor productivity at site	3.61	5

The fourth and fifth rank factors from the viewpoint of government engineer are difference in culture of labor (mean = 3.64) and low labor productivity at site (mean = 3.61) respectively. However it is noted that there exist a remarkable contrast from the perceptions of both the respondents on factors that influence project delay in Bhutan.

The culture of labor is taken into account in relation to the intake of Indian construction labor in Bhutanese construction industry. The maximum border area of Bhutan is marked up by West Bengal, a state of India from where the maximum number of foreign construction labor is employed.

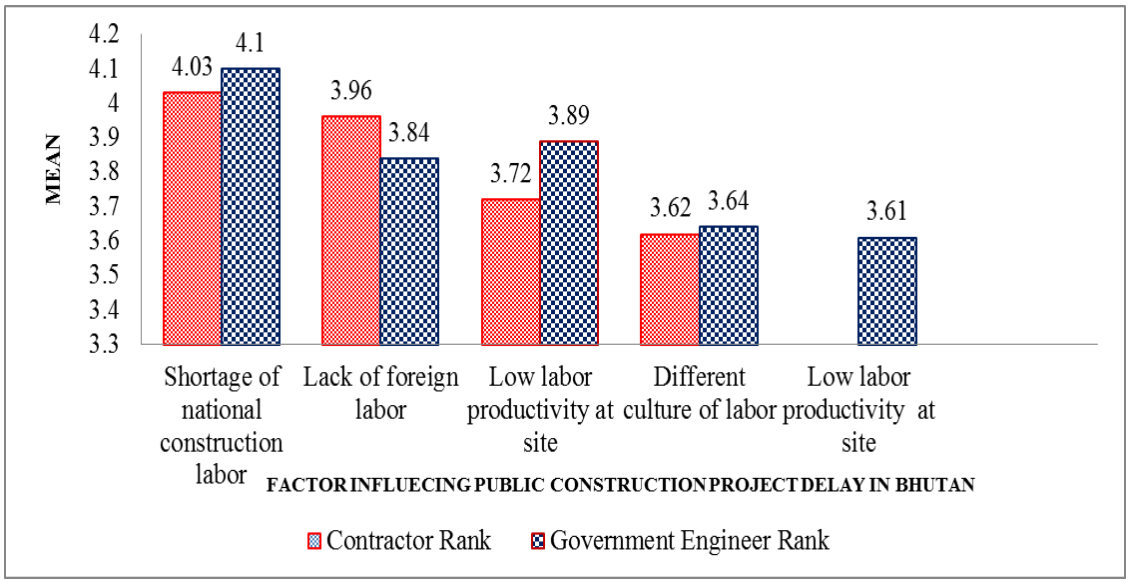

Figure 5-6 Mean difference of factors between the Contractors and Government Engineers under construction labor category.

In comparison to all the Indian states, West Bengal is the state which observes different kinds of festival, providing long public holidays. Because of this, the labor of this state working in Bhutan often visit their hometown during all these occasions leaving behind low number of construction worker in Bhutan in some cases.

5.3.3 Comparison of viewpoint for Equipment related delay

The Figure 5-7 and Table 5-7 compare the perceptions for the contractors and government engineers under equipment classification. The level of perception is compared for the factors with the mean value of 3.50 and above.

As illustrated below, lack of modern equipment hiring agency (mean = 3.90) is first rank from government engineer viewpoint and this factor is the main cause of

delay under equipment classification in public construction in Bhutan. Similarly, from the viewpoint of contractor, the unavailability of equipment parts in the market (mean = 3.58) is the most significant factors impacting minimum on project delay. Unavailability of equipment parts in the market (mean = 3.51) is ranked third from the viewpoint of government engineer.

In Bhutan, the availability and purchase of equipment is quite difficult task for the contractor which makes them dependent on the application of old and obsolete equipment at the site which has lower output. The lower productivity of equipment also has a significant impact on the project performance since project time is regarded as the integral part of every plan that the construction industry develops for the performance of any contract work.

Table 5-7 Comparison of perceptions from Contractors and Government Engineers for equipment category

Contractors			
Classification	Factors influencing construction project delay in Bhutan	Mean	Rank
Equipment	Unavailability of equipment parts in the market	3.58	1
Government Engineers			
Equipment	Lack of modern equipment hiring agency	3.90	1
	Unavailability of modern equipment	3.61	2
	Unavailability of equipment parts in the market	3.51	3

The tax policy for the import of construction equipment is very high which discourages the hiring agency forming open authorized dealership agent. Since different types of projects require application of different types of equipments, the specifications of contractors specialized in certain work like construction of road, building, bridges can induce the contractor to prepare themselves to handle specialized projects and equipment. Further it can add positive impact on the

performance of the project and also reduce the project duration and disruptions in the construction industry.

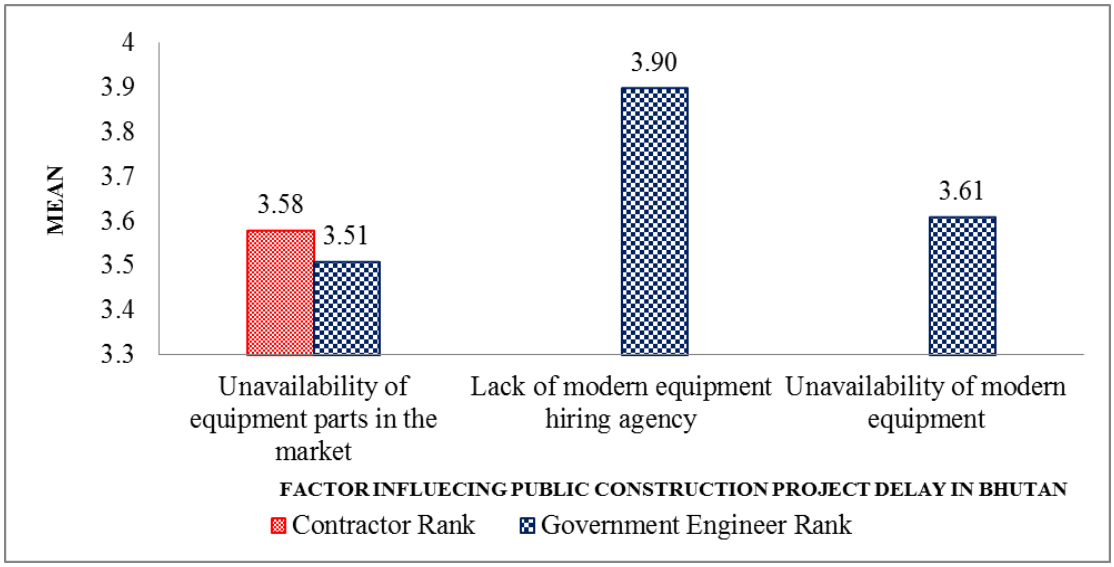

Figure 5-7 Mean difference of factors between Contractors and Government Engineers under equipment category

5.3.4 Comparison of viewpoint for Contractor related delay

As represented in Figure 5-8 and Table 5-8, the factors are compared from the perceptions of contractors and government engineers for the contractor catagory. The level of perception is compared for the factors with the mean value of 3.50 and above. The mean values of all the factors from the viewpoint of contractor are below 3.50 which express that there is no strong level of agreement from contractor viewpoint for this category.

As illustrated below, improper planning and scheduling of the contractor and inadequate technical staff for project have same mean value (mean = 3.90) is ranked first from government engineer viewpoint. This indicates that both the factors have same effects to project delay from his viewpoint. Proper planning and scheduling is the significant factor for successful implementation of project. Bhutan faces deficiency of professional project manager, contractor and other technical expertise who can prepare workable planning and scheduling of the project after the

preliminary investigation of the project site as well as carrying out detailed survey as per the topography of the location.

Besides, there is a huge shortage of technical personnel on construction project who can plan and schedule the project effectively. There is no proper utilization of time in an appropriate and practical method towards planning and budgeting before actual site implementation. Similarly, lack of basic technical knowledge of the contractor (Mean = 3.75) is fifth rank and it means that from his viewpoint, it is affecting less to project delay in Bhutan. The small Bhutanese contractors usually acquire low technical knowledge and thus poor performance on construction project.

Table 5-8 Comparison of perceptions from Contractors and Government Engineers for contractor category

Government Engineers			
	Factors influencing construction project delay in Bhutan	Mean	Rank
Contractor	Inadequate technical staff	3.90	1
	Improper planning and scheduling	3.90	2
	Over project number in hand	3.79	3
	Poor site management and communication	3.77	4
	Lack of basic technical knowledge	3.75	5

In many cases, these contractors require guidance of junior engineers who hold diploma in engineering by qualification. Mandatory rules for the contractors are inadequately practiced while there is requirement of sufficient technical manpower. The existing three technical institutes in Bhutan which produces national engineers and technicians are incapable in fulfilling the demand of the construction industry. On the other hand the top engineers are absorbed in the public sectors which affect the contractor in managing the technical human resource.

In addition to the contractor fraught with above difficulties, the fixing of contract duration is still an arbitrary approach. There is no proper study of time cost relationship in fixing the duration of the project. The duration is fixed by the project manager or the district engineer by judging the experience of work and execution of similar project in the past by the contractor. In real working environment, two or more projects are not similar always because they depend on various factors related to time, cost, quality and safety. The tendering committee provides least supplementary importance to calculate the real and practical contract duration. It is also an essential exercise to analyze the realistic time cost relationships which results in working with the realistic contract duration inclusive of other project related factors. Specifying the uniform bidding time for similar projects judging the experience of similar work of the contractor it is a non-professional practice which has affected project completion time in Bhutan.

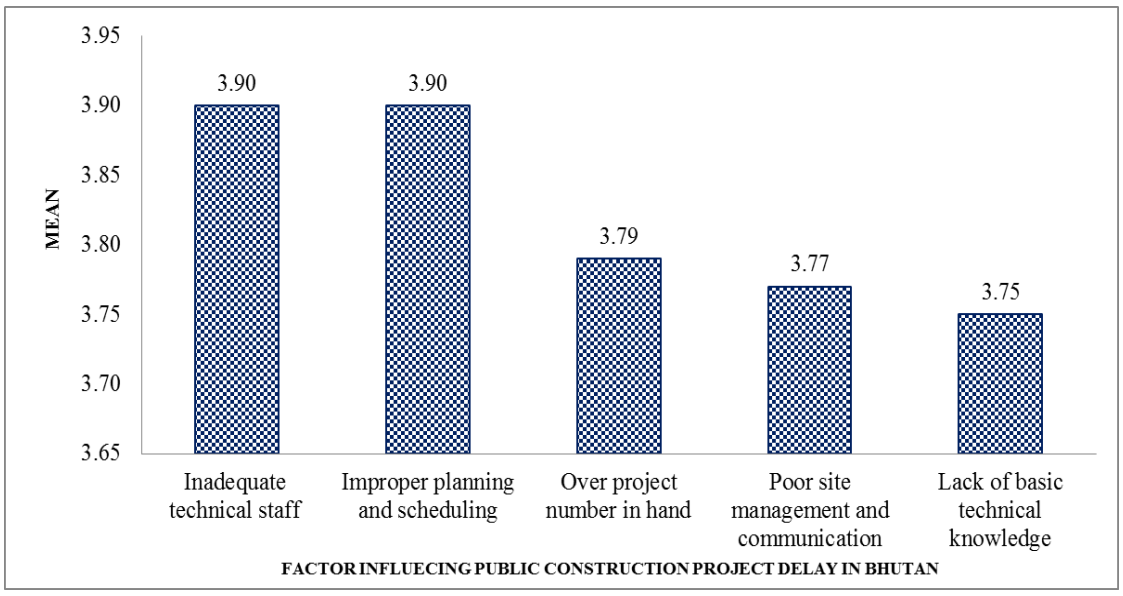

Figure 5-8 Mean difference of factors between Contractors and Government Engineers under contractor category

The contractor's financial strength is one of the main requirements for successful performance of any construction project. But some financially weak contractors depend mostly on other source of finance like banks and credit facilities.

It is worth mentioning that there is delay in payment for the progress of the work due to lengthy bureaucratic procedures in the governmental organizations. The delay in payment directly affects the cash flow pattern of the contractors thereby impacting the delay in procurement of materials and equipment. This sets precedence towards delaying the regular payment to the labors which in built reluctance on site workers working efficiently. In the process, the finance employees are reluctant to make payments for the additional works not listed in the estimate documents. The cash flow problems are more serious at the district engineering level than at the head office level. This is because all the funds are allocated by ministry of finance to the head offices located in Thimphu. Further most of the district offices are located far from the capital, lack of constant follow up in person at districts office delays the release of budget at the district level. This chain of interlinks within the projects finally affects the performance of the projects influencing construction project delay in Bhutan.

There is no proper site management and communication due to lack of necessary manpower and this problem occurs during execution of more than one project at different locations at the same time by the contractor and even by the client. In turn it develops lack of proper communication between the contractor and the client. The supervising engineer of the contractor at the sites has minimum authority for the decision making on any changes over the additional work. On the other hand many contractors are regularly engage with their personal life resulting in poor communication and project performance. Contractor not making stringent decision because of his poor technical knowledge is reluctant to take project risk.

A good communication within the project participants delivers clear understanding on the quality of information flow besides information on availability of technical and financial resource. Smooth inspection and testing of the completed works jointly by the site engineer of the client and contractor or his project supervisor is effective before the subsequent running bill for the completed works is processed by the head office. This also make the contractor to claim for the bill without delay upon verification by the concerned engineer. Finally, the cash received from the head office can be utilized on other activities like payment to the labor and purchase of

extra items and continuation over next site activity. However the government sector should ensure that the budget allocation for the project is approved and regular follow up with the donor agencies is required. Therefore, practicing smooth site management and communication among all the project participants will progress in completion of the project without delay.

5.3.5 Comparison of viewpoint for External factor related delay

The plotting in Figure 5-9 and Table 5-9 compare the perceptions of contractor and government engineer under external factor category. The level of perception is compared to the factors with the mean value of 3.50 and above which shows the strong level of agreement for the factors.

As illustrated, lack of modern construction technologies (mean = 3.77) in the Bhutanese construction industry is ranked first from government engineer viewpoint and this factor is the main cause of delay under external factor category. The limitation of exchange rate (mean = 3.64) and unfavorable site condition and allocation of construction project (mean = 3.52) is ranked second and third respectively from the viewpoint of government engineer.

Similarly, from the viewpoint of contractor, limitation of exchange rate (mean = 3.93) is the most important factor that is causing construction delay. The unfavorable site condition and allocation of construction project (mean = 3.79) and insufficient contract duration for remoteness of project location (mean = 3.58) is rank second and third respectively.

Besides the dependence Indian construction labor in the Bhutanese construction industry, the construction materials including the import of construction equipment are largely imported from India as the Indian merchandise trades these materials with Indian currency only. Import of such goods and services require foreign currency (Indian Rupee) to enhance economic stability. The banking services in Bhutan runs

deficit of Indian currency which make major impact to contractor to execute the projects over actual plans and hence it results in the construction delay.

Table 5-9 Comparison of perceptions from Contractors and Government Engineers for external factor category

Contractors			
Classification	Factors influencing construction project delay in Bhutan	Mean	Rank
External Factor	Limitation of exchange rate	3.79	1
	Unfavorable site condition and allocation of construction project	3.79	2
	Insufficient contract duration for remoteness of project location	3.58	3
Government Engineers			
External Factor	Lack modern construction technologies	3.77	1
	Limitation of exchange rate	3.64	2
	Unfavorable site condition and allocation of construction project	3.52	3

There is deficiency in application of modern and advanced construction technologies in public and even private project. For more than a decade, many of the builders follow traditional methods of construction. The difficulties in transporting modern and heavy equipment to the isolated and mountainous construction sites have made many of the contractors to continue practice traditional form of construction method.

The unfavorable site condition and allocation of construction project occur when the foreign consultants do not consider the importance in physical verification of the sites before they design the project. The major public projects in Bhutan usually involve hiring of consultant and engineer from India who works under specific

contract duration. Due to the limitation of time, they complete the final designing and report writing for the earmarked project without proper preliminary study of project location and topography of its surrounding. This poses difficulty during the project execution and higher risk over project duration and cost. As a result, the risk to project cost increases abnormally and delay the project.

