Factors Affecting Construction Labor Productivity on Building Projects in Pakistan

By

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Dedication

Dedicated to my beloved Father and Mother for their continuous support and prayers.

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Abstract

Construction is one of the Pakistan's largest industries. It is phenomena which convert financial investments into physical assets such as buildings, dams, roads, bridges, houses and other elements of infrastructure. Cost and duration are the main factors due to which construction projects suffer mostly. Many stake holders are involved in projects related to construction i.e. designers, owners, contractors, consultants and others. The basic aim of this study is to find the factors on which labor productivity depends directly or indirectly. Competent labors are the need of good construction. Poor quality and low productivity are common problems on construction projects due to which projects suffer. One reason for this is incompetency of labors. Labors are responsible for most of the construction activities. There is need to identify the factors that hinder the display of construction productivity of labors in the field. Factors affecting labor productivity were retrieved from the literature review and interviews of professionals. This research acquaints construction project managers with knowledge of the potential issues that labors encounter and suggests guidelines for their eradication to enhance the productivity of labors. A literature review, pilot survey and factors recommended by experts were considered to categorize the factors into five groups. Disloyalty with work, lack of required tools and/or equipments and safe environment are the top three factors which affects construction labor productivity on building projects. Disloyality can be converted into loyality by educate, motivate abd guide labors. Contractor should provide complete supply schedule of material and equipment for project. Continuous safety meetings should be arranged and also training on safety.

Chapter 1

INTRODUCTION TO THE STUDY

1.1 INTRODUCTION

There are various critical problems facing the Pakistani contractors in the construction industry of Pakistan, one of the most significant problem is low productivity. In the past, several studies are performed relevant to the enhancement in labor productivity of construction industry (Soekiman, Pribadi et al. 2008; Gundecha 2012; Ibrahim 2013). Many of them were associated to calculate and analyze the consequences of elements which are putting impact on productivity. Proper estimation is very necessary in order to consider the outcome of these factors, it consists approximation of the projects particularly associated with construction, it's planning and scheduling of project has also been taken into account. However, previous researches has proved the measurement of such impacts as an imposible task, and in given cirucm stances there are no any general standards in order to analyze factors influencing productivity in companies which are dealing task related to construction and building. Deficiency of proper methodology for evaluation of effects which spot the requirement to raise measureable judgement for the element related to enhancement or decrease in productivity of construction, and this is considered as a topic of this research.

Systematic inefficiencies in construction projects can no longer be overlooked in a competitive industry operating at low profit margin (Picard 2003). Productivity is one of the important aspects for the companies in the construction industry, which helps for survival or growth. Improvement in the productivity of the construction industry is therefore of critical importance considering its significant contribution to the GDP. Productivity is an effective utilization of the resources to achieve set objectives. Increase in productivity correlates well with increased profitability, competitiveness, achievement of key stakeholder propositions as well as long-term growth and sustainability of a company, an industry and a nation (Durdyev 2012).

Construction industry confronts challenges regarding issues related to productivity and the problems are usually linked with progress of labor. The performance of labor is affected by many elements and it is associated with performance of time, cost, and quality. Knowledge and understanding of the various

factors affecting construction labor productivity is needed to determine the focus of the necessary steps in an effort to reduce project cost overrun and project completion delay, thereby increasing productivity and overall project performance (Soekiman, Pribadi et al. 2008). In many countries, labor cost consists of 30-50% of total project cost (Yates and Guhathakurta 1993; Jergeas 2009; Jarkas and Bitar 2012).

The most primary controlling factors of labors productivity is competency. The project manager always try to find for skilled and competent labors but it is not so simple and rarely succeed. Large number of labors are either unskilled or they didn't get sufficient training. Due to this contractors have to face several challenges. The labor which is not competent perform poor work and hence poor productivity results in delay and costoverrun. Whereas if the labor is competent project will complete in time and within budget (Gundecha 2012).

1.2 BACKGROUND ABOUT PRODUCTIVITY

There are many definitions of productivity. Mean labor productivity is usually taken the definition in construction industry, that is number of units of worked done per man hour. The inverse of labor productivity, man-hours per unit (unit rate), is also commonly used. Productivity is the ratio of output to all or some of the resources used to produce that output. Output can be homogenous or heterogeneous. Resources comprise: Cost, Time, energy, raw materials, etc (Enshassi, Mohamed et al. 2007).

1.3 DEFINITION OF PRODUCTIVITY IN CONSTRUCTION INDUSTRY

At the project site, contractors are often interested in labor productivity. It can be defined in one of the following ways.

$$Labour\ Productivity = \frac{Output}{Labour\ cost} \tag{1.1}$$

Or

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Work hour}} \tag{1.2}$$

There is no standard definition of productivity and some contractors use the inverse of above.

$$Labour\ Productivity = \frac{\frac{Labour\ cost}{work\ hour}}{Output} \quad (1.3)$$

In general, productivity means how one entity uses its resources to produce outputs from inputs (Enshassi, Mohamed et al. 2007).

Productivity can be defined as work performed with respect to time. Productivity can also be calculate by taking the ratio of real output of production to what we want to produce. The resources available to us for using input is normally cost of labor and out put is in volume. Many guidelines are available for contractors to take the reference value for construction cost estimation. These guidelines are similar principle wise but may vary little bit in values.

1.4 SIGNIFICANCE OF THE STUDY

It is universally recognized that there is a major role of productivity in welfare of nation. There is nothing as dangerous to an economy as a decline in productivities because it creates inflactionatory pressure, mutual suspicion and social conflict (Ameh and Osegbo 2011). Increase in productivity is the main source in any country for their economic growth. The main purpose of improvement in productivity is to better the right things not only to do things better. It is just like an evolution. Therefore if we want to improve productivity we have to change the things. Competetive level is necessary to increase productivity (Jayasekera 2003).

1.5 PROBLEM STATEMENT

The main problem which exists in construction industry is loss of productivity. The cost on labor is 33% to 50% of total project cost (Jergeas 2009).Labor is not constant and certain as compared to the other components of cost of project, it is very essential to under go analysis of the impact of various factors affecting productivity of labor. Labor cost can be reduced by increasing productivity (Ailabouni 2005).

Previous researches show that loss of productivity is due to various factors, which includes variation in drawings, additional assigned tasks, inadequate field management and weather conditions but not limited to these. These elements become

source of fluctuations that affect productivity and are not easy to govern by contractor resulting in loss of productivity which cause delay and cost overruns.

1.6 MISCONCEPTION ABOUT CONSTRUCTION PRODUCTIVITY

Some general misconceptions related to labor productivity are presented as follows (Jayasekera 2003):

- Productivity = Production
- Productivity is improved by only improving in labor productivity.
- Productivity is increased by working harder it may be true to some extent but this is not real productivity. To work intelligently is real productivity not harder.
- Loss of jobs is due to higher productivity. May be in short term it is true but it will benefit in large terms.
- Productivity matters in manufacturing and not matter anywhere else.
- There is a relation between productivity and quality one will affect by changing other.
- There is no benefit of productivity to you and me, it is for organizations.
- Labor is the key factor for low productivity in construction industry.

1.7 FACTS ABOUT CONSTRUCTION PRODUCTIVITY

Following are a few facts about the construction productivity studied by Adrian (1990):

- The most productive day of the week is Tuesday.
- The most productive time of the day is 10 a.m.
- Before the time of finishing is least productive with respect to labors.
- A labor is able to hold near about 94 pounds .
- If labor is doing the same task repeatedly then there may be chances of low productivity after 40 to 50 minutes.
- The least productive day of the week is Friday.

1.8 OBJECTIVES

The main objective of this study is to find the factors affecting construction labor productivity and to give recommendations that can be adopted in order to enhance labor productivity. The aim of this study is stated below.

- To discuss different factors which affects construction labor productivity.
- To analyze and calculate the Relative Importance Index (RII) of those elements related to productivity of labor.
- Statistical analysis.
- To make various recommendations in order to enhance labour productivity in construction.

1.9 RESEARCH CONTRIBUTION

Past analysis and researches has determined the key elemmentd which are impacting productivity of labour. Then either these components are utilize for the professionals or not. The main aim of the analysis is to gather details about factors impacting labour productivity and then send it to the management team who assure success of project. Generally, the factors which put impact on production are deficiency in needed materials, missundestading between the parties, weather, and alterations during the construction. Knowledge and experience is required for developing the project time schedule. The major objective of research study is to supply information related to factor of construction that affect the project's success in terms of delay and cost overrun.

1.10 RESEARCH STRUCTURE

This research consists of five chapters and appendices (Questionnaire).

Chapter 1 Background, definitions, Statement of problem, some facts related to productivity, and misconceptions related to productivity is studied in chapter 1.

Chapter 2 Literature related to productivity which is present in journals and books has been presented in this chapter. It also includes different factors which affects productivity and then discover the factors which can affect rate of production is studied in chapter 2.

Chapter 3 Research methodology and a discussion of the survey approach used is discussed in chapter 3.

Chapter 4 Analysis method and statistical method and results obtained from the web survey and interviews is studied in chapter 4.

Chapter 5 Conclusions, Recommendations and suggestions is discussed in chapter 5.

Figure 1.1 shows the flow-chart presenting several levels in research and its structure.

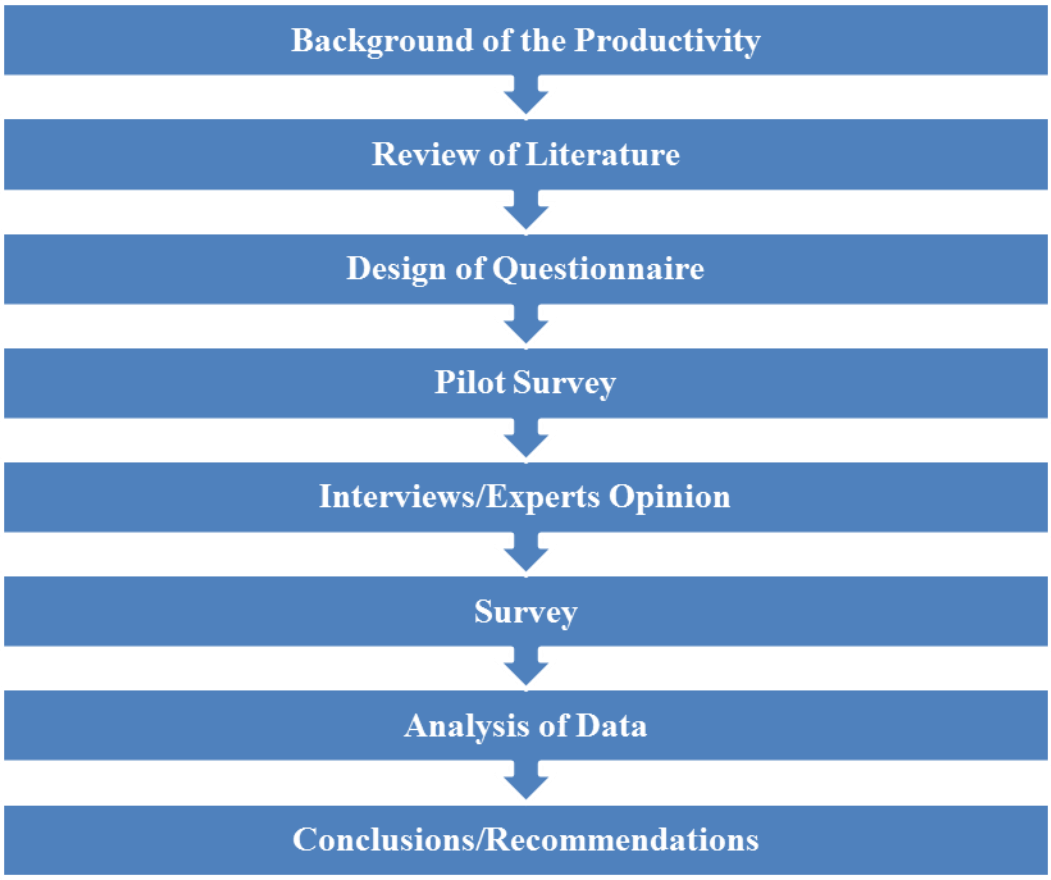

Figure 1.1 : Flow Chart of Research Structure

Chapter 2

LITERATURE REVIEW

2.1 REVIEW OF LABOUR PRODUCTIVITY FROM PREVIOUS STUDIES

The ratio of output to input of labor is productivity; and there are many factors which affects on output that are not under the control of workers e.g. lack of equipment, the introduction of new technologies and so on (Parham 1999).

By using the focus group interviews perceptions can be explored by engaging the participants. The findings recommends a greater emphasis on four key aspects i.e. planning, welfare, teamwork and job security (Chan 2004).

Construction industry is one of the most labor incentive industries and human resource covers a large project cost. Project managers always face problems to improve their project results by improving labor productivity. Now developing countries are also giving importance to productivity. Building and infrastructure projects are normally included in construction industry. Mostly building projects are focused for productivity. The overall impact of factors varies with type of construction and other aspects of project. The research was carried out for local construction projects to understand the problems which are faced by the workers during road construction projects based on the condition and circumstances of Pakistan. Basic needs of laborers must be fulfilled to expect good output from them. The influential factor for road construction projects is lack of planning (Muzamil 2014).

Construction industry faces challenges and problems and these challeneges and problems are also associated with labor. Many factors are there which affects labor productivity and usually related to time period, expenditure and better quality . In last decade recognition of those elements have been made which have a signifanct impact on labor productivity but stil there is need of indepth realization in order to enhance the productivity of labor. The factors which highly affect are execution plan, supervision, material shortage etc. Equipment factors also have high effect but in large construction companies. Owner and consultant factors may affect in small and medium companies. In small construction companies, importance is not given to health and safety factors and therefore has some effect, while in large companies it is

better, although not as major concern and has average effect (Soekiman, Pribadi et al. 2008).

Productivity varies from country to country and also from company to company. It is also related to how the employee be motivated to do his work. To get better productivity one have to optimal utilization of manpower , accurate estimation of time and cost, high morale of employee etc (Ailabouni 2005). In building projects one main reason of cost and time overruns is poor productivity of labor. In developing countries, productivity of labors is very important where still most work is done on manual basis. There are many ways that have been proposed to improve the productivity of the building industry (Alinaitwe 2006). Productivity is one of the significant issue in construction industry. In both developed and developing countries, it is an important issue. The developed countries are well aware of the importance of social welfare and economic growth. The developing countries are facing unemployment issues, inflation and resource scarcity hence they are seeking to utilize resources in such a way to achieve better economic growth and improve citizens' lives (Enshassi, Mohamed et al. 2007). Cost overruns, delays and productivity issues are associated with construction projects everywhere. There are many poor management practices that results in poor productivity and hence delay and cost overruns. Many researchers tries to overcome these by recommendations but these recommendations have yet to be implemented (Jergeas 2009). It is a big challenge for any manager to find appropriate ways to increase productivity. This is especially true in the field of labor productivity, where an accurate identification of output quantitatively is more difficult.

Olomolaiye, Jayawardene et al. (1998) classified factors into external and internal, internal are in control of firm whereas external is outside the control of firm. In external factors knowledge of client related to construction, weather, nature of work are included. In internal factors management, labor, technology and labor unions are included. Jarkas and Bitar (2012) worked on questionnaire survey to evaluate and rank the relative inortance index of factors which affect construction labor productivity on construction projects in Kuwait. The questionnaire consisted of 45 factors and classified in following four groups management, technological, labor and external. Kaming, Holt et al. (1997) conducted a study to find the top main factors affecting labor's productivity in Indonesia. Top factors which affecting productivity are rework, absenteeism, lack of equipment and tool. Discontinuation of material

delivery to site occurs if suppliesr are not paid at defined time , change order by consultants, late issuance of drawings are the major factors putting impact on productivity of residential projects of Malaysia is concluded by AbdulKadir, Lee et al. (2005). Ghoddousi and Hosseini (2012) conluded that factors which affects subcontractors production rate in construction projects in Iran are raw materials and equipment shortage, practical application, planning, supervision, rework and weather. One of the important and key component of success of every construction company is productivity (Mojahed 2005). Level of skill, experience of work force, adequacy of method of construction and inadequate supervision are the constraints with high affect on labor productivity is concluded by Durdyev (2012). Attar, Gupta et al. (2012) mean labor productivity is taken in construction projects. To calculate productivity is a complex problem in construction projects. Dozzi and AbouRizk (1993) identified two major and important ways of labor productivity and they are the effectiveness with which labor is utilized and efficiency of labor to what is required. Six key factors which highly affects labor productivity are lack of material, supervision delays, lack of equipment, rework interference and absenteeism (Makulsawatudom and Emsley 2001).

2.2 DIFFERENT FACTORS AFFECTING PRODUCTIVITY OF LABOR

Productivity depends on various interdependent factors. Different factors impacting the labor productivity have been presented as follows and these are reviewed from past studies.

2.2.1 Time

Many tasks are there in construction projects which are the reasons for loss of productivity. Working overtime is one of those reasons due to which productivity decreased. Working overtime can be due to many reasons some of them are absenteeism, poor workmanship, higher rework and accidents during construction. It is generally believed that reductions in working hours increase labor productivity (Office 2004).

2.2.2 Schedule Compression

If there are stays in a project, then later activites are often be compressed to complete the project in assigned time. Schedule compression, when related with

overtime, it oftens result of loss in productivity due to shortage of equipment or material tools which help the extra labors, resulting in unmanageable issues regarding contriving and managing of unavailability of experienced labors (Gundecha 2012).

2.2.3 Type of Project

In order to attain substantive productivity, all member of a crew needs enough space to accomplish his tasks without having any impact of other crew members. In case Where large number of labor are appointed to carry out project, in a defined space, probability of ocuurence of interference always exists, which results in decrement of productivity. In addition , when numbers of deals are alloted to operate in similar environment, the chances of occurrence of intervention always increases and due to which rate of production may be diminish. Intervene occurredamong the different laborers is because of lack of proper management on construction sites. For example, if the carpenter's framework is not complete due to some reason then consequently before fastening the reinforcement rods, steel-fixture group has to face postponement. Different forms of activities and construction methods also have a great affect on productivity of labor (Gundecha 2012)

In order to realize good productivity performance minimiziation in change is very necessary. Even in case ,when a project has little or almost no change, costs, schedules, and labor productivity can alter from plan. Projects that have alteration and variation , even in a small amounts, are much more likely to have high risk cost and schedule performance than budgeted (William 2011).

2.2.4 Safety

Labor productivity is highly affected by safety accidents. Several types of accident ussualy happen at the site, in which some can results in death casualty and prevention of entire work for long time . An mishap that makes an wounded person to be admit in hospital resulted in form of decrement in performance of team. Reduction in productivity also occurs due to small accidents like nails and steel wires which results in discontinuation of progress. Even deficient lighting shows drop off in production because adequate lighting is needed to execute tasks in effective way and improper lighting has bad impacts. In order to demonstrate the regulations related to safety and way to adopt them, it is very essential to employ a

safety officer , which results in reduction of accidents, and thus increase in productivity (Gundecha 2012).

2.2.5 Quality

Major factors of decline in productivity are inadequacy of equipment and low quality of the raw material. The productivity rate obtained by using equipment which have insufficient performance is always low. Out dated equipment is subject to a large number of failures , and it require a suuficient for the labors to accomplish their assigned tasks, and in this way production is going to be decrease . Use of material which does not fulfill any standard criteria during task execution is an other reason , because low qualtiy materials resulted in form of unacceptable outcome and can be disapproved by ispectors , thus decreasing the rate of production. (Gundecha 2012).

2.2.6 Managerial Factors

Productivity growth is highly dependent upon conduct and acquirements of mangers. In several establishment, productivity increment is very low and the advance technology and well trained crew is provided. Decrease in productivity occurs due to improper and dissimilar team management. Qualified and devoted managers can achieve astonishing output by utilizing mediocre team. Functioning of employee is depending upon their mind wheather they are capable and willing to perform their assigned tasks. Management is the catalyst to make both of them. Improved technology always requires well educated laborers who, in turn, work fruitfully under professionally certified managers. It is only possible through effective management that optimum usage of human and technical resources can be guaranteed.

2.2.7 Manpower Group

Literature depicts that improper labor experience is the factor which have a negative impact on labour productivity and it demonstrate that, in order to attain better productivity, labour always represents an important role. Contractors should always have prporley competent laborers. If propely qualified labor is unaccessible and a contractor has only choice to acomplish his specific project with less qualified labor, then there is possibility that productivity will be influenced negatively. The unavailibilty of any team worker may influences the team’s production rate because workers will, be uncapable to justify the same rate of production with few resources

and with a new team member. Missconception among labourers results in improper correspondence about their duties and the duty constraints of each labour, which results in a lot of performance faults and reduces productivity of labour. Due to improper compensation and over age labour affect labour productivity in negative manner because labour speed, agility, and strength decreases with age and decline productivity (Gundecha 2012).

2.2.8 Motivation

Since motivation is an inducement for higher output it should be accorded a right of place by employers of labor for the construction industry to achieve higher productivity, which will lead to greater contribution to the nation's Gross Domestic Output (Olotuah 2006).

2.2.9 Supervision

Generally, projects come across some alterations during construction which includes designs, engineering drawings and detail description of material. If drawings have some faults and are poorly described then productivity is presumed to decline, since labour in the field have lack of confidence. Due to which , task may be cause to slow down, or have to be entirely prevented and postpone it, until clearly defined instructions. Loss of productivity increases upto 30% when work changes are being executed. Proper inspection given by the inspector is an necessary requirement to carry on. For example, casting of concrete can not be done by the contractor before an assessment of the formwork and steel work, thus affecting labour productivity.

Supervisors may demand for modification in a specific task due to non-accomplishment of the pre-defined tasks according to the technical requirments,. Supervisors' un avalilibilty stops the performance entirely for processes that need their presence, such as concrete caasting and backfilling, delaying inspection of the completed task which, in turn, leads to stay in starting new project.

2.2.10 Material/Tools

Material management is considered as one of the greatest effective element in construction firm. Productivity can be influenced if requirement of materials, tools, or construction equipment for the specific task is not fulfilled and are not present at the right place and time. Suitable type selection and size of construction apparatus often affects the time which is required, therefore, it is very necessary for site

managers to be well known with the attributes of the significant kinds which are widely used in construction. In order to enhance job-site productivity, it is most enhancing matter to choose equipment with adequate qualities and a size which are most desirable for the working situations at a construction site. Labour require a minimum number of equipments in order to work effectively and efficiently to fulfill the pre defined requirments of the allotted task. If the provided tools or equipment are not suitable, productivity may be affected.

2.2.11 Project Management Factors

The construction manager must has an ablility to lead project until its accomplishmen. Leader ship produce distinguish skills in the construction manager to plan, observe, and control the progress of a project in an eeficient manner. There are five different ways to enhance productivity: enlarge input but get a greater increase in output, sustain input but enhance output, decrease input with a smaller decline in output, decrease input while keeping output as a constant factor , and decrease input but enhance output. The leaders could use one of these procedures in order to raise productivity based upon on two important tools: leadership skills (vision, motivation, team building and trust) and selecting the most adequate and desirable leadership approach from various types to guide the employees for the primary objective which is basically productivity enhacenment (Mohamed 2014).

2.2.12 Natural Factors

Several natural factors which affect labour productivity have been gathered from former research and these factors are usually situations of weather at the job-site and geographical cosiderations. Others factors such as fuel, water, and minerals also have an impact on productivity to certain level. Productivity is found to be severaly affected if weather state is too being at extreme point (too cold, heavy rainfall, too hot).

2.2.13 External Factors

Different atmospheric conditions are important factor regarding execution of any project. Severe winter weather, such as winds and rains, decreases productivity, specially for external job such as formwork, T-shape work, concrete casting, external plastering, external painting, and external tiling. Harsh weather sometimes acts as a major barrier in continuation of the work totally.