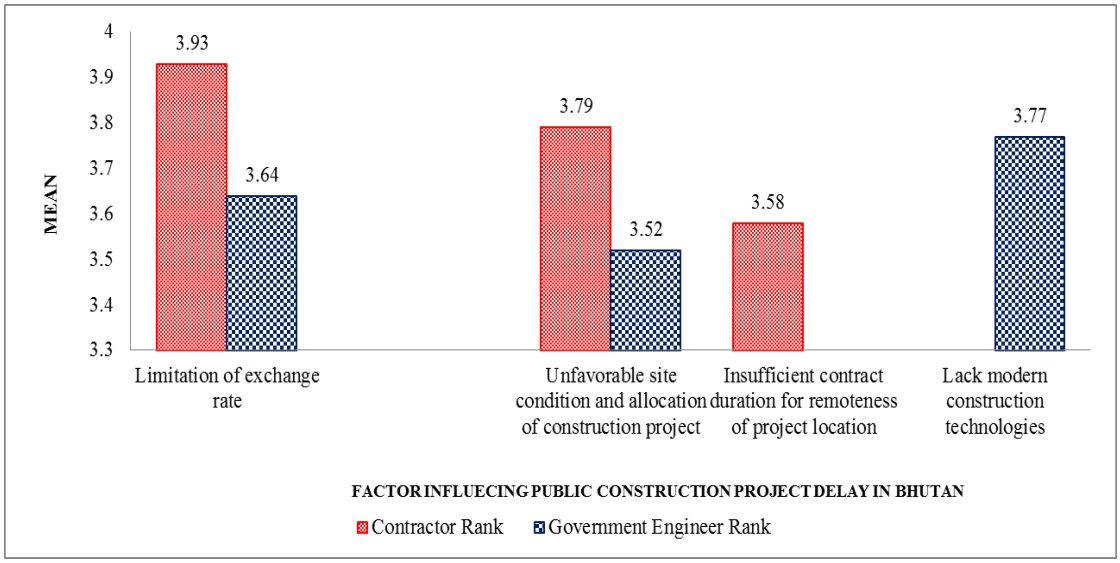

Figure 5-9 Mean difference of factors between Contractors and Government Engineers under external factor category

In addition, many of the contractor experience insufficient contract duration as there is no proper study on the time cost relationship of project which can decide the bid period depending on the location and volume of the project location. There is no realistic bid period provided to the contractor and client specifies the uniform bidding time for similar projects judging the experience of the contractor. There is no proper clause on the procurement regulations that favor the fresh contractor in winning the tender. Similarly, other factors like traffic regulations, accidents during the construction, climatic and bad weather conditions and lack of basic facilities at site like water, electricity and telephone communications are not considered at the time of fixing the contract duration.

As stated earlier, Bhutanese contractors are classified under large, medium and small catagory. As per the regulations of the government, small contractor can execute only one construction project at one time, medium contractor can take up to three projects at a time and the large contractor can execute at least five construction projects at the same time. However, in many cases the contractor tires to execute more number of projects than specified without the notice of the management. There is no system within the procuring agency to check and ensure that contractor sincerely declares the existing work in hand. Nevertheless, several contractors lack ability to carry out multi project management trends. The acceleration of work is not achieved within the contract duration because of the volume of project. In addition, insufficient lighting facilities at site do not facilitate any encouragement with the construction labor to work overtime. Sometimes the scope of the project escalates when the real site condition is different from the plan and variation in the drawing which increases the volume of the work to be executed further increase the duration of project completion. Therefore, the problem of managing the contract duration arises which finally delay the construction project.

5.4 Reliability of factor

The two respondents namely the contractor and government engineer has given their perception to each factors scaling the level of influence of project delay using Likert scaling techniques. As shown in Table 5-10, in order to confirm the factors influencing construction project delay, Cronbach's alpha coefficient of internal consistency is computed for the data.

Table 5-10 Cronbach's alpha for public construction project delay (N=90)

Value	Reliability
0.95	Good

Cronbach's alpha with the value 0.6 or more (Joseph and Rosemary) is acceptable, the reliability of scale of the data with the value of 0.95 was considered to be

acceptable. Based on the value, it is assumed that the questionnaire of the research was reliable, valid and ready for distribution to the sample population.

5.5 Relative Importance Index (RII)

The computation of Relative Importance Index (RII) includes allocation of numerical scale to represent the level of influence of factors applying Likert scaling technique with a five scale range of 5 (very strongly agree) to 1 (very weakly agree) as indicated in the Likert scale shown in Table 3.2. The RII is the ratio of average of scores to the maximum score. RII expresses the relationship between different factors in terms of percentage which is easier to understand. The ranking of all the factors from the viewpoint of both the respondents is shown in appendix C.

5.5.1 Ranking of ten critical factors by RII from contractors viewpoint

As illustrated in Figure 5.11 and Table 5-11, the top seven factors are ranked by RII based on the level of importance for the factor. From the ranking, unqualified workforce at site has the highest RII of 0.807 ranked first and different culture of labor is ranked second with RII value of 0.793.

Table 5-11 Critical factors by Relative Importance Index from viewpoint of Contractors

Factors Influencing Public construction Project delay in Bhutan	RII	Rank
Unqualified workforce at site	0.807	1
Different culture of labor	0.793	2
Conflict within project participants	0.786	3
Delay in obtaining construction permit from municipality	0.759	4
Lack of foreign labor	0.745	5
Low labor productivity at site	0.724	6
Use of obsolete equipment with low working efficiency	0.717	7

The third rank is conflict within project participants (mean = 0.786) and fourth rank is delay in obtaining construction permit from municipality (mean = 0.759). The fifth and sixth factors are lack of foreign labor (mean = 0.745) and low labor productivity at site (mean = 0.724) respectively. Finally the seventh rank factor which influence project delay is use of obsolete equipment with low working efficiency (mean = 0.717).

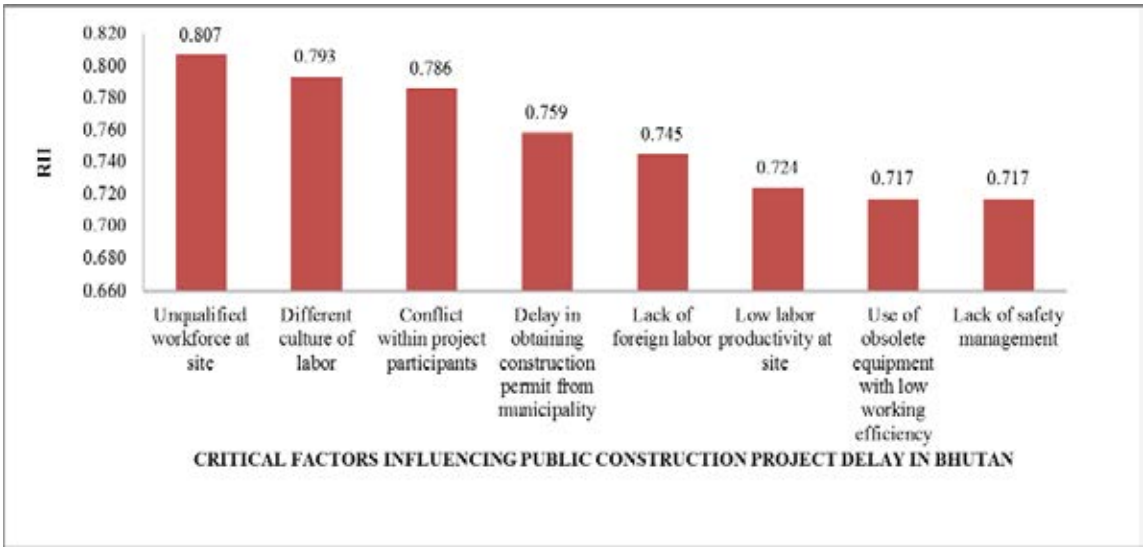

Figure 5-10. 8 critical factors rank by RII

The low labor productivity influence project delay because most of the foreign labor especially the Indian labor do not possess good construction experience and lack technical skill for the execution of construction project influencing project delay. Highlighting on the application of obsolete equipment, Bhutan does not have well set up equipment dealer and most of the equipment require import from India, Thailand and Singapore. The obsolete equipment which frequently wear and tear remains idle till the required maintenance is taken up. The lack of required output from the application of obsolete equipment in the ongoing activities influences project delay. In addition, the import of most of the construction material including the labor and equipment are from India. This dependent character of Bhutanese construction industry with India has a higher influence to construction project delay and cost escalation. The ranking of all the 58 factors from the viewpoint of contractor is illustrated in appendix C.

5.5.2 Rank of critical factors by RII from Government Engineers viewpoint

As illustrated in Table 5.12, the top 21 factors are rank by RII based on the level of importance for the factor. As shown, the first rank of factors from the viewpoint of government engineer is the unqualified workforce at site with RII of 0.820. The second and third ranks are lack of modern equipment hiring agency and improper planning and scheduling by contractor with RII value of 0.780 each. The fourth and fifth factors are inexperience sub-contractor and shortage of national construction labor with RII values of 0.780 and 0.777 respectively. The sixth rank is low labor productivity at site with RII of 0.767.

The Figure 5.12 represents the ten critical factors graphically from the viewpoint of government engineers.

In Bhutan, most of the public projects are time bound and budget tied. If the fund allocated for the particular public project is not utilized within the specified duration, the fund do not gets reallocated to other activities. This time bound system is one feature of the bureaucratic process in Bhutan.

Table 5-12 Rank of critical factors by RII from Government Engineers viewpoint

Factors Influencing Public construction Project delay in Bhutan	RII	Rank
Unqualified workforce at site	0.820	1
lack of modern equipment hiring agency	0.780	2
Improper planning and scheduling	0.780	3
Inexperience sub-contractor	0.780	4
Shortage of national construction labor	0.777	5

During special cases, when the project need to be executed within the specified time, the drawings of the public project when scrutinize by municipal corporations provide certain consideration during approval. But generally, the municipal authority scrutinizes the designs more cautiously for the public projects which require more

time to get an approval. Further due to insufficient technical manpower, the design takes longer time than normal for final approval and is sometimes subsided with the lengthy bureaucratic process in the government organizations.

Table 5-12 Rank of critical factors by RII from Government Engineers viewpoint (continues)

Factors Influencing Public construction Project delay in Bhutan	RII	Rank
Low labor productivity at site	0.767	6
Lack of basic technical knowledge	0.757	7
Over project number in hand	0.754	8
Audit objection is the main concern for decision maker	0.754	9
Inadequate technical staff	0.751	10
Delay in material delivery at site	0.748	11
Unreliable sub-contractor	0.741	12
Different culture of labor	0.728	13
Conflict within project participants	0.728	14
Lack of foreign labor	0.721	15
Equipment allocation problem at site	0.721	16
Shortage of construction material in market	0.715	17
Delay in obtaining construction permit from municipality	0.705	18
Late procurement of high quality material	0.702	19
Use of obsolete equipment with low working efficiency	0.702	20
Delay in progress payment of running bills and other overheads	0.702	21

The seventh and eighth factors are lack of basic technical knowledge of contractor and over project number in hand. They have the RII values of 0.757 and 0.754 respectively.

In Bhutan, the government sectors have higher dependency ratio over the financial assistance provided by the government of India. If the budget is released on

time, the payment can be provided to the contractor for the submitted running bills and other overheads for the completed work. With the aid of payment received from the public department, the contractor continues over the next activity. But usually the budget requires longer time to release from the Indian government which poses difficulty for the public department to disburse payment for the contractor. The chain between the external donor for financial assistance, government sector and the contractor links to project completion on time.

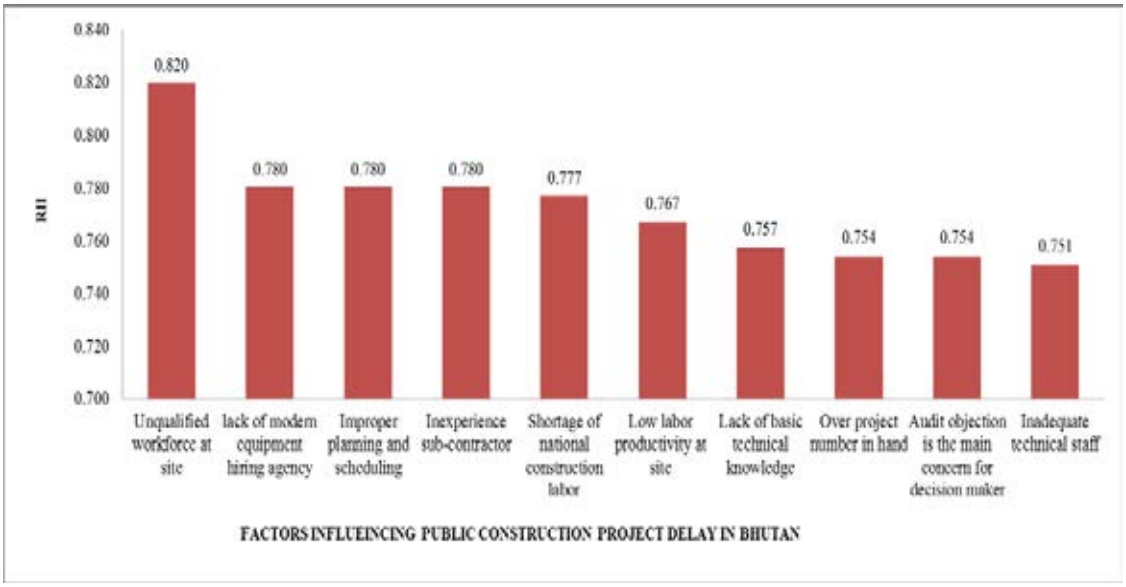

Figure 5-11 Ranking of 10 critical factors by RII

Finally the ninth and tenth ranks are concerns of audit objection for decision maker and inadequate technical staff of contractor with the RII values of 0.754 and 0.751 respectively.

During the execution of the public projects, the government counterpart usually makes many changes in order slowing the progress of works. The change in specification of the materials is one of the elements that usually experience in public projects. This is because the contractor depends on import of the specified constituents if not available in Bhutan. In the process, this overruns the actual contract duration delaying the project. The limited exchange rate especially the Indian Rupee with the Bhutanese currency from the financial institutes leads to project delay.

Furthermore, procuring the construction material from India requires substantial amount of Indian rupee which most of the Bhutanese builder do not possess to purchase the construction materials on time. This influence project delay in Bhutan. The ranking of all the 58 factors from the viewpoint of government engineer is illustrated in appendix C.

5.6 Frequency Index (FI)

The computation of Frequency Index (FI) includes allocation of numerical scale to represent the level of influence of factors applying Likert scaling technique with a five scale range of 5 (very strongly agree) to 1 (very weakly agree) as indicated in the Likert scale shown in Table 3.1. The frequency index is used to rank the factors of delay based on the frequency of occurrence as identified by the participants. FI expresses the relationship between different factors in terms of percentage and can be interpreted in simple method.

5.6.1 Ranking of ten critical factors by FI from contractors viewpoint

In Figure 5.13 it represents the critical factors ranked by frequency index from the viewpoint of 29 contractors. However from the total of 58 factors,8 of them are found to have strong level of perception that influence project delay from their viewpoint.

As indicated from the figure below, the unqualified workforce at site (FI = 80.69) is the most frequently occurring factors that influence project delay in Bhutan. This is because most of the foreign labors imported from India are illiterate and inexperience in construction. This affects the construction productivity and delaying to the project. The second rank from FI is different culture of labor (FI = 79.31). The working culture of Indian labor is not similar in many aspects is relation to the working culture of Bhutan. This difference in culture affects the construction productivity and time overrun in Bhutan.

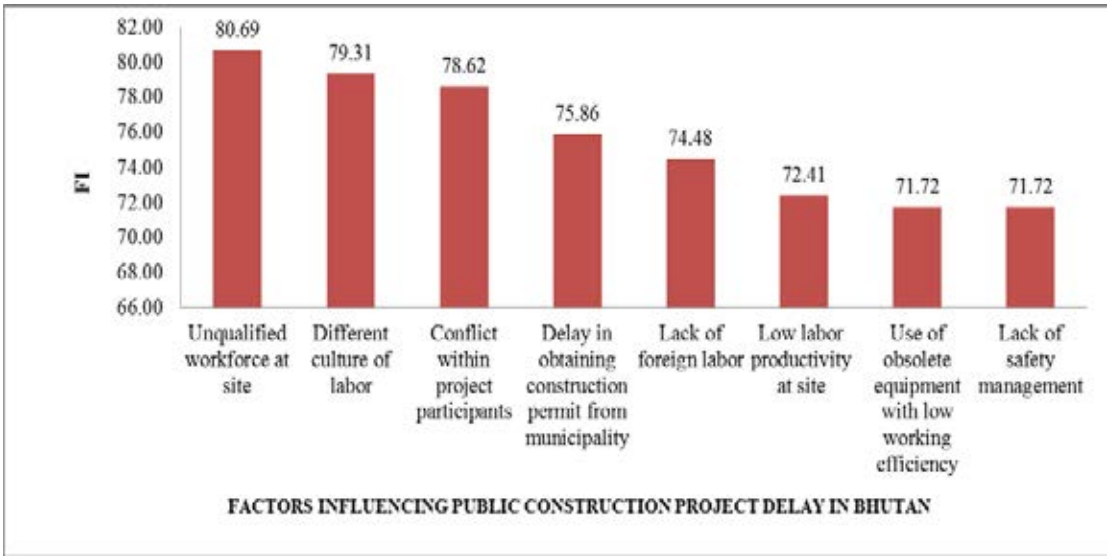

Figure 5-12. Ranking of critical factors by FI from Contractors viewpoint

The third and fourth highest frequency index rank is the conflict with project participants (FI = 78.62) and delay in obtaining construction permit from municipality (FI = 75.86). The fifth and sixth ranked factors are lack of foreign labor (FI=74.48) and low labor productivity at site (FI = 72.41). The productivity in Bhutan is affected in part by the cold climatic condition which affects the productivity of workers. In addition, the setting time for the formwork and other concreting usually takes longer duration in slow downing the progress of activities. The factors having seventh and eighth rank are use of obsolete equipment with low working efficiency (FI = 71.72) and lack of safety management (FI = 71.72). However the FI values of both these factors are same which indicate that the frequency of occurrence for this problem is similar from the viewpoint of contractor.