2.2.14 Political Factors

Law and order situation, stabilization of government, etc. are very necessary for productivity enhancement in the construction firms. The government's taxation policies put impact on compliance to work and enlargement of plants.

2.3 IDENTIFICATION OF POSSIBLE FACTORS AFFECTING PRODUCTIVITY IN BUILDING CONSTRUCTION

Based upon the literature study, this review pulls out several factors affecting labour productivity in construction from the former researches. Some similar factors were intermixed, and addition of some new factors were been made. They are usually set up on generaly defined standards. Table 2.1 shows several factors affecting labour productivity in construction which are attained from the former studies.

Table 2.1 : Top Factors Affecting Labour Productivity

Sr. #	Top Factors From Previous Studies	A	B	C	D	E	F
1	High morale of staff		☑	☑		☑	
2	Delay in arrival of materials	☑			☑		
3	Rework			☑		☑	☑
4	Labor strikes	☑				☑	
5	Financial difficulties of the owner	☑		☑	☑		
6	High absenteeism of labors	☑			☑	☑	
7	Labour disloyalty			☑			☑
8	Supervisors absenteeism	☑				☑	
9	Lag of equipment	☑				☑	
10	Design changes				☑		
11	There is no definite schedule		☑			☑	
12	Training Investment				☑		☑
13	Lag of Material	☑				☑	
14	Site close to home		☑		☑	☑	
15	Job security and retention of staff		☑				
16	Working Over time		☑	☑			
17	Unclear instruction to laborer	☑		☑	☑		☑

18	Balance between work , recreation and family time.				☑		
19	Reasonably well paying job				☑		☑
20	No supervision method		☑				
21	Working 7 days per week without taking a holiday				☑		☑
22	Accidents			☑			
23	Maintain Work Discipline				☑		☑
24	Advance site layout			☑			☑
25	Shortage of power and/or water supply				☑		☑

Detail of studies A, B, C, D, E, F are shown in Table 2.2.

Table 2.2 : Detail of Studies

Sr. #	**Detail of Studies**
A	Factors Related to Labour Productivity which are affecting the Project Schedule Performance in Indonesia (Soekiman, Pribadi et al. 2008).
B	Factors Affecting Labour Productivity of Construction Industry in UK (Chan 2004).
C	Factors Constraining Labour Productivity: Case Study of Turkmenistan (Durdyev 2012).
D	Factors Affecting Productivity of Employee in the UAE Construction Industry (Ailabouni 2005).
E	Factors Affecting Labour Productivity in Building Projects in the Gaza Strip (Enshassi, Mohamed et al. 2007).
F	Study of impact of Factors on Labour Productivity at a Construction Project in the USA (Gundecha 2012).

2.4 FACTORS AFFECTING LABOUR PRODUCTIVITY

Table 2.3 shows existing factors which affect labour productivity in construction.

Table 2.3 : Possible Factors Affecting Labour Productivity

Sr.	**Factors Affecting Productivity of labor at Construction Projects**

1	Several Accidents and incidents
2	Methodology of construction
3	Drawings and specifications change during execution process
4	Rules and regulations of Government
5	High peculiarity of desired work
6	Increasing number of labors
7	Inefficient equipments
8	Delay in Inspection
9	Insufficient means of transportation
10	Improper lighting
11	Absenteeism of labour
12	Lack of Labour patriotism
13	Lack of competition among workers
14	Deficiency of financial motivation schemes
15	Inadequacy of skils and experience of labour
16	Need of periodicaly interactions with labour
17	Personal problems and troubles of labour
18	Absence of refreshment centres for meal and relaxation
19	Insufficiency of training activites
20	Defective raw materials
21	Short fall of material
22	Misunderstading and miscommunication among labours
23	Misscommunication between labours and superintendents
24	Misappliacation of time schedule
25	Delays in pays
26	Reworking
27	Unavalabilty of Supervisors
28	Shortages of tool and equipment
29	Different type of project activities
30	Unsuitability of location for materials inventory
31	Infraction of safety precautions
32	Variation in weather

33	Working at high place
34	Overtiming in working

2.5 DIFFERENCE IN PROJECT CHARACTERISTICS

The key variations in project with high and low productivity have been summarized and shown in Table 2.4.

Table 2.4 : Difference in Project Characterisitics

	Highly productive projects	**Low productive projects**
1	Realistic plans	Poor planning, inexperienced planner
2	Building design that allows the use of trade skills	Repetitive, simple design that uses very little trade skills
3	Good communication between senior management and operatives	'Them' and 'Us' attitude among senior management and operators
4	Training investment	Lack of training avtivities
5	Experienced staff	Inexperienced staff
6	High staff morale	Low staff morale
7	Good welfare	Little or no welfare
8	Highly qualified and self-devoted site manager	Inexperienced site manager
9	Site near to home	Site far away from home
10	Job security and retention of staff	Subcontractors or Labour only subcontractors

Chapter 3

METHODOLOGY

3.1 INTRODUCTION

A quantitative task of research in which comparatively huge number of persons are interviewed, and each being asked a properly defined set of questions, presented in the similar manner each time. For many of the questions there will be a range of standard responses, from which the respondent must pick out. The findings are collected as numerical data, are generally subjected to computer analysis and are interpreted at least in part through the application of statistical concepts.

The procedure of accumulation of data which is utilized in this research had the choice of two types of methodologies: questionnaires and personal interviews. Both methods were followed. A questionnaire was taken as the most adequate and desirable technique of data-collection for study purposes, however interviews for advancement in questionnaire had been conducted. Finally it was concluded that the questionnaire was considered as a self-administered tool with web-design questions, and an adequate response. A questionnaire in a web-survey format needed less time, resulted in cost optimization and enables all the repondents to answer the questionnaire comfortably. However, in this methodology the response rate is generally less as compared to interviews conducted in face-to-face manner. Information was gathered from literature reviews, books, journals, conferences and websites which underline labour productivity. A survey was passed to employees from various trades engaged with projects of construction. Then interviews were taken from professionals to study the factors in deep. Fifteen different projects were considered for interviews. All projects were building construction projects.

3.2 RESEARCH DESIGN

Advanced technology has been adopted in research activities e.g. emails were used in order to send out the survey questionnaire. Basically the purpose of the survey was to gather data reagarding several factors which affects labor productivity particularly in construction all over the Pakistan. The intention and methodology adopted in the survey was elaborated to the respondents in detail. Proper instructions were given to the respondents in order to assure that the procedure was implemented in an efficient manner to minimize errors. In survey, some oversights were presented

in order to checkout that whether the operation was going out in a steady and consistent manner. The data was collected in order to keep up secrecy. Obtained results consisted the overall statistics as well as on individual basis.

3.3 CONSIDERATIONS FOR THE SURVEY

The principal condition of survey was that it must be comfortable for respondents. If level of difficulty of questions is very high, then chances of high drop-out rate was analyzed. Precautions were followed so that the questions at initial level did not affect the results of later questions in neagative way. At start, text was presented in order to describe the survey project in detail to the respondents. Page breaks were inserted on the web pages in order to the improve the text's readability. Logical questions were averted because they can be resulted in frustration of respondents eventually increment in the drop-out rate. Study was performed to dig out any dangerous flaws and loopholes.

3.4 ORGANIZATION OF THE QUESTIONNAIRE

One of the major concerns of the research study was about many reactions with entire data. Identification and realization of respondents about the gains and roles of this research was also of an important interest. Following criteria was utilized to initiate the questionnaire design process:

Questionnaire	**Response Rate**
Exactness	Duration
Applicable	Ease of Completion
Completeness	
Understanding	

Carefulness and productivity were obtained by analyzing the accuracy and logicality of the relevant questions, by taking former studies into consideration (Table 2.1). Even strong and great steps were taken to develop an questionnaire effective, but still it was not guaranted that the percentage of response will be of high value. Immense precautions was considered to ensure respondents to obtain accurate time duration in order to respond to the questionnaire which finally come out in the form of online researcher. By taking into effect of length, significance, sensitivity, past experience of researcher's advisor, responses gathered from pilot survey , expert persuation and conducted interviews it was determined that, the mean time to finish the entire

survey questionnaire would need about fifteen minutes. Duration of 6 weeks was specified for completion and submition of survey questionnaire. Questionnaire was kept effectual and comfortable for the respondents. Several parts were projected for the survey questionnaire and they were alotted discrete colours for suitable response.

3.5 QUESTIONNAIRE

The designing pattern of questionnaire usually advanced on the basis of communication. It was arranged into profile of the respondent and several elements that affect labor productivity. Questions in the profile of respondent were asked to gather concerned data such as job situation, work experience, positioning of the current operations and contact information. It was analyzed that questions asked in the survey had very significance regarding research by studying loss of productivity from sort of dissimilar profiles of respective areas. It was pragmatical to predict that place and position can have an affect on the productivity loss due to several field disruptions e.g. adverse geographicalconditions and climatic situations.

The next set of questions was pointing out the factors in the five different groups which have significant impact on labor productivity. It is consisted upon factors affecting labour productivity. Respondents had simply provided the factors affecting productivity for given condition. Hence, each respondent had an option to choose single alternative for each factor. The responses were depending on the interpretation, technical familiarization of the respondents and were not associated with any defined task. This simplified form of methodology was adopted to set up ways of formulating a list of factors which have impact on productivity of labours.

3.6 PILOT SURVEY, INTERVIEWS AND QUESTIONNAIRE REVISION

In order to modify the questionnaire part, a pilot study and expert views were combined. In this part identification of several causes, collection, and conclusions of data was presented so that it would be utilized in better constitution of the web-survey development.

Total 38 questionnaires, were sent to, architectures, owners, contractors, project managers, and consultants of different companies by e-mail. Completion and submission of the response was awaited within fifteen days . At the end of 2nd week, 27 responses had been gathered from the pilot survey, in which uncomplete responses

were seven and were taken out, which resulted in the database comprising on total of 20 respondents. Informations and the recommendations obtained from pilot survey are discussed below.

- Questionnaire should always be initiated with the general particulars of the organization.
- Few factors are irrelevant regarding construction. They must be took out or in altered form.
- In order to find more desirable and consistent interpretation some factors should be formatted.
- Few factors should be improved with further details.
- Repetition of factors having same sense should be avoided.
- Some factors should be altered in order to provide clear signifance and comprehension.
- Effective and precised questionnaire relevant to the topichad been obtained through pilot study.

After Pilot Survey, for more improvement in questionnaire interviews were taken from contractors, owners, architectures, operation managers, and project engineers. From 20 different professionals interviews have been taken. It was a difficult task as professionals showed resistance on interviews. It took 2 months because of very busy schedule of every one.

After Pilot Survey and Interviews, number of factors becomes 38 which was the ultimate refined form of this questionnaire.

The perfection is relevant to the firm of the questionnaire and the response time. In terms of firm, the web survey was established by utilizing a light appearing and pleasurable font of colours. It consisted a percentage bar for the finalized survey and had an possibility of navigation regarding any query and uncertainty at any given time. All the data recorded via web had an option of auto-save and it resulted as facility for respondents to come back to the survey within the specified time limit.

3.7 SURVEY SAMPLE

3.7.1 Sample Selection

The motive of statistics is to have summarized results about features of the populace through sampling. The sample should be the true representative of the population if one has to attain the good results. The sample that was chosen for this research was

randomly selected for the population of Civil Engineers that were working of various projects in Islamabad and were registered with Pakistan Engineering Council (PEC) with qualification of BSc Civil Engineering and above. However, there were a few of the responses from the respondents who had not been registered with Pakistan Engineering Council as their qualification was Diploma of Associate Engineering in Civil Technology. Their response was also registered as they were also a part of various construction companies and government departments and were deployed for the supervision of the projects. As per the PEC magazine 2013, there are around 32184 registered civil engineers. Assuming that twelve thousand are unregistered engineers or in process of registration, the total population size can be calculated as approx. 45000. This is fairly a large population and the sample that is being selected, it represents the construction experts that are working with clients, consultants and contractors at various levels depending upon their experience, qualification and competency. For this research to be carried out, a random sampling technique was used which included the Civil Engineers from various firms and departments. However, most of the projects were selected from Federal, Punjab, AJK and KPK. The questionnaire was distributed to 180 respondents working with client, consultant and contractor. Main focus of the survey was on building construction projects.