5.6.2 Ranking of critical factors by FI from government engineers viewpoint

In Figure 5.14 it represents the critical factors rank by frequency index from the viewpoint of 61 government engineers. However from the total of 58 factors, 21 of them are found to have strong level of perception that influences project delay from their viewpoint. However the top ten factors are represented graphically. The plotting from graph shows that unqualified work force at site (FI=81.97) is the first rank. It is observed that three factors as lack of modern equipment hiring agency, improper

planning and scheduling and inexperience sub-contractor are characterized by same value of frequency index of 78.03. This infers that these three factors are frequently occurring at the same time which influence project delay. The fifth and sixth critical factor ranks are shortage of national construction labor (FI=77.70) and low labor productivity at site (FI=76.72).

Similarly, the seventh rank is lack of basic technical knowledge (FI=75.74). The eighth and ninth rank factors that have higher frequency of occurrence are over project number in hand and audit objection as concern for decision maker which carry same FI value of 75.41 each. Many public sectors in Bhutan are headed by non-technical professionals who have inadequate technical knowledge.

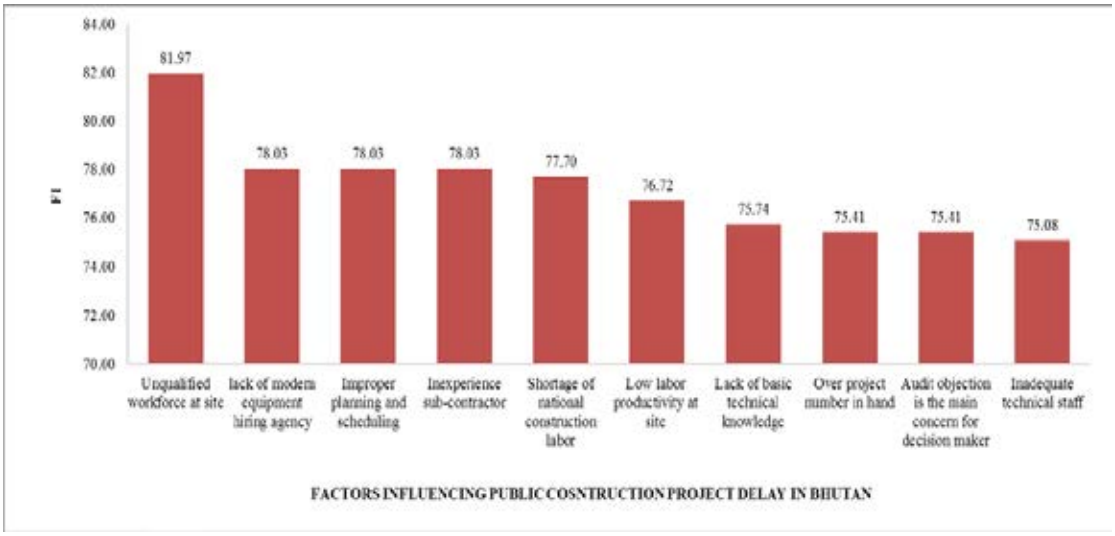

Figure 5-13. Ranking of ten critical factors by FI from Government Engineers viewpoint

5.7 Result of Independent sample by t- test analysis

The similarity and difference in perception of the government engineer and the contractor for the list of factors influencing construction project delay is determined by analyzing the data set using the independent sample t- test as shown in Table 5-13. The factors analyzed for this test uses the SPSS program for finding the result shown in Table 5-13 and 5-14.

Table 5.13 Similar in perception of Government Engineers and Contractors

Similar Factor	Government Engineer	Contractor	Over all mean	Rank	Sig- 2 tailed
	Mean	Mean			
Unqualified workforce at site	4.10	4.03	4.07	1	0.808
Different culture of labor	3.64	3.97	3.80	2	0.221
Conflict within project participants	3.64	3.93	3.79	3	0.355
Low labor productivity at site	3.84	3.62	3.73	4	0.491
Shortage of national construction labor	3.89	3.45	3.67	5	0.141
Lack of foreign labor	3.61	3.72	3.67	6	0.646
Delay in obtaining construction permit from municipality	3.52	3.79	3.66	7	0.358
Use of obsolete equipment with low working efficiency	3.51	3.59	3.55	8	0.772
Delay in material delivery at site	3.74	3.31	3.52	9	0.129
Shortage of construction material in the market	3.57	3.45	3.51	10	0.635
Equipment allocation problem at site	3.61	3.38	3.49	11	0.419
Rework due to error during construction	3.41	3.48	3.45	12	0.801
Delay in progress payment of running bills and other overheads	3.51	3.38	3.44	13	0.637

Table 5.13 Similar in perception of Government Engineers and Contractors (continues)

Similar Factor	Government Engineer	Contractor	Over all mean	Rank	Sig- 2 tailed
	Mean	Mean			
Lack of safety management	3.30	3.59	3.44	14	0.302
Emphasis on specification of the design	3.21	3.48	3.35	15	0.334
Unreliable supplier of construction material	3.34	3.34	3.34	16	0.998
Limitation of exchange rate	3.34	3.31	3.33	17	0.904
lack of experience in construction	3.33	3.28	3.30	18	0.837
Unavailability of equipment parts in the market	3.48	3.10	3.29	19	0.181
Delay in import of construction material	3.49	3.03	3.26	20	0.134
Inadequate design	3.18	3.31	3.25	21	0.627
Indirect impact of interest rate	3.05	3.41	3.23	22	0.173
Inconsistency in price of material	3.28	3.14	3.21	23	0.584
Unavailability of basic construction material in the market	3.16	3.24	3.20	24	0.778
Poor and irregular site inspection	3.20	3.17	3.18	25	0.292
Poor site management & communication	3.31	3.03	3.17	26	0.251

Table 5.13 Similar in perception of Government Engineers and Contractors (continues)

Similar Factor	Government Engineer	Contractor	Over all mean	Rank	Sig- 2 tailed
	Mean	Mean			
Late in approval of design and drawing from concerned authority	2.95	3.38	3.17	27	0.113
Lengthy bureaucratic procedures	3.08	3.21	3.14	28	0.696
Interference due to change in system of government during construction phase	3.03	3.24	3.14	29	0.400
Suspension of work for design change	3.03	3.17	3.10	30	0.581
Scope of project is not equivalent to the qualification of the engineer	3.02	3.17	3.09	31	0.532
Difference in exchange rate of foreign currency	3.11	3.07	3.09	32	0.885
Difference in exchange rate of foreign currency	3.11	3.07	3.09	32	0.885
Complexity of project design to execute	3.15	3.00	3.07	33	0.576
Change in material types and specification during construction	3.05	3.07	3.06	34	0.948
Lack of finance from concerned public ministries and agencies	2.80	3.31	3.06	35	0.061

Table 5.13 Similar in perception of Government Engineers & Contractors (continues)

Similar factor	Government Engineer	Contractor	Over all mean	Rank	Sig- 2 tailed
	Mean	Mean			
Insufficient contract duration for the scope (volume) of the project.	3.16	2.93	3.05	36	0.398
Slowness in decision making process	2.85	3.14	3.00	37	0.303
Difficulties in financing the project	3.02	2.97	2.99	38	0.851
Unfavorable site condition and allocation of construction project	3.23	2.72	2.98	39	0.098
Lack of knowledge on using advance engineering software	3.00	2.90	2.95	40	0.684
Poor quality of construction material	3.07	2.79	2.93	41	0.331
Lack of coordination with parties	3.07	2.76	2.91	42	0.307
Inadequate design team experience	3.07	2.72	2.89	43	0.178
Improper feasibility study during inception of project.	3.03	2.72	2.88	44	0.240
Insufficient contract duration for remoteness of project	2.84	2.90	2.87	45	0.827
Lack of modern construction technologies	3.05	2.62	2.83	46	0.098

Table 5.13 Similar in perception of Government Engineers & Contractors (continues)

Similar factor	Government Engineer	Contractor	Over all mean	Rank	Sig 2-tailed
	Mean	Mean			
Regular change order by client during construction	2.67	2.83	2.75	47	0.506

As shown, the t-test result shows that from the total of 58 factors listed, 47 of them have similarity in perception of both the government engineer and contractor. In other words, both the respondents agree that forty seven factors influence to project delay in Bhutan .

Table 5.14 Difference in perception of Government Engineers and Contractors

Significant Difference Factor	Government Engineer	Contractor	Rank	Sig 2-tailed
	Mean	Mean		
lack of modern equipment hiring agency	3.90	3.21	1	0.009
Improper planning and scheduling	3.90	2.97	2	0.000
Inexperience sub-contractor	3.90	3.00	3	0.000
Lack of environmental clearance	2.89	3.41	4	0.047
Lack of basic technical knowledge	3.79	3.03	5	0.003
Over project in hand	3.77	3.24	6	0.039
lack of training and awareness	3.77	3.10	7	0.014
Inadequate technical staff	3.75	2.93	8	0.001
Unreliable sub-contractor	3.70	2.79	9	0.001

Table 5.14 Difference in perception of Government Engineers and Contractors (continuous)

Significant Difference Factor	Government Engineer	Contractor	Rank	Sig 2-tailed
	Mean	Mean		
Late procurement of high quality material	3.51	2.72	10	0.001
Unavailability of modern equipment	3.43	2.83	11	0.009

As represented, the results of t-test also show the result for the lists of factors which have difference in perception of government engineer and contractor. The result shows that from the total of 58 factors, 11 of them have difference in perception of both the government engineer and contractor. In other words, both the respondents do not agree in common that these 11 factors have influence to project delay in Bhutan. The details of result for t-test are shown in appendix D.

5.8 Recommendations for solving construction project delay in Bhutan

The public construction project delay is widespread in most of the construction sectors in Bhutan. It is however noticed that problems related to project delay resulting in project cost overrun and over usage resources have higher frequency of occurrence especially in the regions where the availability of basic resources like human, equipment and construction materials are inadequate. After the identification of all the factors in this study, the determination of critical factors by using the statistical analysis is found to be useful in order to solve problems related to public construction project delay in Bhutan. The Table 5-15 shows the technique for providing the useful recommendations to prevent construction project delay.

Table 5-15 Technique for final recommendation to prevent construction project delay

Classification	Critical Factors	Recommendation	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency

To frame the useful recommendations for project delay in Bhutan, a total of ten experts are identified from six public sectors and four large private construction companies who have at least ten years of working experience in construction project. In depth interviews are conducted with these experts in order to seek valuable suggestions which can solve the problems of project delay in Bhutan. However, during the interviews, the experts extended full cooperation and assistance. The information of the ten experts is appended in appendix E.

The top rank factors each from the viewpoint of government engineer and contractor are selected for the recommendation. A total of 58 factors are grouped under seven categories and from these top two factors from each category are finally selected to provide useful recommendations.

5.9 Useful suggestions and recommendations

From the discussion of the result it is found that the construction project delay is prevailing in construction industries of Bhutan. Therefore, useful recommendations are provided for the public department and also the private contractor to prevent and minimize construction project delay in Bhutan.

5.9.1 Delay in material delivery at site

Preparation of effective material procurement plan and bill of quantity by the contractor should be made mandatory during tendering stage. Alternatively, the

authorities should explore the possibility of identifying standard material manufacturer in other neighboring countries. The dealer should be mandated to import construction materials from these pre-selected companies.

5.9.2 Shortage of construction material in market

The procurement rules and regulations emphasizing on the specification of materials should be reviewed to facilitate the construction process. The mobilization advance for the contractor should be increased in order to ensure availability of adequate construction material. Provisions should also specify the replacement of specified materials with the alternative materials type setting the quality of construction.

5.9.3 Shortage of national construction labor

The introduction of better incentives and trainings to the job seekers especially the unemployed youth can help to increase the national labor force. Advertising the long term significance and benefits of working and experience in construction sectors can encourage more national labors.

5.9.4 Lack of foreign labor

Enforcement of proper working environment with provision of basic living facilities including trouble-free basic health care system and also providing reasonable incentives to encourage more foreign labor to participate in construction project in Bhutan. In addition, exploring new labor markets in other neighboring countries like China, Bangladesh and Nepal can reduce the labor shortage problem in Bhutan.

5.9.5 Unqualified workforce at site

Introduction of basic construction skills for the unqualified workers can increase the productivity of labor. The introduction of authorized distributor of quality labor

outlet in the country can increase the performance of the project.

5.9.6 Lack of modern equipment hiring agency

The flexibility to lower import tax for machineries can increase number of modern equipment hiring agency which would ease and overcome the manual working condition in Bhutan.

5.9.7 Unavailability of modern equipment and its spare parts

Construction firms should strengthen bilateral relationship with other developing countries for the purchase of modern equipment and capture the knowledge and productivity of modern construction equipment. An introduction of agent based system operated by the private company for the readily available stock of all the equipment parts should be encourage. Application of online system for the delivery of modern equipment parts creates a better working environment.

5.9.8 Inadequate technical staff

The increase in the number of vocational trainings institutes in the country likely to reduce this problem. Preparing proper human resource management plan can succeed the project with adequate staff.

5.9.9 Improper planning and scheduling by contractor

Proper planning and scheduling of the project prepared by the contractor should match with the existing resources and time. The contractor and his team should utilize time appropriately on planning, scheduling and budgeting applying various planning techniques available like CPM, PERT and RSM to schedule the activities.

5.9.10 Difficulties in financing the project

The problem of financing occurs when the budget allocated for the particular project is not utilized with in the financial year and it is appropriated to the government before the succeeding financial year. For instance, if the public project which exists in the five year plan is not executed within the earmarked financial year, the government should allow the budget to continue for the spillover works in the next financial year.

5.9.11 Delay in progress payment of running bills and other overheads

Late payment of running bills to the contractor delays the overall project performance. Hence it is recommended that complete bills should be submitted on time to head office and the procuring agencies should verify and pay the payment within 30 days from the date of submission of bills. If budgets are not available on time, the procuring agency should be held responsible to follow up on the release of budget from other alternative sources. The project supervising engineer should verify and pass the bills on time.

5.9.12 Interference due to change in the system of government during construction phase

The contract law, rules and regulations require strict implementation in the public construction sector especially in cases related to the interference from the formation of new government.

5.9.13 Lack of knowledge using advance engineering software

Initiatives for consistent trainings exposure, knowledge and the application of advance engineering technologies is required to upgrade the performance of the consultant. The government should also ensure that any consultant applying for the

consultancy license should have full term design engineer, architect and quality surveyor who can use these software.

5.9.14 Limitation of exchange rate

The public department needs to pursue the discussion at policy level with the government of India to provide adequate Indian currency to the Bhutanese monetary authorities so that the construction and other economic activities remain unaffected due to insufficient foreign currency reserves.

5.9.15 Lack of modern construction technologies

The capturing of technology that are applied by the developed nation in Bhutan need to be given higher importance for Bhutanese construction sector to perform more independently over similar project within the stipulated duration.

5.10 Summary

In summary, this chapter lists all the factors influencing construction project delay in Bhutan identified and grouped from two sources of literature review and face to face interview with the government engineer and the contractor. The data collection carried out in four districts of Bhutan namely Thimphu, Paro, Chhukha and Phuentsholing. The data is collected from 61 government engineers from public sector and 29 contractors from private sector which results to sample size of 90 respondents. During the data collection period, it was observed that most of the project participants face the problems of human resources starting from working level to decision making level in construction sector.

The analysis and ranking of factors are discussed in two different approaches. The first approach ranks the factors from the viewpoint of 61 government engineers and 29 Bhutanese contractors and discussed the results. The second approach ranks the factors from the viewpoint of 29 government engineers and equally 29 Bhutanese

contractors and discusses the results in order to reduce the biasing of result. Statistical tools like mean, standard deviation, coefficient of variation, frequency index and relative importance index are applied for the data analysis. The method of data analysis also apply SPSS program to run t-test. This test is run to check the similarity and significance difference of the factors from the perceptions of government engineer and contractor.