3.7.2 Sample Size

Elements which should be considered in specifying an appropriate size of sample are:

- Errors in Sampling
- Size of Population
- Level of Confidence

Equation 3.1 mentioned below provides the mathematical expression which can be utilized in order to compute the sizes of sample (Dillman 2000):

$$N_s=\frac{[N_p*P*(1-P)]}{[(N_p-1)*\left(\frac{B}{C}\right)^2+P(1-P)}} \quad (3.1)$$

Where;

N_s: Sample size for precision level desired

N_p: Size of population i.e. 30000

P: Proportion of the population that is anticipated to select one of the response categories (yes/no); P = 0.5

B: Acceptable sampling error; (±10% or ±0.10)

C: Z statistic related to the level of confidence (1.96 corresponds to 95% level of confidence)

Various population sizes with acceptable sizes of sample for 95% confidence level with different errors in sampling are shown in Table 3.1. The sample sizes can also be calculated by using the formula which is mentioned in the above equation suggested by (Dillman 2000). Table 3.1 shows completed sample sizes required for several population sizes and characterisitcs at three precision levels.

Table 3.1 : Sample Sizes for 95% level of Confidence

Completed sample sizes needed for various population sizes and characteristics at three levels of precision.

	Sample size for the 95% confidence level					
	±10% Sampling Error		±5% Sampling Error		±3% Sampling Error	
Population Size	50/50 split	80/20 split	50/50 split	80/20 split	50/50 split	80/20 split
100	49	38	80	71	92	87
200	65	47	132	111	169	155
400	78	53	196	153	291	253
600	83	56	234	175	384	320
800	86	57	260	188	458	369
1,000	88	58	278	198	517	406
2,000	92	60	322	219	696	509
4,000	94	61	351	232	843	584
6,000	95	61	361	236	906	613
8,000	95	61	367	239	942	629
10,000	95	61	370	240	965	640
20,000	96	61	377	243	1,013	661
40,000	96	61	381	244	1,040	672
100,000	96	61	383	245	1,056	679
1,000,000	96	61	384	246	1,066	683
1,000,000,000	96	61	384	246	1,067	683

However, the sample size for the targeted population may also be calculated by using Eq. 3.2, Eq. 3.3 and Eq. 3.4 (Abdul-Hadi 1993):

$$n = \frac{n'}{\left(1 + \frac{n'}{N}\right)} \tag{3.2}$$

$$n' = \frac{S^2}{V^2} \tag{3.3}$$

$$S^2 = P\,(1\text{-}P) \tag{3.4}$$

Where;

n: Sample size from finite population

N: Total population

n´: Sample size from infinite population

S2: Standard error variance of population elements, maximum at P = 0.5

V: standard error of sample population which is 0.05 for confidence level 95%

The valid responses were one hundred and two out of 180 showing an total response rate about 56.67%. As far as the construction enterprises are concerned, round about 30% response rate is considered as a good response rate . Therefore, the response rate which was received in this research was acceptable for the result formulation. The sample size was 138 for this questionnaire survey, in order to determine whether this sample size is the true representative of the whole population, Table 3.1 was used to estimate the sizes of sample needed for different community sizes and characterisitcs at three different level of correctness. However, these values can be reassessd by utilizing the formulae given in equations (3.3) and (3.4).

Until September 2014, more than thirty thousand construction firms have been registered with Pakistan Engineering Council, which can be used as population size. 95% confidence level was selected. The answers were assumed to be homogeneous the *p-value* to 0.5 (which means that probability of occurrence is 50%). Using a fifty-fifty split maximizes the question variance, which requires the largest possible sample to control for the differences among the response options. By applying these values in Eq-3.3 and/or Eq-3.4, the sample size comes out to be 96 for a sampling error of ±10%. After the careful analysis of the collected data using SPSS-17, the maximum sampling error came out to be ±9.47%, which is less than ±10% so any sample size over 96 is quite acceptable for a sampling error of ±10%. As, the sample size used in this research was 102, so the responses of the respondents were quite acceptable for further analysis.

3.8 DESIGN OF SURVEY

3.8.1 Reliability and Validity of Survey

Many researches that are being conducted for different purposes are not able to achieve their basic objectives. Therefore, the data that is being collected should be reliable. For that purpose, the reliability and validity of the data must be checked so that the results that are taken out of that data should be representative of the whole population. The authenticity and credibility of a study determine that the research fulfills its motive for which it was carried out. “Reliability refers to the consistency of

a measure and to the probability of obtaining similar results if the measure is to be duplicated" (Oppenheim 1992). Various methods can be used to measure the reliability however the internal consistency is the most commonly used method in the researches. "Validity determines whether the score or question can measure what it is supposed to measure" (Oppenheim 1992). Researchers use various methods to ascertain the reliability and validity of the questionnaires. Some will be concerned to the research instrument utilized in former analysis, already been verified as effectual and credible. Similar methodology has been adopted in this research. Before choosing the questionnaire, a thorough literature review was arranged and a questionnaire was prepared. Then few modifications were made in the questionnaire after consultation and interview sessions with the professionals of the construction industry working with the stakeholders of the industry; client, consultant and contractor. It eventually enhanced the authenticity and validness of questionnaire. The collected data was examined by using MS Excel and SPSS-17 with the usage of frequency analysis, reliability analysis, normality test and Kruskal-Wallis test for non-parametric data to find out the major difference among the perceptions of the stakeholders of the construction industry, consultant, client and contractors on any specific aspect of delay factors.

3.9 STATISTICAL TECHNOLOGIES

The statistical terms that are used in this research are taken from Choudhry and Kamal (2008) and are given below:

3.9.1 Hypothesis Testing and Statistical Hypothesis

It is a very significant phase of statistical inference. This is the method that assists to decide on the information basis received from the collected data that whether statement about the population parameter value should be accepted or rejected. Statistical hypothesis is a statement/assumption that might be true or vice versa. The hypothesis that is being supported by the collected data from the sample size is accepted as true whereas when the sample data fails to support it, stands rejected.

3.9.2 Null Hypothesis and Alternative Hypothesis

The statement that is to be tested for the possible rejection under the assumption that is true is called Null hypothesis and is denoted by H_o. The hypothesis that is accepted when H_o is rejected is called alternative hypothesis and is denoted by H_a.

3.9.3 Significance Level and Test of Significance

The probability which is utilized as a standard for disapproving H_o, when H_o is presumed to be true is called important level. Significance's test is a process by which sample results are utilized to decide whether to adopt or reject H_o.

3.10 DATA ANALYSIS TECHNIQUES

Analysis of the collected data was done using MS excel and SPSS-17. Usual level of significance i.e. $\alpha = 0.05$ was followed in the study. For the purpose of analysis following statistical techniques was used.

3.10.1 Test for Normality

The condition that prevails before the use of various statistical tests is to evaluate the normality of the gathered data. The normality test is usually executed in order to determine whether the collected data is normally circulated or not, which means that either the data is parametric or non-parametric in nature. If the data sets are two thousand or less, then the most suitable test used to evaluate the normality of the collected data is Shapiro-Wilk test. In order to be as satisfactorily normal, an important (Sig.) value should be non-significant (i.e. it should be larger than 0.05). If the given sets of data are greater than two thousand, then the most suitable test used to evaluate the normality of the collected data is Kolmogorov-Smirnov test, also called as K-S Lilliefors. Hence in this research work Shapiro-Wilk test was used to check the normality owing to the limitation of sample size which was less than two thousand.

3.10.2 Kruskal-Wallis Test and one way ANOVA

If three or more independent groups (client, consultant and contractor) are identical or diverse on some variable of interest then the Kruskal-Wallis test and one-way analysis-of variance are used to determine the variation in the response of each group. It is most suitable to find the statistical indication of variation or dissimilarities in the perceptions of the stakeholders such as client, consultant and contractor, using average values or indices of the various groups. If the data is non-parametric the Kruskal-Wallis test is used whereas if the data is parametric in nature then one way ANOVA is used for further analysis. The data that was collected for this questionnaire based research was not able to be validated by the normality test that's why Kruskal-

Wallis test was used for further analysis to check the variations in the perceptions of the stakeholders. It is very less sensitive to outliers.

The H_o for the test is that the means of variables are same and is rejected if the result is meaning full. The results are tested against the difficulty of significance of 0.05. All the stakeholders will have same perception if the significance value is above 0.05 and vice versa.

3.10.3 Correlation Between Stakeholder's Responses

The correlation between the responses shown by the stakeholders was calculated in order to check whether the responses had a good degree of agreement between one another. The following equation was used for calculation of degree of agreement among the responses of the construction industry stakeholders.

$$Correlation = \frac{\sum_{i=1}^{n}[(X_i - X')(Y_i - Y')]/(n-1)}{S_x S_y} \quad (3.5)$$

$$S_X = \sqrt{\frac{(X_i - X)^2}{n-1}} \quad (3.6)$$

$$S_Y = \sqrt{\frac{(Y_i - Y)^2}{n-1}} \quad (3.7)$$

Where:

n: total number of delay factors

Xi: value of RIF given by first stakeholder for ith delay factor

X': mean of all the RIF of delay factors by first stakeholder

Yi: value of RIF given by second stakeholder for ith delay factor

Y': mean of all the RIF of delay factors by second stakeholder

3.11 INTERVIEW

Through literature review, the common activities which are included in building projects have been basically identified. Total interviews arranged were 18 and data was collected from 18 different building construction projects. Same questions were asked. Then interviews of 18 professional were arranged. Same questions were asked from all of them.

It was classified into description of the respondent and several activities included in building project, their estimated completion duration and actual completion duration. Questions in the respondent profile were produced to gather particulars such as construction company, nature of project, name of interviewer (optional), location of project, estimation of project cost, actual project cost, estimation of duration of project and actual completion of project.

The next set of questions was targeting the activities which are common in all building projects, their estimated duration and actual duration. On the basis of this data average cost and average duration of all the projects was calculated to find out that on average how much projects are cost overruns and delayed in percentage. Then percentage average duration of each activity was calculated.

3.12 SUMMARY

This research study uses multiple or mixed research methods. Questionnaire survey and interview technique is adopted as the main research instrument. In this chapter, the research method, design, sampling techniques and design of the survey are discussed. Above discourse provides a clear understanding of the research methodology used.

Chapter 4

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

In Pakistan, many factors affect labor productivity in construction projects. All the stakeholders don't give the importance to it. As a result most of the projects undergo unnecessarily delay that results in cost as well as time overruns. Data gathered through questionnaire based upon survey and interviews was examined by utilizing Microsoft Excel and SPSS-17. Out comes of survey have been demonstrated in the later paragraphs.

4.2 CHARACTERISTICS OF RESPONDENTS & FREQUENCIES

4.2.1 Grouping of Respondents

There were one hundred and two justifiable replies out of 150, showing a rate of response about of 68.00%. Responses received from clients were 33 out of 102 with 32.35% as overall response rate, responses received from consultants were 22 out of 102 with 21.56% as overall response rate and responses received from contractors were 39 out of 102 with 38.23% as overall response rate and responses received from researcher/academia were 8 out of 102 with 7.82%. Grouping and frequencies (percentages) of respondents are shown in Table 4.1 and Figure 4.1.