The sample size calculation and the reliability test are also computed in order to validate the internal consistency of the data. The screening and ranking of factors work out in four categories as overall ranking, ranking from the contractor viewpoint, ranking from the government engineer viewpoint and finally comparison of perception and ranking of factors from each of the seven category for 58 factors. The key factors from each of seven groups for both contractors and engineers are represented by bar graphs and tables. Finally, top two factors each from seven categories are selected to provide useful recommendations in this study.

CHAPTER VI
CONCLUSIONS

6.1 General

The first objective of this research is to identify and group the factors that influence the construction delay in context to Bhutanese construction industries. The second objective is to rank the factors evaluating using descriptive statistical methods like mean, standard deviation, relative importance index, frequency index and also check for the reliability index. The significance of the factors is tested applying t-test from SPSS software. The third objective of this study is to conduct in depth interview with the construction experts of Bhutan who have at least ten years of working experiences in construction projects. This is done to provide useful recommendations from the result of this research to resolve the problems of project delay in Bhutan.

6.2 Conclusion

The public construction project delay is widely spread in Bhutanese construction industries from decades. The construction sector in Bhutan is still in its infancy stage and still follows age-old traditional methods of construction processes in many parts of the country. Inadequate human resources in the field of technical education, inability of fulfilling the required demand of construction material and absence of modern construction equipment and technology have contributed towards vulnerable stage of construction project, resulting to delay and cost overrun. Comparative studies are done after screening and ranking the factors separately from the viewpoint of government engineer and contractor since it is understood that different project participants have different viewpoints in relations to each factor that influence project delay.

In the overall ranking, the factors which have mean value of 3.50 and above are screen. From the viewpoint of 90 respondents comprising of 29 contractors and 61 government engineers, shortage of national construction labor in Bhutan is rank first with mean value of 4.08. The Bhutanese harbor minimum interest to work as construction labor. This is because of the difficulties and complexity of the working environment of the construction sector. The different culture of labor is rank second with mean value of 3.77. As discussed, most of the construction labor is imported from India and these foreign labor usually have their own working culture indeed not similar in context to Bhutanese construction industry. In order to complete the work within the deadlines, Indian labor are sometime made to work until midnight which is unacceptable to many site workers. There is no proper management of safety culture and promotion for the foreign construction labor due to which the frequency of accidents at construction sites is on increase. The third rank is unqualified workforce at site with mean value of 3.74.

In order to reduce biasing of the result, the overall ranking is also computed from the viewpoint of 58 respondents comprising of 29 contractors and 29 government engineers. From the result, it is found that 30 factors have mean value of 3.50 and above and the level of agreement is strong. The first rank is unqualified workforce at site with mean value of 4.08. Most of the construction labor brought in from India are illiterate and possess inadequate knowledge of construction which affect the project completion time in Bhutan. The second rank is delay in obtaining construction permit from municipality with the mean value of 4.10. The process of scrutiny of design is more stringent in municipal offices as compared to district office and hence requires longer duration for design approval. The third rank is difference culture of labor with mean value of 4.07.

The factors rank from the viewpoint of 29 contractors screens 8 factors with the mean value 3.50 and higher. From the result, unqualified workforce at site is ranked first with mean value of 4.03, RII value of 0.807 and FI value of 80.69. The second rank is the different culture of labor with mean value of 3.97, RII value of 0.793 and

FI value of 79.31. The third rank factor is conflict within project participant with mean value of 3.93, RII value of 0.876 and FI value of 78.62.

The factors ranked from the viewpoint of 61 government engineers screens 21 factors with value of 3.50 and above. From the results, unqualified workforce at site ranked first with the mean value of 4.10, RII value of 0.820 and FI value of 81.97. The second rank factor is lack of modern equipment hiring agency with mean value of 3.90, RII value of 0.780 and FI value of 78.03. The third rank factor is improper planning and scheduling of contractor with mean value of 3.90, RI value of 0.780 and FI value of 78.03.

The factors are further compared and rank from seven categories each comprising of material, construction labor, equipment, contractor, government engineer consultant and external factors from the viewpoint of sixty one government engineers and twenty nine contractors.

The result indicates that three factors have value more than 3.50 from government engineer viewpoint which are delay in material delivery at site with mean of 3.74, shortage of construction material in the market with mean of 3.57 and late procurement of high quality material with mean of 3.51. However, from the viewpoint of contractor, all the factors under material category have mean value less than 3.50 which concludes that there is no strong level of agreement on the material related factors from their viewpoint.

The result from the construction labor category ranks only 4 factors each for both the respondents which have mean value of 3.50 and above. However, shortage of national construction labor is ranked first with mean value of 4.03 and 4.10 for contractor and government engineer respectively. Lack of foreign labor with mean 3.96 is rank second from contractor and unqualified workforce at site with mean value 3.89 from government engineer viewpoint. The third rank from contractor viewpoint is low labor productivity at site with mean of 3.72. Similarly, lack of foreign labor with mean value of 3.84 is rank third from the government engineer viewpoint.

Likewise, from equipment category, only 1 factor has mean value above 3.50 from contractor and 3 factors above 3.50 from government engineer. From the contractor view, unavailability of equipment parts in the market is rank first with mean 3.58 and the same factor is rank third with mean 3.51 for the other respondent. In addition, from the view of government engineer, lack of modern equipment hiring agency is rank first with mean value 3.90 and unavailability of equipment parts with mean value 3.61 is rank second.

From the factors related to contractor, there are only five factors whose values are more than 3.50 from the viewpoint of government engineer and there is no factor from contractor side. However, from the viewpoint of contractor, inadequate technical staff is rank first and improper planning and scheduling of contractor is rank second each with mean value of 3.90. The third factor is over project number in hand for the contractor with the mean value of 3.79.

Moreover, it is observed from the result that there is no factor which has mean value of at least 3.50 related to government engineer and consultant category.

Similarly, 4 factors from external catagory have mean above 3.50 of which 2 factors exist in common from both the respondent which are limitation of exchange rate and unfavorable site condition and allocation of construction project. The limitation of exchange rate with mean 3.93 is rank first from contractor viewpoint and the same is rank second with mean3.64 for the government engineer. Unfavorable site condition and allocation of construction project is rank second for contractor with mean value 3.79 and the same is ranked third with mean 3.52 for government engineer. The lack of modern construction technologies is ranked first with mean 3.77 from government engineer viewpoint and insufficient contract duration for remoteness of project location with mean value 3.58 is rank third from contractor view.

Finally useful suggestions and recommendations for the critical factors sorted from fifty eight factors are provided to prevent and minimize construction project delay in Bhutan.

The material related delay can be minimized by preparing an effective material procurement plan and bill of quantity by the contractor and submission of this plan to be made mandatory during tendering stage. The mobilization advance for the contractor requires an increase for ensure availability of adequate construction material.

Similarly for the factors related to construction labor problem, an introduction of better incentives and trainings to the unemployed youths can maximize the national labor strength. In addition, exploring new labor markets in neighboring countries like China, Bangladesh and Nepal can help reducing the labor shortage problem in Bhutan.

Likewise equipment related delay can be resolved by minimizing the tax for import of machineries which can further increase participation for modern equipment hiring agency resulting to dissipation towards manual project execution. An introduction of agent based system introducing public private partnership for easy availability of equipment parts requires further encouragement.

Finally for the external factor, the limitation of exchange rate like insufficiency for Indian Rupee requires public department to intervene at policy level with the government of India for inflow of adequate foreign currency so that the construction works remain unaffected due to this problem.

6.3 Limitation of the study

The study has gathered adequate data for the analysis and findings to arrive at the conclusion. However this study has considered the perception from 29 contractors and

61 government engineers which have unequal ratio. Therefore, the viewpoint may encounter some gap from the response of two respondents.

The time and resources were also limited during this research. Therefore, the data collection was done only in four districts located within western and south western part of Bhutan. The perception would be more realistic if the data were collected from different regions of Bhutan because the perception could vary in line with the geographical area and its surrounding environment. Furthermore, the viewpoint for the consultant is not included on this study in spite of having factors related to the consultant.

Lastly, the data collected is scope to public construction only and the private construction projects are excluded. Therefore, the perception of the private owner is not studied with which the interpretation of the results and findings would be different.

6.4 Further study

The recommendation for the further study can be pursued in the following manner. Comparative studies of public construction project delay for specific public infrastructure project in Bhutan like bridges, hospitals, and road, public buildings etc be undertaken. Similarly, the comparative study be made between the public and the private construction project so that the problems of construction project delay can be resolved in Bhutan.

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APPENDICES

APPENDIX A

DETAIL OF TWO RESPONDENTS

61 NUMBERS OF GOVERNMENT ENGINEERS BACKGROUND						
Sl. No.	**Company Name**	**Respondent Name**	**Experience (In Years)**	**email**	**Position**	**Infrastructure Built**
THIMPHU CITY						
1	Department of culture, (Ministry of Home And Cultural Affairs)	Mr Pema	5	pema0789@gmail.com	Government Engineer	Offices, Dzong Renovation and Heritage sites
2	Department of culture, (Ministry of Home And Cultural Affairs)	Ms Phuntsho Wangmo	5	wpinsa@gmail.com	Government Engineer	Dzong Renovation
3	PIU, DES, (Ministry of Work And Human Settlements)	Ms Sonam Choden	10	Schokden@gmail.com	Government Engineer	Low income residential housing, Bridge/culvert/retaining wall Bus terminal, Substations/transmisson towers, Offices, Road/domestic runways
4	Judiciary, Bhutan	Mr Kinga Nidup	5	Kuengddup@gmail.com	Government Engineer	Road/domestic runways, Offices, Basic Health Units(BHU)
5	EARRD, DES, (Ministry Of Work And Human Settlements)	Mr Karma Euthra	14	euthraoff@gmail.com	Government Engineer	Low income residentail housing, Schools, Road/domestic runways
6	Department of Engineering Service	Ms Sonam Yangdhen	10	Sonam-yang@hotmail.com	Project Manager	Offices
7	DES, MOWHS, Thimphu	Ms Yangzom	10	yangzomlham@gmail.com	Government Engineer	Low income residential housing, Bridge/culvert/retaining wall Bus terminal, Substations/transmisson towers, Offices

8	UISD, DES, (Ministry of Works and Human Settlements)	Ms Dechen Yangden	10	----	Executive Engineer	Low income residential housing, Bridge/culvert/retaining wall Bus terminal, Road/domestic runways Offices and water/sewerage
9	Department of Engineering Service	Mr Om Nath Giri	31	Omnatb58@gmail.com	Government Engineer	Low income residential housing, Road/domestic runways, bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices
10	Department of Engineering Service	Ms Chimi Wangmo	10	ednal11@hotmail.com	Estimator	Bridge/culvert/retaining wall Bus terminal, Offices
11	Thimphu Dzongkhag Adminstration	Mr Kado	10	kascho*11@gmail.com	Site Engineer	All works
12	Thimphu Dzongkhag Adminstration	Ms Sangay Pemo	10	Sonamo_2007@yahoo.com	Site Engineer	Road/domestic runways
13	Thimphu Dzongkhag Engineering services	Ms Pabita Rai	5	pabita6363@gmail.com	Site Engineer	Road/domestic runways, Schools, Basic Health Units(BHU), Offices, Bridge/culvert/retaining wall Bus
14	District Engineering, Thimphu	Mr Daw Penjor	15	----	Site Engineer	Schools
15	Dzongkhag Engineering sector	Mr Pema Wangda	15	----	Site Engineer	Road/domestic runways, Schools, Bridge/culvert/retaining wall Bus terminal, Basic Health Units(BHU), Offices, Low income residential housing
16	Dzongkhag Adminstration, Thimphu	Ms Ugyen Eden	10	ugyenyuden@hotmail.com	Site Engineer	Almost all the works
17	Thimphu Thromde	Mr Prem Rai	30	premrai2002@hotmail.com	Site Engineer	Schools

18	Thimphu Thromde	Ms Dema Yangzom	5	----	Site Engineer	Schools
19	Thimphu Thromde	Ms Peldon	5	peldon2011@gmail.com	Site Engineer	Road/domestic runways, Schools
20	Thimphu Thromde	Mr Sangay Drakpa	15	sdrakpa@gmail.com	Site Engineer	low income residental housing
21	Thimphu Thromde	Ms Wangmo	5	----	Site Engineer	Road/domestic runways, Schools, bridge/culvert/retaining wall Bus terminal, Offices
22	Thimphu Thromde	Ms Karma Choden	15	----	Site Engineer	Low income residential housing
23	Thimphu Thromde	Ms Tandin Wangmo	15	----	Site Engineer	Low income residential housing and offices
24	Thimphu Thromde	Mr Ram Badhur Rai	5	imranrai@gmail.com	Site Engineer	Low income residential housing
25	Engineering Division, Thimphu Thromde	Mr Sonam Jamtsho	5	s.jamtsho7@gmail.com	Site Engineer	Offices
26	Thimphu Thromde	Mr Sonam Dhendup	10	sdhendup1976@gmail.com	Site Engineer	Low income residential housing
27	Thimphu Thromde	Ms Tshomo	15	tshomokelzang@gmail.com	Site Engineer	Road/domestic runways and utilities
28	Thimphu Thromde	Mr Pekar Rabgay	22	prabgyal@gmail.com	Project Manager	Road, culvert/retaining wall/bus terminal and Schools
29	Thimphu Thromde/Construction and Maintenance	Mr Kezang Chophel	15	----	Site Engineer	Road/domestic runways, Schools, Bridge/culvert/retaining wall Bus terminal, Substations/transmisssion
30	Thimphu Thromde(Municipal)	Mr Thukten Tshering	25	----	Site Engineer	Road/domestic runways,Schools, Sewage and water supply
31	Thimphu Thromde	M/s Yangden	5	----	Site Engineer	Low income residential housing

32	Thimphu Thromde	Mr Kinley Penjore	15	----	Project Manager	Road/domestic runways,Schools, Bridge/culvert/retaining wall Bus terminal, Urban infrastructure that is water supply, sewer
33	Thimphu Thromde	M/s Yangki Tshomo	10	----	Site Engineer	Road/domestic runways
34	Thimphu Thromde	Ms Singye Choki	10	----	Site Engineer	Low income residential housing, Offices and commercial buildings
35	Ministry of Labour & Human Resources,Thimphu	Thinley Jamtsho	15	---	Govt Engineer	Buildings/Roads/Irrigation channel.
36	Ministry of Labour & Human Resources,Thimphu	Kinley Bida	5	---	Govt Engineer	Bridge/culvert/retaining wall Bus terminal, Offices
37	Ministry of Labour & Human Resources,Thimphu	Wangda Dorji	10	---	Govt Engineer	Schools/Offices/River Trainng works
38	Ministry of Labour & Human Resources,Thimphu	Sonam Dorji	10	---	Govt Engineer	Schools
39	Ministry of Labour & Human Resources,Thimphu	yeshey chhoden	5	yeshey@yahoo.com	Govt Engineer	Schools/Offices
40	Department of Agriculture-Engineering Division	Nima Dorji	5	nyimadorji@yahoo.com	Govt Engineer	Bridge/culvert/retaining wall Bus terminal, Offices,Roads/domestic runways/irrigation Chhanels.
41	Department of Agriculture-Engineering Division	Namgay Tshering	10	---	Site Engineer	Schools

42	Department of Agriculture-Engineering Division	Jigme Tenzin	10	---	Project Manager/Site Engineer	Low income residential housing, Road/domestic runways, bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices.
43	Department of Agriculture-Engineering Division	Karma Tenzin	10	---	Project Mangaer	Roads/Domestic runways and Offices
44	Department of Agriculture-Engineering Division	Ugyen Dorji	10	---	Designer	Bridge/culvert/retaining wall Bus terminal, Offices,Roads/domestic runways.
45	Construction Development Board	Mr Tashi Phuntsho	5	----	Govt Engineer	Others
CHHUKHA DISTRICT						
46	Chhuka Dzongkhag Engineering sector	Mr Tika Ram Giri	24	tikaramgiri8111@yahoo.com	Site Engineer	Low income residential housing, Road/domestic runways, bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices, Immigration and water supply
47	Chhuka Dzongkhag Adminstration office	Mr Chura Muui Bhattarai	5	----	Site Engineer	Road/domestic runways, Low income residential housing, Bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices
48	Chhuka Dzongkhag Adminstration office	Pamela yangzom	50	stucool@gmail.com	Site Engineer	low income residential housing, Road/domestic runways, schools, Bridge/culvert/retaining wall Bus terminal, Basic Health Unit(BHU), Offices and water

49	Chhuka Dzongkhag adminstration/ Engineering sector	Mr Tshering Chopel	15	tsheringchophel25@yahoo.com	Project Manager	All the works
50	Chhukha Dzongkhag Adminstration	Ms Tashi Penden	30	trasheeylion@hotmail.com	Site Engineer	Schools
51	Chhuka Dzongkhag Adminstration	Mr Damcho Tshering	5	tsheringdamcho@gmail.com	Site Engineer	low income residential housing, Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices, Monastic structures, Community centres
52	Chhuka Dzongkhag Adminstration/Engineering sector	Mr Sangay Drakpa	23	sangaydak65@yahoo.com	Site Engineer/Project Manager	Road/domestic runways, Schools, Bridge/culvert/retaining wall Bus terminal, Basic Health Units(BHU), Offices, Water
PHUENTSHOLING CITY						
53	Phuntsholing Municipality	Ms Sangay Wangmo	10	swangmo13@yahoo.co.in	Site Engineer	Road/domestic runways, Bridge/culvert/retaining wall Bus terminal
54	Phuntsholing Thromde	Mr Karma Wangdi	5	----	Site Engineer	Road/domestic runways, Offices
55	Phuntsholing Thromde	Ms Sonam Zangmo	15	----	Project Manager	Road, Bridge/culvert/retaining wall Bus terminal, Offices, Parks, Parking spaces, water supplies, land fill sites,sewerage services.
56	Phuntsholing Thromde	Ms Jangchuk Choden	5	pemscv124@yahoo.com	Designer	Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Offices

PARO DISTRICT						
57	Paro Dzongkhag adminstration/ Engineering sector	Dorji Wangchuk	5	wangs_dorjik@yahoo.com	Site Engineer	Road/domestic runways, Low income residential housing, Bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices
58	Paro Dzongkhag adminstration/ Engineering sector	Kencho Wangdi	10	---	Site Engineer	Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices
59	Paro Dzongkhag adminstration/ Engineering sector	Sangay Duba	10	sangaysinzin@gmail.com	Site Engineer	Roads/Domestic runways ,schools/ Basic health unit(BHU)
60	Paro Dzongkhag adminstration/ Engineering sector	Pema Tenzin	5	pemarinzin@yahoo.com	Site Engineer	Road/domestic runways, Low income residential housing, Bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices
61	Paro Dzongkhag adminstration/ Engineering sector	Rinchen Zangmo	10	---	Project Manager	Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Schools, Basic Health Units(BHU), Offices

THREE CLASSES OF CONTRACTORS BACKGROUND							
Sl. No.	**Company Name**	**Respondent Name**	**Experience (In Years)**	**Contact Number**	**email**	**Class of Contractor**	**Public Projects Constructed**
1	M/s Tacho Construction	Dasho Dorji Tshering	15	975-17111370	tachoconstructionpvtltd@gmail.com	Large	school, Basic Health Unit,Road/Runways,Bridge/Culvert/RRM wall/Bus terminal,Offices.
2	M/s Wangthang Construction	Mr.Ngawang Jamtsho	15	Post Box no-539	----	Large	Roads,Schools,bridge/Culvert/RRM wall.
3	M/s Neten Construction	Mr.Neten Wangdi	22	975-17119380	NetenCons@gmail.com	Large	offices,Bridge/Culvert/RRM wall,Low income residential housing,Buildings
4	M/s Chapcha construction	Mr Yangka Dawa	26	975-17111528	Chapcha@gmail.com	Large	Low income residential housing, Offices
5	M/s Thuenlam (N) construction	Mr Nidup Denkar	5	Gyaltshen Penor house, Changzamtog	ceo.thuenlam@gmail.com	Large	Bridge/culvert/retaining wall Bus terminal
6	M/s Lotey construction	Mr Gyem Tshering	15	Paro Town	----	Large	Road/domestic runways
7	M/s Sonam Tobagy construction	Mr Karma Namgyal	10	Lower Motithang	knamgyal@gmail.com	Large	Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Schools, offices
8	M/s U.S. Construction	Mr Padam Pakwal	15	975-77200422	----	Large	Road/domestic runways, Schools, Bridgw/culvert/retaining wall Bus terminal,Basic Health Units(BHU), Offices

9	M/s Construction Development Board	Mr Chungdu Tshering	5	975-17604060	chungdutse@gmail.com	Large	Low income residential housing
10	M/s Tshering Meto Construction	Mr Gembo	15	Trongsa, Dzongkha	----	Medium	Low income residential housing,Bridge/culvert/retaining wall Bus terminal, Substayions/transmission towers,Offices,Road/Domestic runways, Schools,Basic Health Units
11	M/s K.J Builders	Mr Domang	10	975-17114183	----	Medium	Substations/tranmission towers, Offices, Others
12	M/s Druksam builders	Mr Anand Pradhan	22	P.O box 220	druksam@220yahoo.com	Medium	Road/domestic runways, Schools, Basic Health Units(BHU), river projects and Dzongs
13	M/s Dungkar Construction	Ms Meena Sharma	10	975-17374031	Dung@yahoo.com	Medium	Schools, Basic Health Units(BHU), Offices
14	M/s Pasnag Construction	Mr Karma Gyaltshen	15	975-17111002	Pasa123@hotmail.com	Medium	Road/domestic runways
15	M/s Thundrel Construction	Mr Tashi Dorji	10	975-17634040	Thundrel@druknet.bt	Medium	Road/domestic runways, Schools, Bridge/culvert/retaining wall Bus terminal, Basic Health Units(BHU), Offices
16	M/s Yangdak Construction	Ms Tshering Yangdak	10	-	Yukiyangz@gmail.com	Medium	Offices.

17	M/s Kawang Consruction	Md, Hafiz Rana	5	975-1690825	MHRANA00@yahoo.com	Medium	Low income residential buildings
18	M/s Sangdol Construction	Aita Sing Tamang	13	Post Box no-84	----	Medium	Bridge/Retaining wall/Bus Terminal/Roads/Domestic runways/Offices
19	M/s Kay Phunsum Construction	Tashi Dorji	14	---	tdkinley@gmail.com	Medium	Low Income Residential housing
20	M/s kamal Construction	Kamal	15	---	kamal_construction@yahoo.com	Medium	Low income residential housing, Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Schools, Offices
21	M/s mindu Construction	Mindu	15	17111034	---	Medium	Bridge/Retaining wall/Bus Terminal/Roads/Domestic runways/Offices
22	M/s Rai Construction	Mr Jit Bhadur Rai	15	975-17613142	Jitb@yahoo.com	Small	Road/domestic runways, Schools, bridge/culvert/retaining wall Bus terminal,Substations/transmission towers, basic Health Units(BHU),Offices
23	M/s Tripple 5 Construction	Mr Sonam Tshering	5	Zhemgang	Somtshering6483@yahoo.com	Small	Others
24	M/s Shonzai Builder	Mr Tshultrum Dorji	10	----	Shonzai@druknet.bt	Small	Bridge/culvert/retaining wall Bus terminal

25	M/s Khomsar Construction	Mr Dorji Drukpa	5	Zhemgang	----	Small	Others
26	M/s Karma Tshering construction	Mr Karma Tenzin	15	Dekiling, Bumthang	ktkt@yahoo.com	Small	Low income residential housing, Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Schools, Substations/transmission towers, Basic Health Units(BHU), Offices
27	M/s Tangu and wangditse project	Mr Dechen Dorji	15	----	dechen806@hotmail.com	Small	Schools, Basic Health Units(BHU), Offices
28	M/s Samyog Hangsam ThebaCont.	Mr Ran Dhoj Subba	15	975-17697554	----	Small	Road, Bridge,Culvert,Retaining wall and Substations
29	M/s Druk Nawang Construction	Mr Sonam Penjor	10	975-17115248	----	Small	Substations/transmission towers

25	M/s Khomsar Construction	Mr Dorji Drukpa	5	Zhemgang	----	Small	Others
26	M/s Karma Tshering construction	Mr Karma Tenzin	15	Dekiling, Bumthang	ktkt@yahoo.com	Small	Low income residential housing, Road/domestic runways, Bridge/culvert/retaining wall Bus terminal, Schools, Substations/transmission towers, Basic Health Units(BHU), Offices
27	M/s Tangu and wangditse project	Mr Dechen Dorji	15	----	dechen806@hotmail.com	Small	Schools, Basic Health Units(BHU), Offices
28	M/s Samyog Hangsam ThebaCont.	Mr Ran Dhoj Subba	15	975-17697554	----	Small	Road, Bridge,Culvert,Retaining wall and Substations
29	M/s Druk Nawang Construction	Mr Sonam Penjor	10	975-17115248	----	Small	Substations/transmission towers

APPEXDIX B

QUESTIONNAIRE FOR DATA COLLECTION

CHULALONGKORN UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING

QUESTIONNAIRE SURVEY

SURVEY ON FACTORSINFLUENCING PUBLIC CONSTRUCTION PROJECT DELAY IN BHUTAN

This questionnaire consists of two sections:

Section A: The profile of the project and the respondent.

Section B: Factors influencing construction delays

Objective of the Study:

- To identify the factors influencing public construction project delay in Bhutan and rank them
- To provide guidelines and recommendation to prevent delay.

Research student: Ashok Sunwar, Master Student, Chulalongkorn University, Bangkok; Thailand.

Research Supervisor: Assist. Prof. Noppadon Jokkaw, Ph.D., Chulalongkorn University, Bangkok; Thailand.

NOTE:

The response of the respondents will be treated confidential and this study is carried out exclusively for academic purposes. The name of the respondent is optional.

Thank you for you kind cooperation

SECTION A

THE PROFILE OF THE PROJECT AND THE RESPONDENT.

Please, tick the box or fill in the blanks to answer this Research Survey Questionnaire:

Name of Respondent : ……...

Class of Contractor : ……

Name of the Company/Department: ……

Mailing Address : ……

Contact Address : ……

1. What group of respondent are you in this company?

☐ Client ☐ Consultant

☐ Contractor ☐ Other, please specify

2. What is your position in the organization?

☐ Project Manager ☐ Designer

☐ Site Engineer ☐ Other, please specify

3. How many years of working experience you have in the construction projects?

☐ 0-5 years ☐ 6- 10 years

☐ 11-15 years ☐ other, please specify…

4. How old has the company working with construction projects?

☐ 0-5 years ☐ 6- 10 years

☐ 10-15 years ☐ other, please specify…

5. How many construction projects have your company executed?

☐ 1-5 projects ☐ 6- 10 projects

☐ 11-15 projects ☐ other please specify…

6. State the type of construction projects the company has executed?

☐ Low income residential housing ☐ Road/domestic runways

☐ Bridge/culvert/retaining wall ☐ Bus terminal

☐ Substations/transmission towers ☐ Basic health Units

☐ Offices ☐ other please specify…

7. What is the bid amount (In Million Ngultrum) for the project you have executed till date?

☐ 0.50 - 1.00 ☐ 1.00 - 4.00

☐ 4.00 - 10.00 ☐ 10.00 – 15.00

8. What is the project completion time as per the contract documents

☐ 3 – 6 months ☐ 6- 9 months

☐ 9 – 12 months ☐ other please specify…

9. Want is the actual duration spent for the project

☐ 3 – 6 months ☐ 6- 9 months

☐ 9 – 12 months ☐ other please specify…

SECTION B

FACTORS THAT INFLUENCE TO PUBLIC CONSTRUCTION PROJECT DELAY IN BHUTAN

Please, tick the box or fill in the blanks to answer this Research Survey Questionnaire:

Each scale represents the level of influence as follows:

Level of Influence	Scale
Very Strongly Agree	5
Strongly Agree	4
Moderately Agree	3
Weakly Agree	2
Very Weakly Agree	1

Question: what is the scale of each factor that have influence the construction project delay in BHUTAN?

Category	Factors Influencing project Delay in Bhutan	Scale for level of influence to project				
		1	2	3	4	5
Material	Shortage of construction material in market					
	Change in material types and specification during construction					
	Delay in material delivery at site					
	Late procurement of high quality material					
	Inconsistency in price of material					
	Unreliable supplier of material					
	Delay in import of construction material					
	Poor quality of construction material					
	Unavailability of basic construction material in the market					
Construction Labor	Unqualified workforce at site					
	Shortage of national construction labor					
	Low labor productivity at site					
	Lack of foreign labor					
	Different culture of labor					

Category	Factors Influencing project Delay in Bhutan	Scale for level of influence to project				
		1	2	3	4	5
Equipment	Unavailability of equipment parts in the market					
	lack of modern equipment hiring agency					
	Unavailability of modern equipment					
	Equipment allocation problem at site					
	Use of obsolete equipment with low working efficiency					
Contractor	Difficulties in financing the project					
	Rework due to error during construction					
	Poor site management & communication					
	Over project number in hand					
	Lack of basic technical knowledge					
	Inadequate technical staff					
	Improper planning and scheduling					
	Inexperience sub-contractor					
	Unreliable sub-contractor					
Client (Government official)	Delay in progress payment of running bills and other overheads					
	Late in approval of design and drawing from concerned authority					
	Slowness in decision making process					
	Suspension of work for design change					
	Regular change order by client during construction					
	Interference due to change in system of government during construction phase					
	lack of experience in construction					
	Lack of coordination with parties					
	Improper project feasibility study during inception of project.					
Consultant	Inadequate design					
	Complexity of project design to execute					
	Inadequate design team experience					
	Lack of knowledge on using software					
	Poor and irregular site inspection					

Category	Factors Influencing project Delay in Bhutan	Scale for level of influence to project				
		1	2	3	4	5
External Factors	Unfavorable site condition and allocation of construction project					
	Delay in obtaining construction permit from municipality					
	Lengthy bureaucratic procedures					
	Limitation of exchange rate					
	Difference in exchange rate of foreign currency					
	Conflict within project participants					
	Indirect impact of interest rate					
	Lack of finance from concerned public ministries and agencies					
	Lack of environmental clearance					
	Insufficient contract duration for remoteness of project					
	Lack of safety management					
	Insufficient contract duration for the scope (volume) of the project.					
	Emphasis on specification of the design					
	Scope of project is not equivalent to the qualification of the engineer					
	Lack of modern construction technologies					
	Audit objection is a major concern for decision maker					

APPENDIX C

DATA ANALYSIS BY STATISTICS

Table C.1 Overall ranking of factors by mean from both viewpoint of 58 respondents

Overall Ranking from 58 respondents		
Factors influencing public construction project delay in Bhutan	**Mean**	**Rank**
Unqualified workforce at site	4.38	1
Delay in obtaining construction permit from municipality	4.10	2
Different culture of labor	4.07	3
Conflict within project participants	4.05	4
Low labor productivity at site	3.97	5
Shortage of national construction labor	3.95	6
Lack of foreign labor	3.91	7
lack of modern equipment hiring agency	3.91	8
Use of obsolete equipment with low working efficiency	3.86	9
Equipment allocation problem at site	3.83	10
Rework due to error during construction	3.79	11
Delay in material delivery at site	3.74	12
Shortage of construction material in market	3.71	13
Lack of safety management	3.71	14
Over project in hand	3.69	15
Delay in progress payment of running bills and other overheads	3.67	16
Emphasis on specification of the design	3.67	17
Poor and irregular site inspection of engineer	3.66	18
Unreliable supplier of construction material	3.62	19
Improper planning and scheduling	3.62	20
Inexperience sub-contractor	3.62	21
Delay in import of construction material	3.60	22
Lack of basic technical knowledge	3.60	23
Unavailability of basic construction material in the market	3.59	24
Limitation of exchange rate	3.59	25
Unavailability of equipment parts in the market	3.57	26
Inadequate design	3.57	27
lack of experience in construction	3.53	28
Inadequate technical staff	3.52	29
Lack of environmental clearance	3.50	30

Table C.1 (continues)

Overall Ranking from 58 respondents		
Factors influencing public construction project delay in Bhutan	**Mean**	**Rank**
Indirect impact of interest rate	3.48	31
Poor site management & communication	3.47	32
Poor and irregular site inspection	3.47	33
Inconsistency in price of material	3.45	34
Lengthy bureaucratic procedures	3.43	35
Unreliable sub-contractor	3.41	36
Interference due to change in system of government during construction phase	3.41	37
Unavailability of modern equipment	3.40	38
Suspension of work for design change	3.40	39
Complexity of project design to execute	3.36	40
Difference in exchange rate of foreign currency	3.33	41
Slowness in decision making process	3.31	42
Lack of knowledge on using advance engineering software	3.31	43
Lack of finance from concerned public ministries and agencies	3.31	44
Late procurement of high quality material	3.29	45
Difficulties in financing the project	3.28	46
Unfavorable site condition and allocation of construction project	3.28	47
Insufficient contract duration for the scope (volume) of the project.	3.24	48
Change in material types and specification during construction	3.22	49
Late in approval of design and drawing from concerned authority	3.22	50
Scope of project is not equivalent to the qualification of the engineer	3.21	51
Improper project feasibility study during inception of project.	3.19	52
Lack of coordination with parties	3.16	53
Inadequate design team experience	3.16	54
Insufficient contract duration for remoteness of project	3.16	55
Poor quality of construction material	3.10	56
Lack of modern construction technologies	3.07	57
Regular change order by client during construction	3.00	58