Table 4.1: Classification of Respondents

Respondents	No. of Questionnaires Returned	Percentage	Cumulative Percentage
Clients	33	32.35	32.35
Consultants	22	21.56	53.91
Contractors	39	38.23	92.14
Researcher/Academia	8	7.82	100
Total	102	100	100

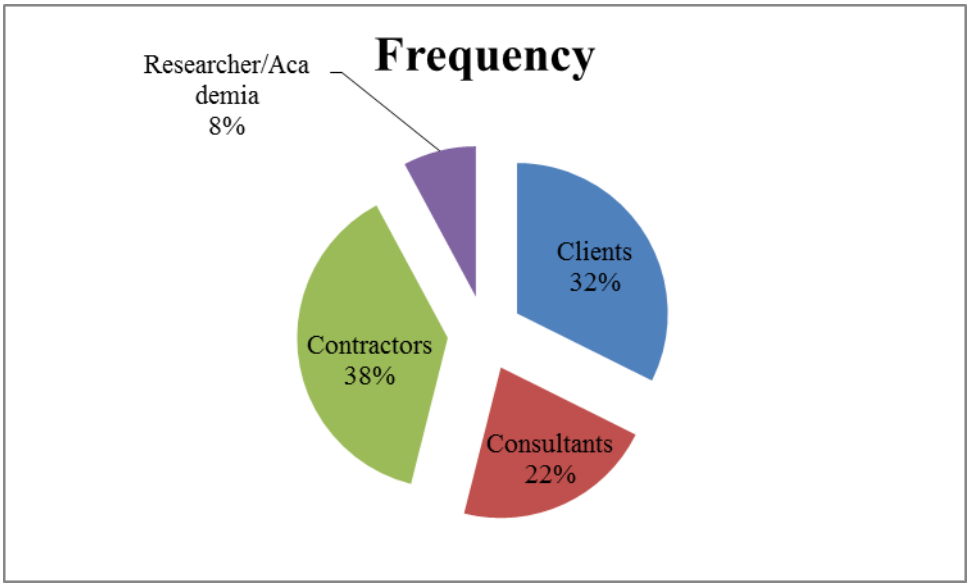

Figure 4.1: Grouping of Respondents

4.2.2 Experience of Stakeholders in Construction Industry

Respondents were having invariant experience in the construction industry as shown in Table 4.2 and Figure 4.2. Approximately 14.7% (15) of the respondents had gathered over 15 years of construction experience, 19.6% had 10 to 15 years of construction experience, 24.5% (25) had six to ten years of contruction esperience and whereas 41.17% (42) had 0 to 5 years of experience construction. Therefore, the data provided by these professionals can be viewed as an credible and adoptable .

Table 4.2 : Experience of Respondents in Construction Industry

Experience of Respondents	**Frequency of Respondents**	**Percentage of Respondents**	**Cumulative Percentage**
0-5 Years	42	41.17	41.17
6-10 Years	25	24.5	65.67
10-15 Years	20	19.6	85.27
More than 15 Years	15	14.7	100
Total	102	100	100

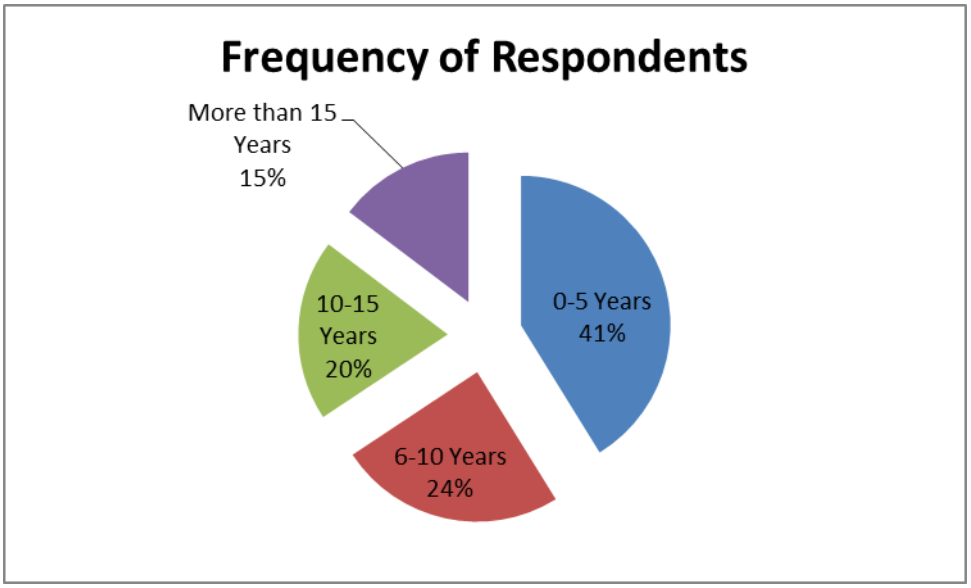

Figure 4.2: Percentage of Respondents Based on Industry Experience

4.2.3 Sectors of Respondents

Respondents belonged to both public and private sectors. 40.2% of the respondents were from public sector, whereas 59.8% are from private sector, as shown in Table 4.3.

Table 4.3 : Frequency of Respondents Based on Type of Sectors

Type of Sectors	Respondents Frequency	Respondents Percentage	Cumulative Percentage
Public	41	40.2%	40.2
Private	61	59.8%	100.00

4.2.4 Location of the Respondents in Pakistan

The respondents who have registered their responses were from various provinces of Pakistan as shown in Table 4.4.

Table 4.4 : Location of Respondents in Pakistan

Location of Respondents in Pakistan	Frequency of Respondents	Respondents Percentage
Federal	41	40.20%
Punjab	26	25.4%
AJK	20	19.6%
KPK	15	14.70%
Total	102	100%

4.3 STATISTICAL ANALYSIS

4.3.1 Sample Reliability

4.3.1.1 Cronbach's Coefficient Alpha Method

Cronbach's Coefficient Alpha method is the widely used standard of internal reliability. It is mostly utilized in order to assure the reliableness of adopted scale when questions are postulated on Likert scale. If Cronbach's Coefficient Alpha value is greater than 0.7, it means that the collected information is acceptable for analysis whereas if its value is higher than 0.9, this means that the data is excellent for further analysis (Li, 2007). For the data collected for this questionnaire survey, its value was calculated as 0.883 using SPSS, as given in Table 4.5. Its grater value shows that the information is arranged in ordered way and reliable manner for advance analysis.

Table 4.5 : Reliability Statisitcs

<table>
<tr><td colspan="4">Case Processing Summary</td><td rowspan="2">Cronbach's Alpha</td><td rowspan="2">0.883</td></tr>
<tr><td colspan="2"></td><td>N</td><td>%</td></tr>
<tr><td rowspan="3">Cases</td><td>Valid</td><td>101</td><td>100.0</td><td rowspan="4">Number of Items</td><td rowspan="4">38</td></tr>
<tr><td>Excluded[a]</td><td>0</td><td>.0</td></tr>
<tr><td>Total</td><td>101</td><td>100.0</td></tr>
<tr><td colspan="4">a. Listwise removal based on all invariant parameter in the procedure.</td></tr>
</table>

4.3.2 Normality Test

In order to obtained the verification of normality of the gathered data, ‘Shapiro Wilk normality test’ was organied due to reason that size of sample was smaller than 2000. It was executed so to ascertain that whether the obtained data is normally circularized or not, i.e. is the nature of data is parametric or non-parametric. Therefore, data is not normally circularized and non-parametric tests were needed in order to undergo analysis in future. Table 4.6 represents the data obtaine through test of normality by Shapiro Wilk test.

Table 4.6 : Test of Normality-Shapiro Wilk Test

ICT Questions	Shapiro-Wilk Test		ICT Questions	Shapiro-Wilk Test	
	Statistic	Sig.		Statistic	Sig.
Manpower Related Factors Affecting the Productivity of Labor at Construction Site					
Q01	0.820	0.000	Q05	0.850	0.000
Q02	0.840	0.000	Q06	0.854	0.000
Q03	0.847	0.000	Q07	0.894	0.000
Q04	0.828	0.000	Q08	0.779	0.000
External Related Factors Affecting the Productivity of Labor at Construction Site					
Q01	0.857	0.000	Q05	0.838	0.000
Q02	0.792	0.000	Q06	0.828	0.000
Q03	0.845	0.000	Q07	0.870	0.000
Q04	0.819	0.000	Q08	0.838	0.000
Communication Related Factors Affecting the Productivity of Labor at Construction Site					
Q01	0.764	0.000	Q04	0.811	0.000
Q02	0.792	0.000	Q05	0.772	0.000

Q03	0.837	0.000			
Resources Related Factors Affecting the Productivity of Labor at Construction Site					
Q01	0.815	0.000	Q06	0.827	0.000
Q02	0.799	0.000	Q07	0.849	0.000
Q03	0.847	0.000	Q08	0.801	0.000
Q04	0.793	0.000	Q09	0.838	0.000
Q05	0.831	0.000	Q10	0.841	0.000
Miscellaneous Related Factors Affecting the Productivity of Labor at Construction Site					
Q01	0.787	0.000	Q05	0.826	0.000
Q02	0.795	0.000	Q06	0.856	0.000
Q03	0.820	0.000	Q07	0.845	0.000
Q04	0.795	0.000			

Sig: significance value
Q stands for Questions in each ICT Questionnaire Group

4.4 KRUSKAL WALLIS TEST FOR ALL FACTORS

Since the gatherd data was non-parametric so Kruskal Wallis test was executed to assure whether all stakeholders including client and consultants have similar perception regarding all the factors affecting labor productivity of construction projects in Pakistan.

4.4.1 Kruskal Wallis Test for ManPower Factors Affecting Construction Labor Productivity

Kruskal Wallis test was performed for ManPower factors having impact on labor productivity of contruction and results are shown as Table 4.7. The significance values for conformance of ManPower factors can be seen to identify the perception difference among client, consultants and contractors. The highlighted figures show difference in perception since significance values are less than 0.05.

Table 4.7 : Kruskal Wallis Test for ManPower Factors

Sr. #	Manpower Related Factors Affecting the Productivity of Labor at Construction Site	Significance
Q01	Incentives on Good Performance	0.770
Q02	Permanent Induction of Labors	0.245
Q03	Competition between the Laborers	0.768
Q04	Lack of Experience	**0.000**
Q05	Alcoholism/Addiction of Drugs	0.831
Q06	Lack of Training	0.938
Q07	Age	0.739
Q08	Disloyalty with Work	0.475

Contractors, owners and consultants have the same perception regarding the delay factors associated with the resources of a construction projects because of greater p-value than 0.05 except using Lack of Experience (see Table 4.7). When the Relative Index Factor (RIF) of all the three stakeholders regarding this delay factor was analyzed, it was observed that the consultant has given very high importance to this factor as compared to the perception shown by the clieny and the contractor as shown in Table 4.8.

Table 4.8 : Perception of Stakeholders Regarding using Lack of Experience

Sr. #	Manpower Related Factors Affecting the Productivity of Labor at Construction Site with Significance < 0.05	Respondents		
		Client	Consultant	Contractor
		RII	RII	RII
Q04	Lack of Experience	0.7771	0.8148	0.6718

4.4.2 Kruskal Wallis Test for External Factors Affecting Construction Labor Productivity

Kruskal Wallis test was performed for ManPower factors hsving impact on labor productivity of contruction and results are shown in Table 4.9. The significance values for conformance of External factors can be seen to identify the perception

difference among client, consultants and contractors. The highlighted figures show difference in perception since significance values are less than 0.05.

Table 4.9 : Kruskal Wallis Test for External Factors

Sr. #	External Related Factors Affecting the Productivity of Labor at Construction Site	Significance
Q01	Training Sessions for Labors	0.308
Q02	Payment Delays of Labor	**0.032**
Q03	Inspection Delays from Authorities	0.312
Q04	Supervision Delays	0.680
Q05	Repeated Variation of Single Activity	**0.046**
Q06	Complex Designs in the Provided Drawings	0.670
Q07	Variations in the Drawings	0.555
Q08	Incomplete Drawings	0.533

Contractors, owners and consultants have the same perception regarding the external factors affecting construction labor productivity because of greater p-value than 0.05 except using Payment Delays of Labor and Repeated Variation of Single Activity (see Table 4.9). When the RIF of all the three stakeholders regarding these two factors was analyzed, it was observed that the client has given very high importance to Payment Delays of Labour factor as compared to the perception shown by the consultant and the contractor and consultant has given very high importance to repeated variation of single activity as compared to the perception shown by the client and contractor as shown in Table 4.10.