Table C.2 Overall ranking of factors by mean from viewpoint of 90 respondents

OVERALL RANKING OF FACTORS INFLUENCING PROJECT DELAY IN BHUTAN			
CLASSIFICATION	**FACTORS**	**MEAN**	**RANKING**
Construction Labor	Shortage of national construction labor	4.08	1
Construction Labor	Different culture of labor	3.77	2
Construction Labor	Unqualified workforce at site	3.74	3
Construction Labor	Lack of foreign labor	3.74	4
External factor	Limitation of exchange rate	3.73	5
Equipment	Lack of modern equipment hiring agency	3.68	6
Construction Labor	Low labor productivity at site	3.64	7
Contractor	Improper planning and scheduling	3.61	8
External factor	Unfavorable site condition and allocation of construction project	3.61	9
Material	Delay in material delivery at site	3.60	10
Contractor	Poor site management and communication	3.60	11
Contractor	Inadequate technical staff	3.60	12
External factor	Lack of modern construction technologies	3.56	13
Contractor	Over project in hand	3.54	14
Material	Shortage of construction material in market	3.53	15
Equipment	Unavailability of equipment parts in the market	3.53	16
Equipment	Unavailability of modern equipment	3.53	17
Contractor	Lack of basic technical knowledge	3.49	18
Contractor	Unreliable sub-contractor	3.47	19
Contractor	Difficulties in financing the project	3.43	20
Contractor	Inexperience sub-contractor	3.41	21
External factor	Insufficient contract duration for remoteness of project	3.39	22

Table C.2 (continues)

CLASSIFICATION	FACTORS	MEAN	RANK
Equipment	Unavailability of modern equipment	3.36	23
Contractor	Unreliable supplier	3.34	24
Material	Late procurement of high quality material	3.34	25
External factor	Lengthy bureaucratic procedures	3.33	26
Client	Interference due to change in system of government during construction phase	3.31	27
External factor	Insufficient contract duration for the scope (volume) of the project.	3.30	28
Material	Late procurement of material	3.26	29
Material	Inconsistency in price of material	3.23	30
Equipment	Equipment allocation problem at site	3.23	31
Client	Regular change order by client during construction	3.22	32
Consultant	Inadequate design	3.22	33
Material	Shortage of construction material in the market	3.19	34
Consultant	Lack of knowledge on using advance engineering software	3.19	35
External factor	Conflict within project participants	3.17	36
External factor	Delay in obtaining construction permit from municipality	3.12	37
Client	Late approval of design and drawing from concerned authority	3.10	38
Consultant	Complexity project design to execute at site	3.10	39
External factor	Limitation of exchange rate	3.10	40
Client	Delay in progress payment of running bills and other overheads	3.09	41
External factor	Lack of safety management	3.09	42
Client	Slowness in decision making process	3.08	43
Contractor	Poor site management and communication	3.07	44
Client	Lack of experience in construction	3.07	45
Client	Lack of coordination with parties	3.06	46

Table C.2 (continues)

CLASSIFICATION	FACTORS	MEAN	RANKING
Client	Lack of finance from concerned public ministries and agencies	3.06	47
Equipment	Obsolete equipment	3.00	48
Material	Poor quality of material	2.98	49
Contractor	lack of experience	2.97	50
Consultant	Inadequate design team experience	2.97	51
External	Indirect impact of interest rate	2.97	52
Contractor	Complexity of project design	2.96	53
Client	Late in approval of design and drawing from concerned authority	2.94	54
Contractor	Lack of coordination with parties	2.93	55
Client	Scope of project is not equivalent to the qualification of the engineer	2.91	56
External factor	Lack of environmental clearance	2.86	57
Client	Suspension of work	2.72	58

Table C.3 Ranking of factors by mean from 29 Contractors viewpoint

Factors Influencing Public construction Project delay in Bhutan	Mean	Rank
Unqualified workforce at site	4.03	1
Different culture of labor	3.97	2
Conflict within project participants	3.93	3
Delay in obtaining construction permit from municipality	3.79	4
Lack of foreign labor	3.72	5
Low labor productivity at site	3.62	6
Use of obsolete equipment with low working efficiency	3.59	7
Lack of safety management	3.59	8
Rework due to error during construction	3.48	9
Emphasis on specification of the design	3.48	10
Shortage of construction material in market	3.45	11
Shortage of national construction labor	3.45	12
Indirect impact of interest rate	3.41	13
Lack of environmental clearance	3.41	14
Equipment allocation problem at site	3.38	15
Delay in progress payment of running bills and other overheads	3.38	16
Late in approval of design and drawing from concerned authority	3.38	17
Unreliable supplier of construction material	3.34	18
Delay in material delivery at site	3.31	19
Inadequate design of foreign consultant	3.31	20
Limitation of exchange rate	3.31	21
Lack of finance from concerned public ministries and agencies	3.31	22
lack of experience in construction	3.28	23
Unavailability of basic construction material in the market	3.24	24
Over project number in hand	3.24	25
Interference due to change in system of government during construction phase	3.24	26
lack of modern equipment hiring agency	3.21	27
Lengthy bureaucratic procedures	3.21	28
Suspension of work for design change	3.17	29

Table C.3 (continues)

Factors Influencing Public construction Project delay in Bhutan	Mean	Rank
Poor and irregular site inspection	3.17	30
Scope of project is not equivalent to the qualification of the engineer	3.17	31
Inconsistency in price of material	3.14	32
Slowness in decision making process	3.14	33
Unavailability of equipment parts in the market	3.10	34
Audit objection is the main concern for decision maker	3.10	35
Change in material types and specification during construction	3.07	36
Difference in exchange rate of foreign currency	3.07	37
Delay in import of construction material	3.03	38
Poor site management & communication	3.03	39
Lack of basic technical knowledge	3.03	40
Inexperience sub-contractor	3.00	41
Complexity of project design to execute	3.00	42
Difficulties in financing the project	2.97	43
Improper planning and scheduling	2.97	44
Inadequate technical staff	2.93	45
Insufficient contract duration for the scope (volume) of the project.	2.93	46
Lack of knowledge on using advance engineering software	2.90	47
Insufficient contract duration for remoteness of project	2.90	48
Unavailability of modern equipment	2.83	49
Regular change order by client during construction	2.83	50
Poor quality of construction material	2.79	51
Unreliable sub-contractor	2.79	52
Lack of coordination with parties	2.76	53
Late procurement of high quality material	2.72	54
Improper project feasibility study during inception of project.	2.72	55
Inadequate design team experience	2.72	56
Unfavorable site condition and allocation of construction project	2.72	57
Lack of modern construction technologies	2.62	58

Table C.4 Ranking of factors by mean from 61 Government Engineer viewpoints.

Factors Influencing Public construction Project delay in Bhutan	Mean	Rank
Unqualified workforce at site	4.10	1
lack of modern equipment hiring agency	3.90	2
Improper planning and scheduling	3.90	3
Inexperience sub-contractor	3.90	4
Shortage of national construction labor	3.89	5
Low labor productivity at site	3.84	6
Lack of basic technical knowledge	3.79	7
Over project number in hand	3.77	8
Audit objection is the main concern for decision maker	3.77	9
Inadequate technical staff	3.75	10
Delay in material delivery at site	3.74	11
Unreliable sub-contractor	3.70	12
Different culture of labor	3.64	13
Conflict within project participants	3.64	14
Lack of foreign labor	3.61	15
Equipment allocation problem at site	3.61	16
Shortage of construction material in market	3.57	17
Delay in obtaining construction permit from municipality	3.52	18
Late procurement of high quality material	3.51	19
Use of obsolete equipment with low working efficiency	3.51	20
Delay in progress payment of running bills and other overheads	3.51	21
Delay in import of construction material	3.49	22
Unavailability of equipment parts in the market	3.48	23
Unavailability of modern equipment	3.43	24
Rework due to error during construction	3.41	25
Unreliable supplier of construction material	3.34	26
Limitation of exchange rate	3.34	27
lack of experience in construction	3.33	28
Poor site management & communication	3.31	29
Lack of safety management	3.30	30
Inconsistency in price of material	3.28	31

Table C.4 (continues)

Factors Influencing Public construction Project delay in Bhutan	Mean	Rank
Emphasis on specification of the design	3.27	32
Unfavorable site condition and allocation of construction project	3.23	33
Poor and irregular site inspection	3.20	34
Inadequate design of foreign consultant	3.18	35
Unavailability of basic construction material in the market	3.16	36
Insufficient contract duration for the scope (volume) of the project.	3.16	37
Complexity of project design to execute	3.15	38
Difference in exchange rate of foreign currency	3.11	39
Lengthy bureaucratic procedures	3.08	40
Poor quality of construction material	3.07	41
Lack of coordination with parties	3.07	42
Inadequate design team experience	3.07	43
Change in material types and specification during construction	3.05	44
Indirect impact of interest rate	3.05	45
Lack of modern construction technologies	3.05	46
Suspension of work for design change	3.03	47
Interference due to change in system of government during construction phase	3.03	48
Improper project feasibility study during inception of project.	3.03	49
Difficulties in financing the project	3.02	50
Scope of project is not equivalent to the qualification of the engineer	3.02	51
Lack of knowledge on using advance engineering software	3.00	52
Late in approval of design and drawing from concerned authority	2.95	53
Lack of environmental clearance	2.89	54
Slowness in decision making process	2.85	55
Insufficient contract duration for remoteness of project	2.84	56
Lack of finance from concerned public ministries and agencies	2.80	57
Regular change order by client during construction	2.67	58

Table C.5 Ranking of factors by Relative Importance Index (RII) from 29 contractors viewpoints

Factors Influencing Public construction Project delay in Bhutan	RII	Rank
Unqualified workforce at site	0.807	1
Different culture of labor	0.793	2
Conflict within project participants	0.786	3
Delay in obtaining construction permit from municipality	0.759	4
Lack of foreign labor	0.745	5
Low labor productivity at site	0.724	6
Use of obsolete equipment with low working efficiency	0.717	7
Lack of safety management	0.717	8
Rework due to error during construction	0.697	9
Emphasis on specification of the design	0.697	10
Shortage of construction material in market	0.690	11
Shortage of national construction labor	0.690	12
Indirect impact of interest rate	0.683	13
Lack of environmental clearance	0.683	14
Equipment allocation problem at site	0.676	15
Delay in progress payment of running bills and other overheads	0.676	16
Late in approval of design and drawing from concerned authority	0.676	17
Unreliable supplier of construction material	0.669	18
Delay in material delivery at site	0.662	19
Inadequate design of foreign consultant	0.662	20
Limitation of exchange rate	0.662	21
Lack of finance from concerned public ministries and agencies	0.662	22
lack of experience in construction	0.655	23
Unavailability of basic construction material in the market	0.648	24
Over project number in hand	0.648	25
Interference due to change in system of government during construction phase	0.648	26
lack of modern equipment hiring agency	0.641	27
Lengthy bureaucratic procedures	0.641	28
Suspension of work for design change	0.634	29
Poor and irregular site inspection	0.634	30

Table C.5 (continues)

Factors Influencing Public construction Project delay in Bhutan	RII	Rank
Scope of project is not equivalent to the qualification of the engineer	0.634	31
Inconsistency in price of material	0.628	32
Slowness in decision making process	0.628	33
Unavailability of equipment parts in the market	0.621	34
Audit objection is the main concern for decision maker	0.621	35
Change in material types and specification during construction	0.614	36
Difference in exchange rate of foreign currency	0.614	37
Delay in import of construction material	0.607	38
Poor site management & communication	0.607	39
Lack of basic technical knowledge	0.607	40
Inexperience sub-contractor	0.600	41
Complexity of project design to execute	0.600	42
Difficulties in financing the project	0.593	43
Improper planning and scheduling	0.593	44
Inadequate technical staff	0.586	45
Insufficient contract duration for the scope (volume) of the project.	0.586	46
Lack of knowledge on using advance engineering software	0.579	47
Insufficient contract duration for remoteness of project	0.579	48
Unavailability of modern equipment	0.566	49
Regular change order by client during construction	0.566	50
Poor quality of construction material	0.559	51
Unreliable sub-contractor	0.559	52
Lack of coordination with parties	0.552	53
Late procurement of high quality material	0.545	54
Improper project feasibility study during inception of project.	0.545	55
Inadequate design team experience	0.545	56
Unfavorable site condition and allocation of construction project	0.545	57
Lack of modern construction technologies	0.524	58

Table C.6 Ranking of factors by Relative Importance Index (RII) from 61 Government Engineers viewpoints

Factors Influencing Public construction Project delay in Bhutan	RII	Rank
Unqualified workforce at site	0.820	1
lack of modern equipment hiring agency	0.780	2
Improper planning and scheduling	0.780	3
Inexperience sub-contractor	0.780	4
Shortage of national construction labor	0.777	5
Low labor productivity at site	0.767	6
Lack of basic technical knowledge	0.757	7
Over project number in hand	0.754	8
Audit objection is the main concern for decision maker	0.754	9
Inadequate technical staff	0.751	10
Delay in material delivery at site	0.748	11
Unreliable sub-contractor	0.741	12
Different culture of labor	0.728	13
Conflict within project participants	0.728	14
Lack of foreign labor	0.721	15
Equipment allocation problem at site	0.721	16
Shortage of construction material in market	0.715	17
Delay in obtaining construction permit from municipality	0.705	18
Late procurement of high quality material	0.702	19
Use of obsolete equipment with low working efficiency	0.702	20
Delay in progress payment of running bills and other overheads	0.702	21
Delay in import of construction material	0.698	22
Unavailability of equipment parts in the market	0.695	23
Unavailability of modern equipment	0.685	24
Rework due to error during construction	0.682	25
Unreliable supplier of construction material	0.669	26
Limitation of exchange rate	0.669	27
lack of experience in construction	0.666	28
Poor site management & communication	0.662	29
Lack of safety management	0.659	30

Table C.6 (continues)

Factors Influencing Public construction Project delay in Bhutan	RII	Rank
Emphasis on specification of the design	0.659	31
Inconsistency in price of material	0.656	32
Unfavorable site condition and allocation of construction project	0.646	33
Poor and irregular site inspection	0.639	34
Inadequate design of foreign consultant	0.636	35
Unavailability of basic construction material in the market	0.633	36
Insufficient contract duration for the scope (volume) of the project.	0.633	37
Complexity of project design to execute	0.630	38
Difference in exchange rate of foreign currency	0.623	39
Lengthy bureaucratic procedures	0.616	40
Poor quality of construction material	0.613	41
Lack of coordination with parties	0.613	42
Inadequate design team experience	0.613	43
Change in material types and specification during construction	0.610	44
Indirect impact of interest rate	0.610	45
Lack of modern construction technologies	0.610	46
Suspension of work for design change	0.607	47
Interference due to change in system of government during construction phase	0.607	48
Improper project feasibility study during inception of project.	0.607	49
Difficulties in financing the project	0.603	50
Scope of project is not equivalent to the qualification of the engineer	0.603	51
Lack of knowledge on using advance engineering software	0.600	52
Late in approval of design and drawing from concerned authority	0.590	53
Lack of environmental clearance	0.577	54
Slowness in decision making process	0.570	55
Insufficient contract duration for remoteness of project	0.567	56
Lack of finance from concerned public ministries and agencies	0.561	57
Regular change order by client during construction	0.534	58

Table C.7. Ranking of factors by Frequency Index (FI) from 29 Contractors viewpoints

Factors Influencing Public construction Project delay in Bhutan	FI	Rank
Unqualified workforce at site	80.69	1
Different culture of labor	79.31	2
Conflict within project participants	78.62	3
Delay in obtaining construction permit from municipality	75.86	4
Lack of foreign labor	74.48	5
Low labor productivity at site	72.41	6
Use of obsolete equipment with low working efficiency	71.72	7
Lack of safety management	71.72	8
Rework due to error during construction	69.66	9
Emphasis on specification of the design	69.66	10
Shortage of construction material in market	68.97	11
Shortage of national construction labor	68.97	12
Indirect impact of interest rate	68.28	13
Lack of environmental clearance	68.28	14
Equipment allocation problem at site	67.59	15
Delay in progress payment of running bills and other overheads	67.59	16
Late in approval of design and drawing from concerned authority	67.59	17
Unreliable supplier of construction material	66.90	18
Delay in material delivery at site	66.21	19
Inadequate design of foreign consultant	66.21	20
Limitation of exchange rate	66.21	21
Lack of finance from concerned public ministries and agencies	66.21	22
lack of experience in construction	65.52	23
Unavailability of basic construction material in the market	64.83	24
Over project number in hand	64.83	25
Interference due to change in system of government during construction phase	64.83	26
lack of modern equipment hiring agency	64.14	27
Lengthy bureaucratic procedures	64.14	28
Suspension of work for design change	63.45	29
Poor and irregular site inspection	63.45	30