Table 4.10 : Perception of Stake holders using Payment Delays and Repeated Variation of Single Activity

Sr. #	External Related Factors Affecting the Productivity of Labor at Construction Site with Significance < 0.05	Respondents		
		Client	Consultant	Contractor
		RII	RII	RII
Q02	Payment Delays of Labor	0.8514	0.7926	0.7744
Q05	Repeated Variation of Single Activity	0.7657	0.7704	0.6974

4.4.3 Kruskal Wallis Test for Communication Factors Affecting Construction Labor Productivity

Kruskal Wallis test was performed for Communication factors having impact on labor productivity of contructions and results are shown in Table 4.11. The significance values for conformance of Communication factors can be seen to identify the perception difference among client, consultants and contractors. The highlighted figures show difference in perception since significance values are less than 0.05.

Table 4.11 : Kruskal Wallis Test for Communication Factors

Sr. #	Communication Related Factors Affecting the Productivity of Labor at Construction Site	Significance
Q01	Good Management of Supervisor	0.089
Q02	Vague or Incomplete Instructions	**0.000**
Q03	Misunderstanding Among Labors	0.784
Q04	Lack of Proper Planning of the Succeeding activities for the completion of task or Work break down Structure	0.870
Q05	Poor Management of Supervisor	**0.002**

Contractors, owners and consultants have the same perception regarding the Communication factors affecting construction labor productivity because of greater p-value than 0.05 except using Vague or Incomplete Instructions and Poor Management of Supervisor (see Table 4.11). When the RIF of all the three stakeholders regarding these two factors was analyzed, it was observed that the client has given very high importance to this delay factor as compared to the perception shown by the consultant and the contractor as shown in Table 4.12.

Table 4.12 : Perception of Stake holders using Vague/Incomplete Instructions and Poor Management on Site

Sr. #	Communication Related Factors Affecting the Productivity of Labor at Construction Site with Significance < 0.05	Respondents		
		Client	Consultant	Contractor
		RII	RII	RII
Q02	Vague or Incomplete Instructions	0.8743	0.7556	0.7846
Q05	Poor Management of Supervisor	0.7829	0.7704	0.6821

4.4.4 Kruskal Wallis Test for Resource Related Factors Affecting Construction Labor Productivity

Kruskal Wallis test was performed for Resource Related factors having impact on productivity of labor during construction and results are shown in Table 4.13. The significance values for conformance of Resource Related factors can be seen to identify the perception difference among client, consultants and contractors. The highlighted figures show difference in perception since significance values are less than 0.05.

Table 4.13: Kruskal Wallis Test for Resource Related Factors

Sr. #	Resource Related Factors Affecting the Productivity of Labor at Construction Site	Significance
Q01	Use of Latest Technology	0.613
Q02	Adequate Construction Method	0.391
Q03	Material storage location near to site	0.911
Q04	Lack of required tools and/or equipments	0.230

Q05	Lack of required construction material	0.063
Q06	Incompetent Construction Companies in Pakistan	0.062
Q07	Lack of control over Registration of Construction Companies	0.801
Q08	Poor Site Conditions	0.218
Q09	Poor Access within construction job site	**0.001**
Q10	Inadequate Transportation facilities for Workers	0.179

Contractors, owners and consultants have the same perception regarding the Resource Related factors affecting construction labor productivity because of greater p-value than 0.05 except using Poor Access within construction job site (see Table 4.13). When the RIF of all the three stakeholders regarding this factor was analyzed, it was observed that the Contractor has given very high importance to this factor as compared to the perception shown by the client and the consultant as shown in Table 4.14.

Table 4.14 : Perception of Stake holders Using Poor Access within Construction Jobsite

Sr. #	Resource Related Factors Affecting the Productivity of Labor at Construction Site with Significance < 0.05	Respondents		
		Client	Consultant	Contractor
		RII	RII	RII
Q09	Poor Access within construction job site	0.7771	0.6923	0.8120

4.4.5 Kruskal Wallis Test for Miscellaneous Factors Affecting Construction Labor Productivity

Kruskal Wallis test was performed for Miscellaneous factors having impact on productivity of labor during construction activities and results are shown in Table 4.15. The significance values for conformance of Resource Related factors can be seen to identify the perception difference among client, consultants and contractors. The highlighted figures show difference in perception since significance values are less than 0.05.

Table 4.15 : Kruskal Wallis Test for Miscellaneous Factors

Sr. #	Miscellaneous Related Factors Affecting the Productivity of Labor at Construction Site	Significance
Q01	Better Facilities Provided to Labor	0.119
Q02	Safe Environment (as per OSHA's standards)	0.406
Q03	By Motivating Labor	0.774
Q04	Accidents During Construction	0.215
Q05	Working Overtime	**0.015**
Q06	Weather Conditions	0.139
Q07	Labor's Union	0.387

Contractors, owners and consultants have the same perception regarding the Miscellaneous factors affecting construction labor productivity because of greater p-value than 0.05 except using working overtime (see Table 4.15). When the RIF of all the three stakeholders regarding this factor was analyzed, it was observed that the Client has given very high importance to this factor as compared to the perception shown by the Consultant and the contractor as shown in Table 4.16.

Table 4.16 : Perception of Stake holders Using Working Overtime

Sr. #	Miscellaneous Related Factors Affecting the Productivity of Labor at Construction Site with Significance < 0.05	Respondents		
		Client	Consultant	Contractor
		RII	RII	RII
Q05	Working Overtime	0.7657	0.6889	0.6718

4.5 RANKING OF FACTORS BY RIF

The questionnaire comprises five main groups which are further divided into 38 factors that affect labor productivity in Pakistan. The five main groups are manpower, external, communication, resource related and miscellaneous. All the three main stakeholders of the construction project i.e client, consultant and contractor were sent the questionnaires for their responses. They were asked to mark factor on Likert scale that how much each factor is important as far as factors having an impct on labor productivity is concerned. Each stakeholder not only rated the factors which have bad impact on productivity to themselves but also to the other stakeholder in order to calculate the combined effect of all the stakeholders in in order to rank the factors that are most important and are mostly affecting construction labor productivity.

4.5.1 Clients Response

Out of 150 total questionnaires that were sent to all the stakeholders, the clients were sent 50 questionnaires for registration of their response. The responses received from client were 33 out 50 thus a response rate of 66%. The response received from the client against different delay factors is as under.

4.5.1.1 Client's response to ManPower Factor

There are 8 ManPower factors identified that were related to the affecting construction labor productivity. Client ranked *Disloyality* at the top with RIF of 0.8800, *Permanent induction of labors* with RIF of 0.8286 at second. The lowest RIF

are assigned to *Age of labor*, which is 0.7086. The response of client towards these factors in terms of their RIF is as shown in the Table 4.17 and Figure 4.3.

Table 4.17 : Clients Response to ManPower Factors

Sr. #	Man Power Factors	RIF	Ranked within the group
1	LPF01	0.8000	3
2	LPF02	0.8286	2
3	LPF03	0.7543	7
4	LPF04	0.7771	6
5	LPF05	0.8000	4
6	LPF06	0.7829	5
7	LPF07	0.7086	8
8	LPF08	0.8800	1

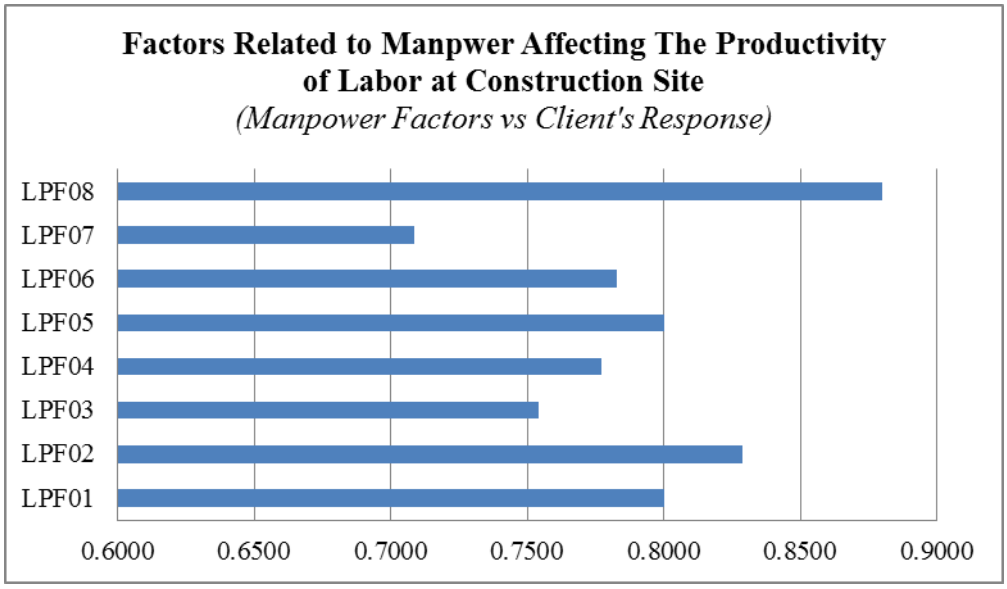

Figure 4.3 : Clients Response for Man Power Factors

4.5.1.2 Client's response to External Factors

The questionnaire consisted 8 factors that were related to External. The client ranked *Payment delays of labors* highest RIF of 0.8514, *Incomplete drawings* at the second with RIF of 0.7886, *Variation in drawings* at third place with RIF 0.7771, *Training Sessions for labor* at lowest place with RIF of 0.7257. The overall response shown by the client on contractor's related problems is shown in the Table 4.18 and Figure 4.4.

Table 4.18 : Clients Response to External Factors

Sr. #	External Factors	RIF	Ranked within the group

1	LPF09	0.7257	8
2	LPF10	0.8514	1
3	LPF11	0.7486	6
4	LPF12	0.7429	7
5	LPF13	0.7657	4
6	LPF14	0.7543	5
7	LPF15	0.7771	3
8	LPF16	0.7886	2

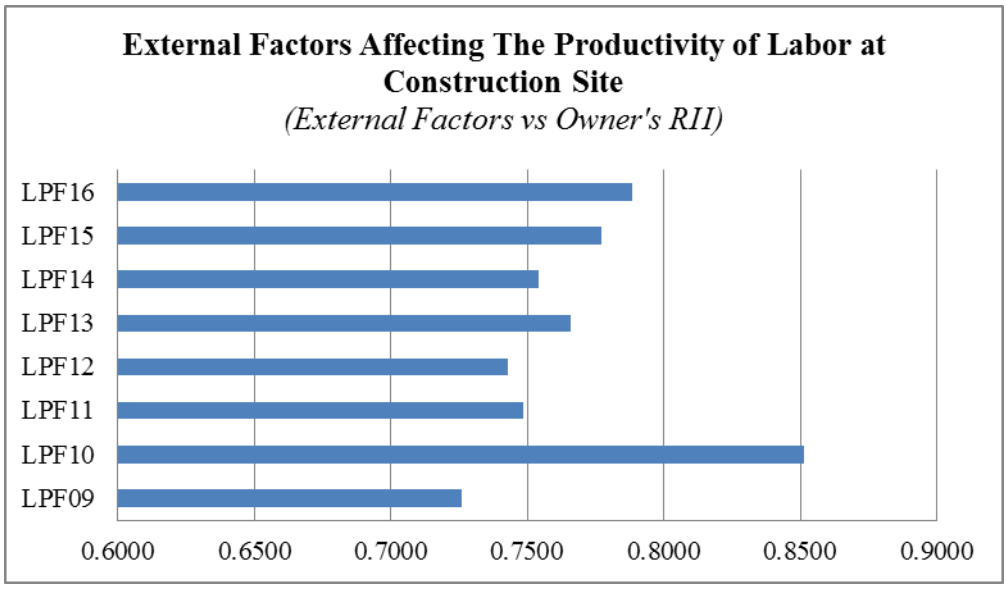

Figure 4.4 : Clients Response to External Factors

4.5.1.3 Client's response to Communication Factors

The questionnaire contained 5 factors that were related to the Communication. The client ranked *effect Vague or incomplete instructions* at the top with RIF of 0.8743, *effect Misunderstanding among labors* at Second with RIF of 0.7943. It is also very important to mention that the client ranked *effect of Good management* at the last place with RIF of 0.7714. The response of client is shown in Table 4.19 and Figure 4.5.