Table C.7 (continues)

Factors Influencing Public construction Project delay in Bhutan	FI	Rank
Scope of project is not equivalent to the qualification of the engineer	63.45	31
Inconsistency in price of material	62.76	32
Slowness in decision making process	62.76	33
Audit objection is the main concern for decision maker	62.07	34
Unavailability of equipment parts in the market	62.07	35
Difference in exchange rate of foreign currency	61.38	36
Change in material types and specification during construction	61.38	37
Delay in import of construction material	60.69	38
Lack of basic technical knowledge	60.69	39
Poor site management & communication	60.69	40
Inexperience sub-contractor	60.00	41
Complexity of project design to execute	60.00	42
Difficulties in financing the project	59.31	43
Improper planning and scheduling	59.31	44
Inadequate technical staff	58.62	45
Insufficient contract duration for the scope (volume) of the project.	58.62	46
Lack of knowledge on using advance engineering software	57.93	47
Insufficient contract duration for remoteness of project	57.93	48
Unavailability of modern equipment	56.55	49
Regular change order by client during construction	56.55	50
Poor quality of construction material	55.86	51
Unreliable sub-contractor	55.86	52
Lack of coordination with parties	55.17	53
Late procurement of high quality material	54.48	54
Improper project feasibility study during inception of project.	54.48	55
Inadequate design team experience	54.48	56
Unfavorable site condition and allocation of construction project	54.48	57
Lack of modern construction technologies	52.41	58

Table C.8. Ranking of factors by Frequency Index (FI) from 61 Government Engineers viewpoint

Factors Influencing Public construction Project delay in Bhutan	FI	Rank
Unqualified workforce at site	81.97	1
lack of modern equipment hiring agency	78.03	2
Improper planning and scheduling	78.03	3
Inexperience sub-contractor	78.03	4
Shortage of national construction labor	77.70	5
Low labor productivity at site	76.72	6
Lack of basic technical knowledge	75.74	7
Over project number in hand	75.41	8
Audit objection is the main concern for decision maker	75.41	9
Inadequate technical staff	75.08	10
Delay in material delivery at site	74.75	11
Unreliable sub-contractor	74.10	12
Different culture of labor	72.79	13
Conflict within project participants	72.79	14
Equipment allocation problem at site	72.13	15
Lack of foreign labor	72.13	16
Shortage of construction material in market	71.48	17
Delay in obtaining construction permit from municipality	70.49	18
Late procurement of high quality material	70.16	19
Use of obsolete equipment with low working efficiency	70.16	20
Delay in progress payment of running bills and other overheads	70.16	21
Delay in import of construction material	69.84	22
Unavailability of equipment parts in the market	69.51	23
Unavailability of modern equipment	68.52	24
Rework due to error during construction	68.20	25
Unreliable supplier of construction material	66.89	26
Limitation of exchange rate	66.89	27
lack of experience in construction	66.56	28
Poor site management & communication	66.23	29
Emphasis on specification of the design	65.90	30

Table C.8. (Continues)

Factors Influencing Public construction Project delay in Bhutan	FI	Rank
Lack of safety management	65.90	31
Inconsistency in price of material	65.57	32
Unfavorable site condition and allocation of construction project	64.59	33
Poor and irregular site inspection	63.93	34
Inadequate design of foreign consultant	63.61	35
Unavailability of basic construction material in the market	63.28	36
Insufficient contract duration for the scope (volume) of the project.	63.28	37
Complexity of project design to execute	62.95	38
Difference in exchange rate of foreign currency	62.30	39
Lengthy bureaucratic procedures	61.64	40
Poor quality of construction material	61.31	41
Lack of coordination with parties	61.31	42
Inadequate design team experience	61.31	43
Change in material types and specification during construction	60.98	44
Indirect impact of interest rate	60.98	45
Lack of modern construction technologies	60.98	46
Suspension of work for design change	60.66	47
Interference due to change in system of government during construction phase	60.66	48
Improper project feasibility study during inception of project.	60.66	49
Difficulties in financing the project	60.33	50
Scope of project is not equivalent to the qualification of the engineer	60.33	51
Lack of knowledge on using advance engineering software	60.00	52
Late in approval of design and drawing from concerned authority	59.02	53
Lack of environmental clearance	57.70	54
Slowness in decision making process	57.05	55
Insufficient contract duration for remoteness of project	56.72	56
Lack of finance from concerned public ministries and agencies	56.07	57
Regular change order by client during construction	53.44	58

Table C.9. Coefficient of Variation (CoV) for 29 Contractors.

Factors Influencing Public construction Project delay in Bhutan	Mean	Standard Deviation	Coefficient of Variation
Unqualified workforce at site	4.03	1.24	0.307
Different culture of labor	3.97	1.30	0.327
Conflict within project participants	3.93	1.33	0.339
Delay in obtaining construction permit from municipality	3.79	1.24	0.326
Lack of foreign labor	3.72	1.16	0.312
Low labor productivity at site	3.62	1.47	0.407
Use of obsolete equipment with low working efficiency	3.59	1.30	0.361
Lack of safety management	3.59	1.32	0.369
Rework due to error during construction	3.48	1.40	0.403
Emphasis on specification of the design	3.48	1.35	0.388
Shortage of construction material in market	3.45	1.24	0.360
Shortage of national construction labor	3.45	1.38	0.400
Indirect impact of interest rate	3.41	1.27	0.371
Lack of environmental clearance	3.41	1.09	0.318
Equipment allocation problem at site	3.38	1.37	0.406
Delay in progress payment of running bills and other overheads	3.38	1.24	0.366
Late in approval of design and drawing from concerned authority	3.38	1.29	0.383
Unreliable supplier of construction material	3.34	1.17	0.351
Delay in material delivery at site	3.31	1.34	0.405
Inadequate design of foreign consultant	3.31	1.11	0.334
Limitation of exchange rate	3.31	1.23	0.371
Lack of finance from concerned public ministries and agencies	3.31	1.28	0.388
lack of experience in construction	3.28	1.07	0.325
Unavailability of basic construction material in the market	3.24	1.09	0.336
Over project number in hand	3.24	1.27	0.392
Interference due to change in system of government during construction phase	3.24	0.99	0.305

Table C.9. (Continues)

Factors Influencing Public construction Project delay in Bhutan	Mean	Standard Deviation	Coefficient of Variation
lack of modern equipment hiring agency	3.21	1.08	0.337
Lengthy bureaucratic procedures	3.21	1.52	0.474
Suspension of work for design change	3.17	1.04	0.327
Poor and irregular site inspection	3.17	1.07	0.338
Scope of project is not equivalent to the qualification of the engineer	3.17	1.23	0.387
Inconsistency in price of material	3.14	1.19	0.378
Slowness in decision making process	3.14	1.19	0.378
Unavailability of equipment parts in the market	3.10	1.35	0.434
Audit objection is the main concern for decision maker	3.10	1.35	0.434
Change in material types and specification during construction	3.07	1.41	0.460
Difference in exchange rate of foreign currency	3.07	1.49	0.484
Delay in import of construction material	3.03	1.35	0.445
Poor site management & communication	3.03	1.09	0.358
Lack of basic technical knowledge	3.03	1.15	0.379
Inexperience sub-contractor	3.00	1.04	0.345
Complexity of project design to execute	3.00	1.20	0.398
Difficulties in financing the project	2.97	1.18	0.398
Improper planning and scheduling	2.97	1.18	0.398
Inadequate technical staff	2.93	1.28	0.437
Insufficient contract duration for the scope (volume) of the project.	2.93	1.33	0.455
Lack of knowledge on using advance engineering software	2.90	1.01	0.349
Insufficient contract duration for remoteness of project	2.90	1.42	0.491
Unavailability of modern equipment	2.83	1.10	0.391
Regular change order by client during construction	2.83	1.00	0.355
Poor quality of construction material	2.79	1.37	0.491
Unreliable sub-contractor	2.79	1.21	0.432

Table C.9. (Continues)

Factors Influencing Public construction Project delay in Bhutan	Mean	Standard Deviation	Coefficient of Variation
Lack of coordination with parties	2.76	1.15	0.418
Late procurement of high quality material	2.72	1.13	0.415
Improper project feasibility study during inception of project.	2.72	1.19	0.438
Inadequate design team experience	2.72	1.13	0.415
Unfavorable site condition and allocation of construction project	2.72	1.36	0.499
Lack of modern construction technologies	2.62	1.24	0.472

Table C.10. Coefficient of Variation (CoV) for 61 Government Engineers.

Factors Influencing Public construction Project delay in Bhutan	Mean	Standard Deviation	Coefficient of Variation
Unqualified workforce at site	4.10	1.12	0.274
lack of modern equipment hiring agency	3.90	1.19	0.306
Improper planning and scheduling	3.90	1.04	0.268
Inexperience sub-contractor	3.90	1.08	0.276
Shortage of national construction labor	3.89	1.10	0.282
Low labor productivity at site	3.84	1.14	0.298
Lack of basic technical knowledge	3.79	1.05	0.277
Over project number in hand	3.77	1.04	0.276
Audit objection is the main concern for decision maker	3.77	1.10	0.292
Inadequate technical staff	3.75	0.96	0.256
Delay in material delivery at site	3.74	0.93	0.249
Unreliable sub-contractor	3.70	1.10	0.297
Different culture of labor	3.64	1.11	0.305
Conflict within project participants	3.64	1.41	0.389
Lack of foreign labor	3.61	1.11	0.309
Equipment allocation problem at site	3.61	1.17	0.325
Shortage of construction material in market	3.57	1.13	0.317
Delay in obtaining construction permit from municipality	3.52	1.31	0.372
Late procurement of high quality material	3.51	1.01	0.288
Use of obsolete equipment with low working efficiency	3.51	1.13	0.323
Delay in progress payment of running bills and other overheads	3.51	1.19	0.340
Delay in import of construction material	3.49	1.34	0.383
Unavailability of equipment parts in the market	3.48	1.16	0.335
Unavailability of modern equipment	3.43	1.06	0.308
Rework due to error during construction	3.41	1.22	0.357
Unreliable supplier of construction material	3.34	1.15	0.345

Table C.10. (Continues)

Factors Influencing Public construction Project delay in Bhutan	Mean	Standard Deviation	Coefficient of Variation
Limitation of exchange rate	3.34	1.25	0.374
lack of experience in construction	3.33	1.14	0.341
Poor site management & communication	3.31	1.19	0.360
Lack of safety management	3.30	1.20	0.365
Inconsistency in price of material	3.28	1.11	0.339
Emphasis on specification of the design	3.27	1.10	0.338
Unfavorable site condition and allocation of construction project	3.23	1.27	0.393
Poor and irregular site inspection	3.20	1.22	0.382
Inadequate design of foreign consultant	3.18	1.22	0.383
Unavailability of basic construction material in the market	3.16	1.27	0.401
Insufficient contract duration for the scope (volume) of the project.	3.16	1.16	0.366
Complexity of project design to execute	3.15	1.15	0.366
Difference in exchange rate of foreign currency	3.11	1.17	0.376
Lengthy bureaucratic procedures	3.08	1.13	0.367
Poor quality of construction material	3.07	1.17	0.381
Lack of coordination with parties	3.07	1.15	0.376
Inadequate design team experience	3.07	1.11	0.362
Change in material types and specification during construction	3.05	1.13	0.371
Indirect impact of interest rate	3.05	1.13	0.371
Lack of modern construction technologies	3.05	1.09	0.356
Suspension of work for design change	3.03	1.15	0.381
Interference due to change in system of government during construction phase	3.03	1.14	0.376
Improper project feasibility study during inception of project.	3.03	1.14	0.376
Difficulties in financing the project	3.02	1.20	0.399
Scope of project is not equivalent to the qualification of the engineer	3.02	1.04	0.345

Table C.10. (Continues)

Factors Influencing Public construction Project delay in Bhutan	Mean	Standard Deviation	Coefficient of Variation
Lack of knowledge on using advance engineering software	3.00	1.17	0.390
Late in approval of design and drawing from concerned authority	2.95	1.13	0.384
Lack of environmental clearance	2.89	1.20	0.415
Slowness in decision making process	2.85	1.24	0.433
Insufficient contract duration for remoteness of project	2.84	1.11	0.393
Lack of finance from concerned public ministries and agencies	2.80	1.14	0.406
Regular change order by client during construction	2.67	1.04	0.391

APPENDIX D

ANALYSIS BY INDEPENDENT SAMPLE t-TEST

Table D.1 Group Statistics

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Shortage of construction material in the market	Equal variances assumed	.116	.735	.476	88	.635	.125	.263	-.398	.649
	Equal variances not assumed			.461	50.806	.647	.125	.272	-.421	.672
Change in material types and specification during construction	Equal variances assumed	4.128	.045	-.071	88	.943	-.020	.277	-.570	.531
	Equal variances not assumed			-.066	45.714	.948	-.020	.300	-.623	.583
Delay in material delivery at site	Equal variances assumed	8.381	.005	1.760	88	.082	.427	.243	-.055	.910
	Equal variances not assumed			1.550	41.277	.129	.427	.276	-.129	.984
Late procurement of high quality material	Equal variances assumed	.141	.708	3.310	88	.001	.784	.237	.313	1.255
	Equal variances not assumed			3.179	49.936	.003	.784	.247	.289	1.279
Inconsistency in price of material	Equal variances assumed	.238	.627	.549	88	.584	.1408	.2564	-.3688	.6503
	Equal variances not assumed			.536	52.037	.594	.1408	.2624	-.3858	.6674

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Unreliable supplier of construction material	Equal variances assumed	.183	.670	-.002	88	.998	-.001	.262	-.520	.519
	Equal variances not assumed			-.002	54.271	.998	-.001	.263	-.528	.527
Delay in import of construction material	Equal variances assumed	.000	.983	1.512	88	.134	.457	.302	-.144	1.058
	Equal variances not assumed			1.507	54.684	.138	.457	.303	-.151	1.065
Poor quality of construction material	Equal variances assumed	2.040	.157	.977	88	.331	.272	.279	-.282	.827
	Equal variances not assumed			.922	47.915	.361	.272	.295	-.322	.867
Unavailability of basic construction material in the market	Equal variances assumed	.448	.505	-.283	88	.778	-.077	.274	-.622	.467
	Equal variances not assumed			-.298	63.305	.766	-.077	.260	-.596	.441
Unqualified workforce at site	Equal variances assumed	.079	.780	.244	88	.808	.064	.262	-.456	.584
	Equal variances not assumed			.236	50.479	.815	.064	.271	-.481	.608

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Shortage of national construction labor	Equal variances assumed	4.347	.040	1.623	88	.108	.437	.269	-.098	.972
	Equal variances not assumed			1.497	45.484	.141	.437	.292	-.151	1.025
Low labor productivity at site	Equal variances assumed	4.083	.046	.759	88	.450	.215	.284	-.348	.779
	Equal variances not assumed			.694	44.593	.491	.215	.310	-.410	.841
Lack of foreign labor	Equal variances assumed	.000	.985	-.461	88	.646	-.118	.255	-.624	.389
	Equal variances not assumed			-.455	53.125	.651	-.118	.259	-.636	.401
Different culture of labor	Equal variances assumed	2.425	.123	-1.233	88	.221	-.326	.265	-.852	.200
	Equal variances not assumed			-1.167	48.263	.249	-.326	.279	-.888	.236
Unavailability of equipment parts in the market	Equal variances assumed	1.260	.265	1.347	88	.181	.372	.276	-.177	.921
	Equal variances not assumed			1.279	48.579	.207	.372	.291	-.213	.957

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of Diff	
									Lower	Upper
lack of modern equipment hiring agency	Equal variances assumed	.284	.596	2.658	88	.009	.695	.261	.175	1.214
	Equal variances not assumed			2.753	60.340	.008	.695	.252	.190	1.199
Unavailability of modern equipment	Equal variances assumed	.051	.821	2.477	88	.015	.599	.242	.118	1.079
	Equal variances not assumed			2.437	52.974	.018	.599	.246	.106	1.091
Equipment allocation problem at site	Equal variances assumed	2.553	.114	.812	88	.419	.227	.280	-.329	.783
	Equal variances not assumed			.768	48.084	.446	.227	.296	-.368	.822
Use of obsolete equipment with low working efficiency	Equal variances assumed	.948	.333	-.291	88	.772	-.078	.268	-.611	.455
	Equal variances not assumed			-.277	49.081	.783	-.078	.281	-.643	.487
Difficulties in financing the project	Equal variances assumed	.000	.990	.189	88	.851	.051	.270	-.485	.587
	Equal variances not assumed			.190	56.173	.850	.051	.268	-.486	.587