Table 4.19 : Clients Response to Communication Factors

Sr. #	Communication Factors	RIF	Ranked within the group
1	LPF17	0.7714	5
2	LPF18	0.8743	1
3	LPF19	0.7943	2

4	LPF20	0.7886	3
5	LPF21	0.7829	4

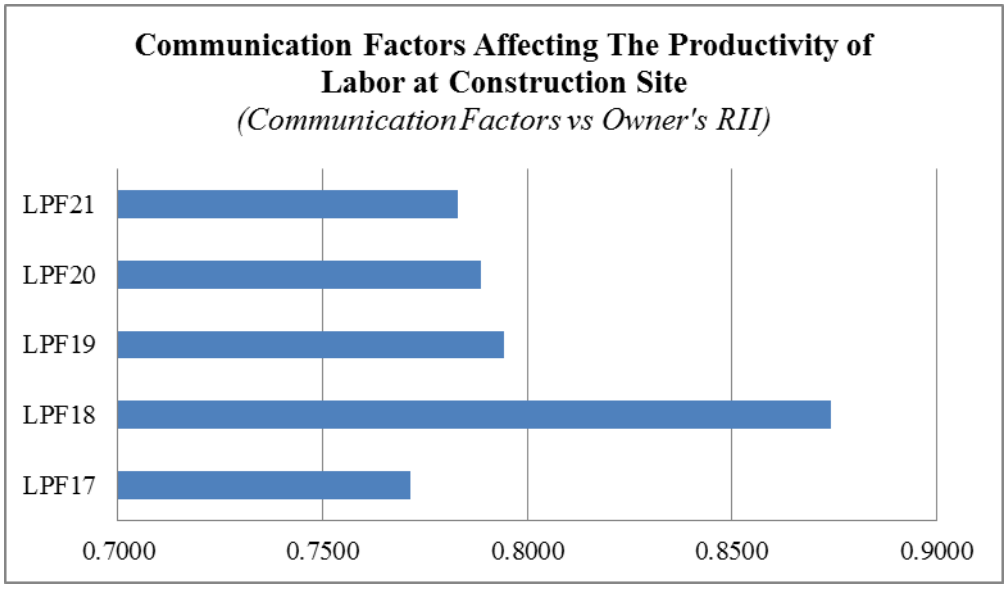

Figure 4.5 : Clients Response to Communication Factors

4.5.1.4 Client's response to Resource Related Factors

The questionnaire contained 10 questions that related to Resource factors. The client ranked *lack of required tool and equipment and incompetent construction companies in Pakistan* at the top with RIF of 0.8400, *effect of In adequate construction method* at second with RIF of 0.8114. It is also very important to mention that the client ranked *effect of Use of latest technology* at the last place with RIF of 0.7543. The response of client is shown in Table 4.20 and Figure 4.6.

Table 4.20 : Clients Response to Resource Related Factors

Sr. #	Resource Factors	RIF	Ranked within the group
1	LPF22	0.7543	10
2	LPF23	0.8114	3
3	LPF24	0.7829	8
4	LPF25	0.8400	1
5	LPF26	0.7943	5
6	LPF27	0.8400	2
7	LPF28	0.8057	4
8	LPF29	0.7886	7
9	LPF30	0.7771	9

10	LPF31	0.7943	6

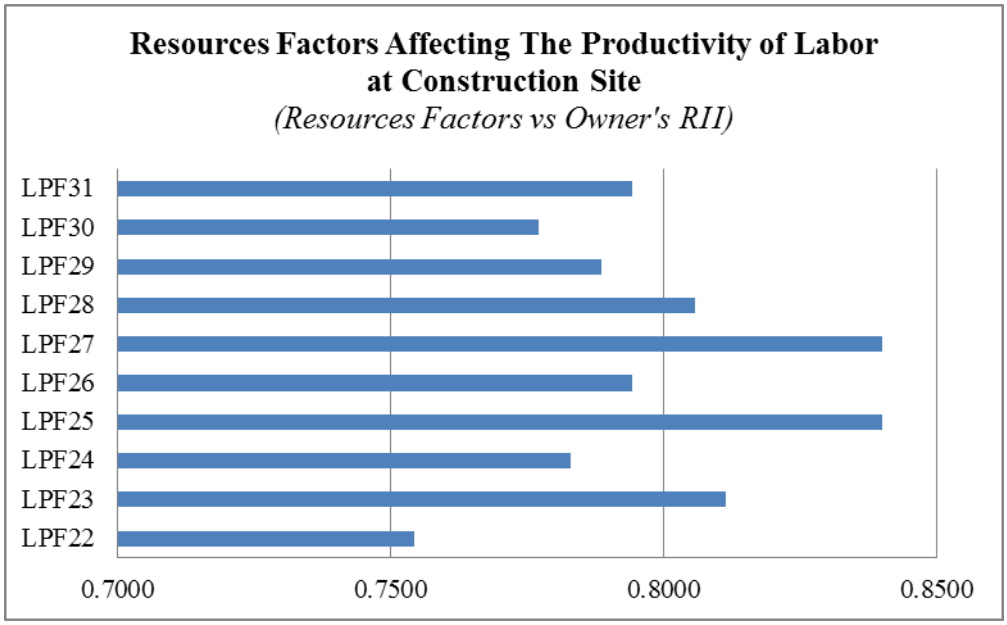

Figure 4.6 : Clients Response to Resource Related Factors

4.5.1.5 Client's response to Miscellaneous Factors

The questionnaire contained 7 questions that were related to the Miscellaneous factors. The client ranked *effect Safe Environment* at the top with RIF of 0.8400, *effect of accident during construction and labor's union* at second with RIF of 0.8229. It is also very important to mention that the client ranked *effect of Better facilities provided to labors* at the last place with RIF of 0.7543. The response of client is shown in Table 4.21 and Figure 4.7.

Table 4.21 : Clients Response to Miscellaneous Factors

Sr. #	Miscellaneous Factors	RIF	Ranked within the group
1	LPF32	0.7543	7
2	LPF33	0.8400	1
3	LPF34	0.7714	5
4	LPF35	0.8229	2
5	LPF36	0.7657	6
6	LPF37	0.7829	4
7	LPF38	0.8229	3

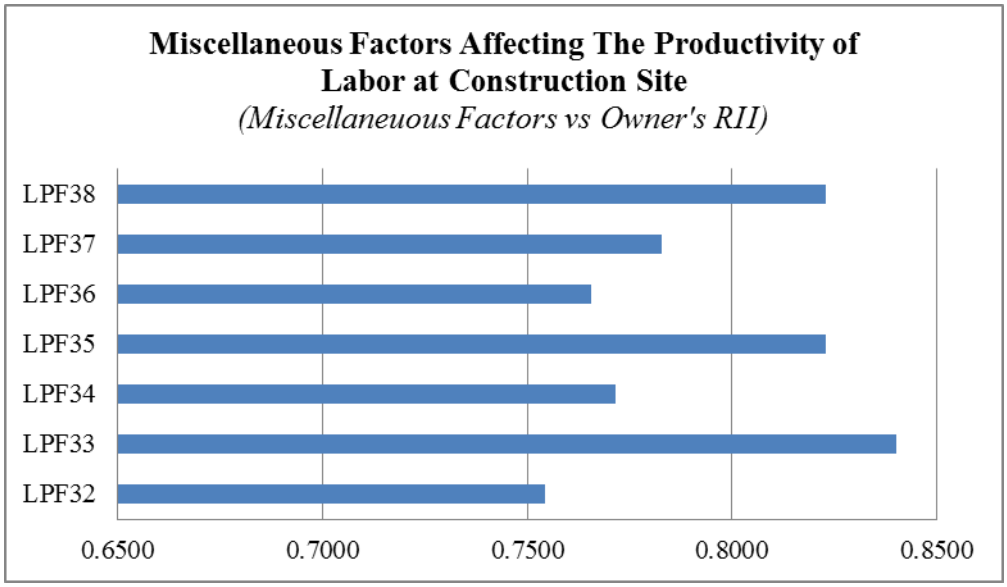

Figure 4.7 : Clients Response to Miscellaneous Factors

4.5.2 Contractors Response

Out of 150 total questionnaires that were sent to all the stakeholders, the Contractors were sent 50 questionnaires for registration of their response. The responses received from client were 39 out 50 thus a response rate of 78%. The response received from the Contractor against different delay factors is as under.

4.5.2.1 Contractor's response to ManPower Factor

There were 8 ManPower factors identified that were related to the affecting construction labor productivity. Contractor ranked *Disloyality* at the top with RIF of 0.8410, *Incentives on good performance* with RIF of 0.8154 at second. The lowest RIF are assigned to *Lack of experience*, which is 0.6718. The response of contractors towards these factors in terms of their RIF is as shown in Table 4.22 and Figure 4.8.

Table 4.22 : Contractor's Response to Manpower Factors

Sr. #	ManPower Factors	RIF	Ranked within the group
1	LPF01	0.8154	2
2	LPF02	0.8000	3
3	LPF03	0.7385	6
4	LPF04	0.6718	8
5	LPF05	0.7897	4
6	LPF06	0.7897	5
7	LPF07	0.6872	7
8	LPF08	0.8410	1

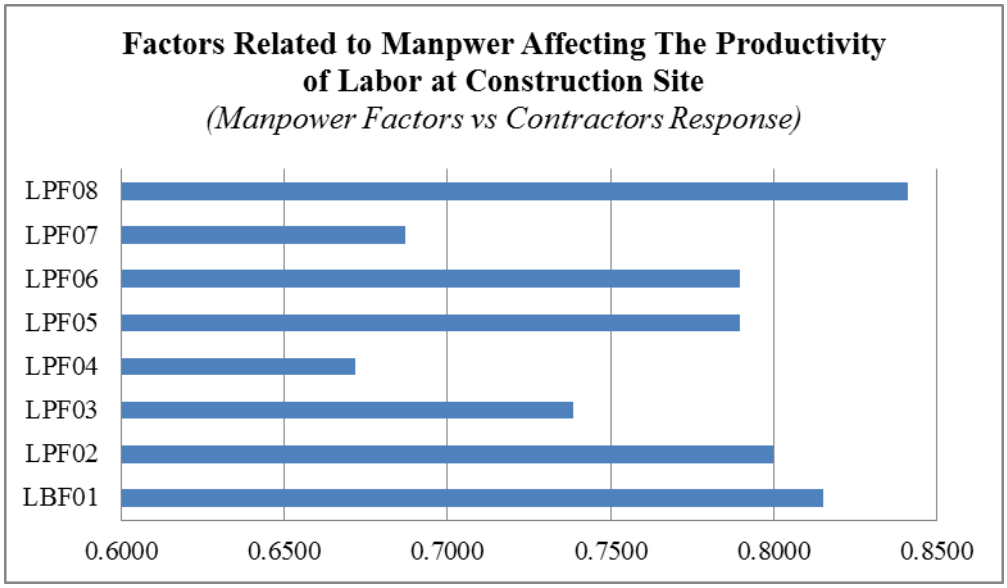

Figure 4.8 : Contractor's Response to ManPower Factors

4.5.2.2 Contractor's response to External Factors

The questionnaire contained 8 factors that were related to External factors. The contractor ranked *Payment delays of labor* highest RIF of 0.7744, *Incomplete drawings* at the second with RIF of 0.7692, *Supervision delays* at Third place with RIF 0.7641, *Training sessions for labors* at lowest place with RIF of 0.6821. The overall response shown by the Contractor to External factors is shown in Table 4.23 and Figure 4.9.