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Rework due to error during construction	Equal variances assumed	2.106	.150	-.253	88	.801	-.073	.289	-.646	.500
	Equal variances not assumed			-.240	48.635	.811	-.073	.304	-.684	.538
Poor site management & communication	Equal variances assumed	1.334	.251	1.060	88	.292	.277	.261	-.242	.796
	Equal variances not assumed			1.096	60.057	.277	.277	.253	-.228	.782
Over project in hand	Equal variances assumed	1.575	.213	2.097	88	.039	.529	.252	.028	1.030
	Equal variances not assumed			1.952	46.403	.057	.529	.271	-.016	1.075
Lack of basic technical knowledge	Equal variances assumed	.129	.721	3.080	88	.003	.752	.244	.267	1.238
	Equal variances not assumed			2.983	50.928	.004	.752	.252	.246	1.259
Inadequate technical staff	Equal variances assumed	3.795	.055	3.403	88	.001	.823	.242	.342	1.304
	Equal variances not assumed			3.076	43.534	.004	.823	.268	.284	1.362

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Improper planning and scheduling	Equal variances assumed	.243	.624	3.811	88	.000	.936	.246	.448	1.424
	Equal variances not assumed			3.648	49.533	.001	.936	.257	.421	1.452
Inexperience sub-contractor	Equal variances assumed	.042	.837	3.761	88	.000	.902	.240	.425	1.378
	Equal variances not assumed			3.813	57.101	.000	.902	.236	.428	1.375
Unreliable sub-contractor	Equal variances assumed	1.335	.251	3.560	88	.001	.912	.256	.403	1.421
	Equal variances not assumed			3.445	50.827	.001	.912	.265	.380	1.443
Delay in progress payment of running bills and other overheads	Equal variances assumed	.901	.345	.474	88	.637	.129	.272	-.412	.670
	Equal variances not assumed			.467	53.336	.642	.129	.276	-.424	.682
Late in approval of design and drawing from concerned authority	Equal variances assumed	.881	.351	-1.602	88	.113	-.428	.267	-.960	.103
	Equal variances not assumed			-1.528	49.067	.133	-.428	.280	-.992	.135

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Slowness in decision making process	Equal variances assumed	.161	.689	-1.037	88	.303	-.285	.275	-.833	.262
	Equal variances not assumed			-1.052	57.217	.297	-.285	.271	-.829	.258
Suspension of work for design change	Equal variances assumed	.798	.374	-.553	88	.581	-.140	.252	-.641	.362
	Equal variances not assumed			-.575	60.820	.567	-.140	.243	-.625	.346
Regular change order by client during construction	Equal variances assumed	.332	.566	-.668	88	.506	-.155	.233	-.618	.307
	Equal variances not assumed			-.678	57.239	.500	-.155	.229	-.614	.303
Interference due to change in system of government during construction phase	Equal variances assumed	.586	.446	-.846	88	.400	-.209	.247	-.699	.282
	Equal variances not assumed			-.890	62.910	.377	-.209	.234	-.677	.260
lack of experience in construction	Equal variances assumed	.412	.522	.207	88	.837	.052	.251	-.447	.551
	Equal variances not assumed			.212	58.471	.833	.052	.246	-.440	.544

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Lack of coordination with parties	Equal variances assumed	.173	.678	1.180	88	.241	.307	.260	-.210	.824
	Equal variances not assumed			1.179	55.069	.243	.307	.260	-.215	.829
Improper project feasibility study during inception of project.	Equal variances assumed	.959	.330	1.183	88	.240	.309	.261	-.210	.827
	Equal variances not assumed			1.164	52.953	.250	.309	.265	-.223	.840
Inadequate design	Equal variances assumed	.248	.620	-.487	88	.627	-.130	.267	-.660	.400
	Equal variances not assumed			-.504	60.286	.616	-.130	.258	-.646	.386
Complexity of project design to execute	Equal variances assumed	.060	.807	.561	88	.576	.148	.263	-.375	.670
	Equal variances not assumed			.554	53.352	.582	.148	.267	-.387	.682
Inadequate design team experience	Equal variances assumed	.022	.883	1.357	88	.178	.341	.252	-.159	.842
	Equal variances not assumed			1.347	54.164	.184	.341	.253	-.167	.849

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Lack of knowledge on using advance engineering software	Equal variances assumed	1.792	.184	.409	88	.684	.103	.253	-.399	.606
	Equal variances not assumed			.431	62.955	.668	.103	.240	-.377	.584
Poor and irregular site inspection	Equal variances assumed	1.637	.204	.092	88	.927	.024	.265	-.503	.552
	Equal variances not assumed			.096	62.251	.924	.024	.253	-.482	.530
Unfavorable site condition and allocation of construction project	Equal variances assumed	.392	.533	1.724	88	.088	.505	.293	-.077	1.088
	Equal variances not assumed			1.682	51.869	.098	.505	.300	-.097	1.108
Delay in obtaining construction permit from municipality	Equal variances assumed	.137	.712	-.924	88	.358	-.269	.291	-.846	.309
	Equal variances not assumed			-.944	58.227	.349	-.269	.284	-.838	.301
Lengthy bureaucratic procedures	Equal variances assumed	7.377	.008	-.437	88	.663	-.125	.286	-.693	.443
	Equal variances not assumed			-.394	43.233	.696	-.125	.317	-.765	.515

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Limitation of exchange rate	Equal variances assumed	.067	.796	.121	88	.904	.034	.280	-.523	.591
	Equal variances not assumed			.122	56.050	.904	.034	.279	-.524	.592
Difference in exchange rate of foreign currency	Equal variances assumed	3.953	.050	.159	88	.874	.046	.289	-.528	.619
	Equal variances not assumed			.146	45.112	.885	.046	.314	-.587	.678
Conflict within project participants	Equal variances assumed	.058	.811	-.931	88	.355	-.292	.313	-.915	.331
	Equal variances not assumed			-.950	58.161	.346	-.292	.307	-.906	.323
Indirect impact of interest rate	Equal variances assumed	.807	.371	-1.374	88	.173	-.365	.265	-.892	.163
	Equal variances not assumed			-1.319	49.879	.193	-.365	.277	-.920	.191
Lack of finance from concerned public ministries and agencies	Equal variances assumed	1.678	.199	-1.895	88	.061	-.507	.268	-1.039	.025
	Equal variances not assumed			-1.814	49.553	.076	-.507	.279	-1.069	.054

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Lack of environmental clearance	Equal variances assumed	.141	.709	-2.013	88	.047	-.529	.263	-1.050	-.007
	Equal variances not assumed			-2.085	60.361	.041	-.529	.253	-1.035	-.022
Insufficient contract duration for remoteness of project	Equal variances assumed	3.318	.072	-.220	88	.827	-.060	.275	-.607	.487
	Equal variances not assumed			-.201	44.894	.841	-.060	.300	-.665	.544
Lack of safety management	Equal variances assumed	1.681	.198	-1.039	88	.302	-.291	.280	-.848	.266
	Equal variances not assumed			-1.004	50.637	.320	-.291	.290	-.873	.291
Insufficient contract duration for the scope (volume) of the project.	Equal variances assumed	.689	.409	.849	88	.398	.233	.274	-.312	.778
	Equal variances not assumed			.807	48.698	.424	.233	.289	-.347	.813

Table D.1 (continue)

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Emphasis on specification of the design	Equal variances assumed	3.527	.064	-.971	88	.334	-.270	.278	-.822	.282
	Equal variances not assumed			-.922	48.611	.361	-.270	.293	-.858	.318
Scope of project is not equivalent to the qualification of the engineer	Equal variances assumed	3.839	.053	-.627	88	.532	-.156	.249	-.651	.339
	Equal variances not assumed			-.591	47.825	.557	-.156	.264	-.687	.375
Lack of modern construction technologies	Equal variances assumed	2.052	.156	1.671	88	.098	.428	.256	-.081	.938
	Equal variances not assumed			1.596	49.231	.117	.428	.269	-.111	.968
lack of training and awareness	Equal variances assumed	1.859	.176	2.497	88	.014	.667	.267	.136	1.198
	Equal variances not assumed			2.325	46.480	.024	.667	.287	.090	1.244

APPENDIX E

COMPARISION OF SUGGESTIONS AND RECOMMENDATIONS FROM EXPERTS

THE PROFILE OF THE EXPERT				
Category	**Designation**	**Representation**	**Department/ Company**	**Experience (Year)**
Government Engineer	Executive Engineer	GE-1	Ministry of Works and Human Settlement	30
	Chief Engineer	GE-2	Ministry of Works and Human Settlement	10
	Chief Engineer	GE-3	Ministry of Works and Human Settlement	20
	Chief Engineer	GE-4	Thimphu Municipality	22
	Executive Engineer	GE-5	Thimphu Municipality	25
	Executive Engineer	GE-6	Construction Development Board	30
Contractor	Chief Executive Officer	C-1	M/s Namgay Construction	11
	Project Manager	C-2	Lhaki Construction Company	30
	Executive Director	C-3	Bhutan Engineering Company (P) Limited	11
	Project Manager	C-4	Singye Construction Private Limited	20

Table E.1 Suggestions for critical factors related to Material delay

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Material	Delay in material delivery at site	Preparation of effective material procurement plan by the contractor	✓	✓	✓		✓					✓	**5***
		Explore more markets in other neighboring countries				✓		✓			✓		3
		Proper estimation on Bill of Quantity(BoQ)							✓	✓			2

Table E.1 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Material	Shortage of construction material in the market	Replacement of alternative material availability in the market if specifications of materials are not insisted by government	✓	✓			✓			✓		✓	**5***
		The percentage of mobilization advance should be increased for contractor			✓		✓		✓				3
		Better management of crushing plants				✓		✓			✓		3

Table E.2 Suggestions for critical factors related to Labor delay

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Labor	Shortage of national construction labor	Introduction of better incentives to attract national labors		✓			✓						**2***
		Train national labor force							✓				1
		More number of vocational training institutes to be establish in Bhutan									✓		1
		Dignity of labor to be recognized to encourage national labors			✓								1
		Innovate proper plans to replace Indian labors by national labors										✓	1
		Advertising the long term significance and benefits of working and experience in construction sectors						✓		✓			**2***
		Facilitating the working environment	✓										1
		Encourage job seeker youths giving proper vocational trainings				✓							1

Table E.2 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Labor	Unqualified workforce at site	Introduction of basic construction skills for the unqualified workers by the management	✓				✓			✓			**3***
		Skilled and trained work force could be developed by labor ministry		✓		✓							2
		Encourage labors trained in vocational institute to participate in construction							✓			✓	2
		Train adequate number of local labor and pay them well			✓			✓			✓		3
		Evaluate the work and constantly guide and educate them with basic skills in construction	✓					✓	✓			✓	4
		Open authorized distributor quality labor outlet in different regions of country									✓		1

Table E.3 Suggestions for critical factors related to Equipment delay

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Equipment	Lack of modern equipment hiring agency	Lower the tax policy for imports of construction equipment			✓		✓		✓	✓	✓	✓	**6***
		We needs more exploration within the construction networks to decrease manual working conditions	✓										1
		Ensure that contractor have access to hire and procure these modern equipment		✓							✓		2
		Government should encourage contractor on handling different machine				✓		✓					2

Table E.3 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
		Government need consider the tax on equipment; contractor may encourage procuring modern equipment.							✓		✓	✓	3

Table E.3 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Equipment	Unavailability of modern equipment	Making available the required and specified equipment should be mandatory and strictly enforced.			✓		✓						2
		Dealer should ensure that they provide periodic maintenance through specialize personnel	✓			✓							2
		Provide soft loans to the construction firms for purchase of equipment.		✓					✓	✓		✓	**4***

Table E.3 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Equipment	Unavailability of modern equipment parts	Availability of agent based system for the readily available of all the equipment parts	✓	✓	✓						✓	✓	**5***
		Training of technicians involved in machinery repairs				✓	✓			✓			3

Table E.3 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Equipment	Unavailability of modern equipment parts	Government should encourage that whoever applies for dealership of license, they should stock all the required parts						✓	✓		✓	✓	4

Table E.4 Suggestions for critical factors related to Contractor delay

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Contractor	Improper planning and scheduling by contractor	Contractor should apply CPM, PERT and RSM for effective project implementation	✓		✓		✓						**3***
		Government should increase the technical scholarship slots in the human resource development plans		✓						✓			2
		Contractor should provide better incentive to site engineer who can plan.				✓							1

Table E.4 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Contractor	Improper planning and scheduling Improper planning and scheduling	Government should promote more technical institute in the country						✓				✓	2
		Government should encourage the people to take up technical studies										✓	1
		Technical personnel with experience and skills should be rewarded with higher pay packages									✓		1
		Government should make mandatory that the contractors must have the required technical staffs							✓				1

Table E.4 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Contractor	Inadequate technical staff	The increase in the number of vocational trainings institutes in the country can reduce this problem	✓	✓	✓		✓			✓			5

Table E.4 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Contractor	Inadequate technical staff	Preparing proper human resource management plan can succeed the project with adequate staff.			✓			✓	✓	✓	✓	✓	**6***

Table E.5 Suggestions for critical factors related to Government Engineer delay

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Government Engineer	Interference due to change in the system of government during construction phase	The consultant and government engineer should provide proper decision and quality assurance plans at the planning and design stages so that the design remains almost the even with new government formation			✓				✓			✓	3
		The contract law, rules and regulations should be strictly implemented	✓	✓		✓	✓	✓		✓	✓		**7***

Table E.5 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Government Engineer	Delay in progress payment of running bills and other overheads	Complete bills should be submitted on time and procuring agencies should verify and pay the bill within 30 days from the date of submission of bills. If budget is not available, procuring agencies should be responsible to follow up on the release of budget.				✓			✓	✓	✓	✓	**5***
		The financial regulation and clauses have to be revised and the he contractor should be asked to prepare bills as per the requirement and the engineer should not delay to verify and pass the bills.	✓		✓						✓		3
		The client should ensure that the budget allocation is approved for the project and regular follow up with the donor agencies is required.		✓			✓	✓					3

Table E.6 Suggestions for critical factors related to Consultant delay

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Consultant	Lack of knowledge in using advance engineering software	Many of the consultants and engineers have only diploma qualification. Government should initiate regular trainings to them in order to advance the working environment.	✓		✓				✓		✓		**4***
		The government sector should have exposure, knowledge, training on the latest technology available including engineering software.		✓		✓						✓	3
		The government should initiate Information technology based construction industry and award work to the consultants who have better experience in handle project					✓	✓		✓			3

Table E.6 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
Consultant	Inadequate detailing in design and drawing	Designer should have clear idea on site conditions before designing.							✓	✓			2
		The government engineer should strictly scrutinize all the designs and detailing before approval.			✓						✓	✓	**3***

Table E.7 Suggestions for critical factors related to External Factor delay

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
External Factor	Lack of modern construction technologies	The capturing of technology that are applied by the developed nation in Bhutan need to be given more important	✓		✓	✓	✓			✓		✓	**6***
		Application of the modern construction technologies should be initiated hiring experts from other countries. BOT system should also be followed		✓		✓		✓	✓		✓		5

Table E.7 (continues)

Category	Critical Factor	Suggestion	GE-1	GE-2	GE-3	GE-4	GE-5	GE-6	C-1	C-2	C-3	C-4	Frequency
External Factor	Limitation of exchange rate	Since most of the construction materials including labors are imported from India, government should discuss at policy level to government of India to provide adequate Indian rupees to Bhutanese monetary authority so that the construction works are not delayed.	✓		✓	✓			✓	✓		✓	**6***
		Government should seriously promote national labor force at construction and allow local materials to be used in construction so that the Bhutanese's construction sectors remain independent.		✓			✓	✓		✓	✓		5

(*) Useful recommendations for Bhutan

BIOGRAPHY

Ashok Sunwar was born in December 28, 1979 in Phuentsholing, a sub district of Bhutan. He completed his primary and secondary level of education in Bhutan. In 2005, he completed his Bachelor of Civil Engineering from Visveswaraiah Technological University, Bangalore; Karnataka, India under Government of India scholarship. Since 2006, he worked as government engineer in Thimphu Thromde (municipality), under Ministry of Works and Human Settlement in Thimphu, the capital city of Bhutan. In 2011, he was awarded RGOB-TICA scholarship by the Royal Government of Bhutan to pursue his Master Degree in civil engineering in the field of Construction Engineering and Management in Chulalongkorn University, Bangkok, Thailand.