Table 4.23 : Contractor's Response to External Factors

Sr. #	External Factors	RIF	Ranked within the group
1	LPF09	0.6821	8
2	LPF10	0.7744	1
3	LPF11	0.7487	4
4	LPF12	0.7641	3
5	LPF13	0.6974	7
6	LPF14	0.7179	6
7	LPF15	0.7436	5
8	LPF16	0.7692	2

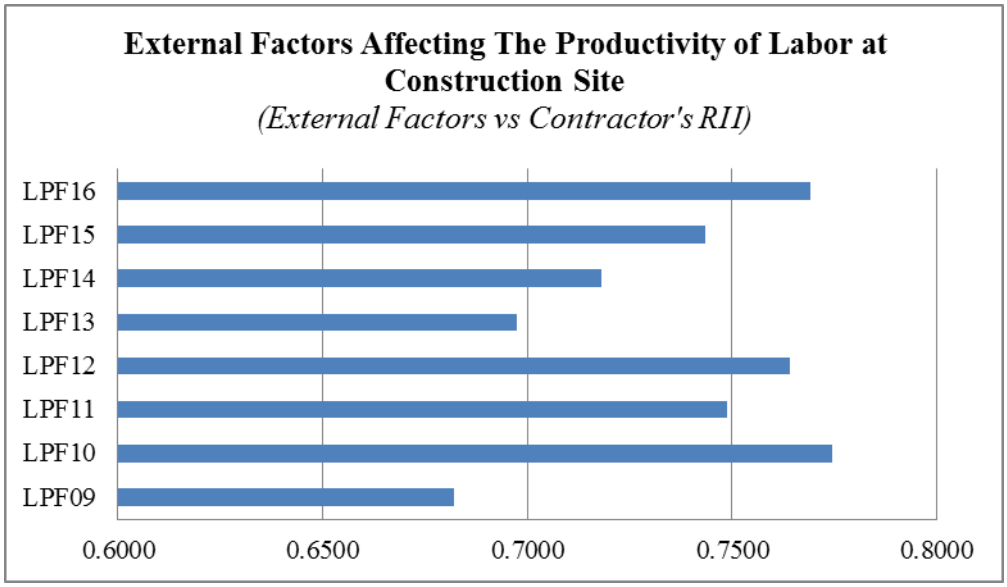

Figure 4.9 : Contractor's Response to External Factors

4.5.2.3 Contractor's response to Communication Factors

The questionnaire contained 5 questions that were related to the Communication. The Contractor ranked *Misunderstanding among labors* at the top with RIF of 0.7949, *Vague or Incomplete Instructions and Lack of Proper Planning of the Succeeding activities for the completion of task or Work break down Structure* at Second with RIF of 0.7846. It is also very important to mention that the contractor ranked *Poor Management of Supervisor* at the last place with RIF of 0.6821. The response of contractor is shown in Table 4.24 and Figure 4.10.

Table 4.24 : Contractor's Response to Communication Factor

Sr. #	Communication Factors	RIF	Ranked within the group
1	LPF17	0.7077	4
2	LPF18	0.7846	2
3	LPF19	0.7949	1
4	LPF20	0.7846	3
5	LPF21	0.6821	5

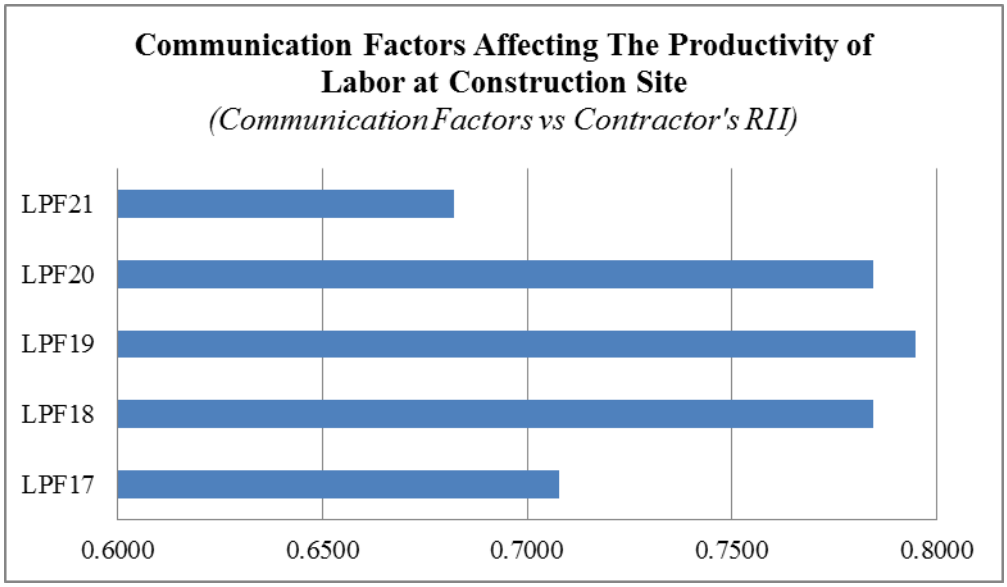

Figure 4.10 : Contractor's Response to Communication Factor

4.5.2.4 Contractor's response to Resource Related Factors

The questionnaire contained 10 questions that were related to the Resource related factors. The contractor ranked *effect of Lack of required tools and/or equipments and Lack of Control Over Registration of Construction Companies* at the top with RIF of 0.7949, *effect of Incompetent Construction Companies in Pakistan* at Second with RIF of 0.7897. It is also very important to mention that the contractor ranked *effect of Poor Access within construction job site* at the last place with RIF of 0.6923. The response of contractor is shown in Table 4.25 and Figure 4.11.

Table 4.25 : Contractor's Response to Resource Related Factors

Sr. #	Resource Factors	RIF	Ranked within the group
1	LPF22	0.7333	8
2	LPF23	0.7846	4
3	LPF24	0.7795	5
4	LPF25	0.7949	1
5	LPF26	0.7385	6
6	LPF27	0.7897	3
7	LPF28	0.7949	2
8	LPF29	0.7385	7
9	LPF30	0.6923	10
10	LPF31	0.7333	9

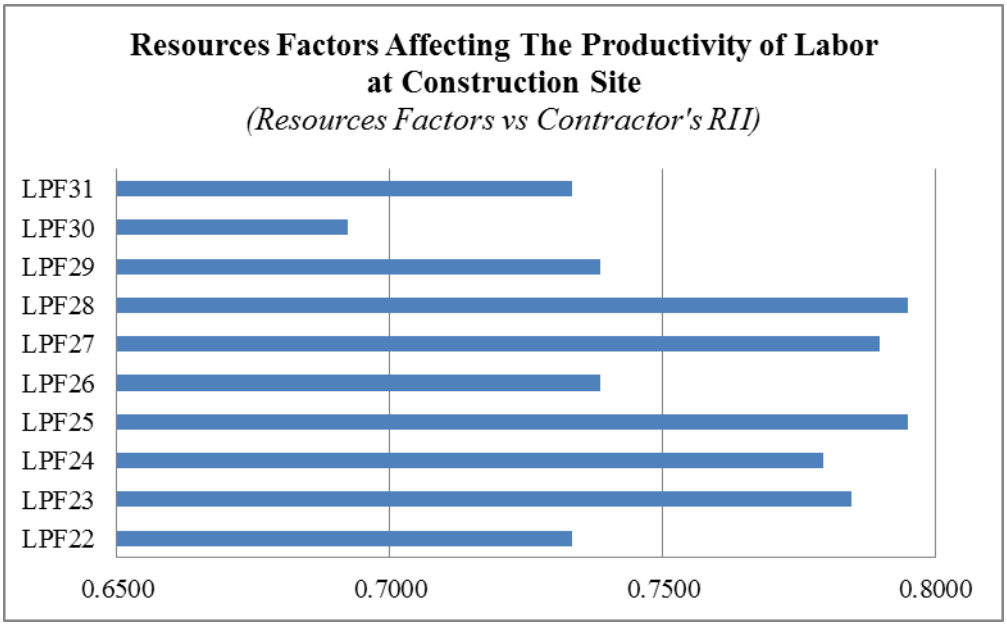

Figure 4.11 : Contractor's Response to Resource Related Factor

4.5.2.5 Contractor's response to Miscellaneous Factors

The questionnaire contained 7 questions that were related to the Miscellaneous factors. The contractor ranked *effect of Safe Environment* the top with RIF of 0.8154, *effect of By Motivating Labor* at Second with RIF of 0.7897. It is also very important to mention that the contractor ranked *effect of Working Overtime* at the last place with RIF of 0.6718. The response of client is shown in Table 4.26 and Figure 4.12.

Table 4.26 : Contractor's Response to Miscellaneous Factors

Sr. #	Miscellaneous Factors	RIF	Ranked within the group
1	LPF32	0.7179	5
2	LPF33	0.8154	1
3	LPF34	0.7897	2
4	LPF35	0.7744	3
5	LPF36	0.6718	7
6	LPF37	0.7128	6
7	LPF38	0.7744	4

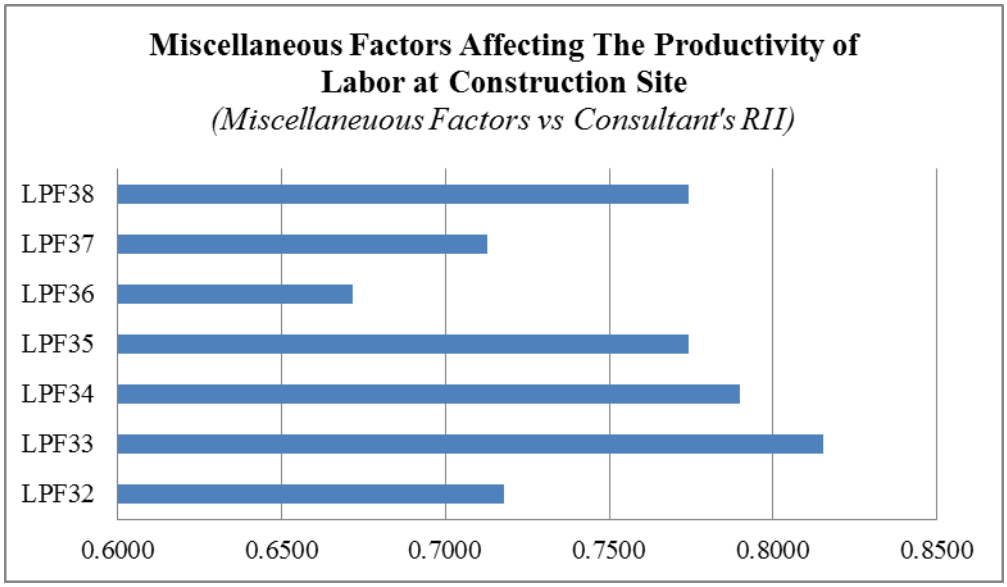

Figure 4.12 : Contractor's Response to Miscellaneous Factors

4.5.3 Consultant's Response

Out of 150 total questionnaires that were sent to all the stakeholders, the Consultant were sent 50 questionnaires for registration of their response. The responses received from Consultant were 22 out 50 thus a response rate of 44%. The response received from the Consultant against different delay factors is as under.

4.5.3.1 Consultant's Response to ManPower Factor

There are 8 ManPower factors identified that were related to the affecting construction labor productivity. Consultant ranked *Disloyalty with Work* at the top with RIF of 0.8370, *Lack of Experience* with RIF of 0.8148 at second. The lowest RIF are assigned to *Age*, which is 0.6667. The response of consultant towards these factors in terms of their RIF is as shown in Table 4.27 and Figure 4.13.

Table 4.27 : Consultant's Response to ManPower Factors

Sr. #	ManPower Factors	RIF	Ranked within the group
1	LPF01	0.7852	4
2	LPF02	0.7630	6
3	LPF03	0.7407	7
4	LPF04	0.8148	2
5	LPF05	0.7926	3
6	LPF06	0.7704	5
7	LPF07	0.6667	8
8	LPF08	0.8370	1

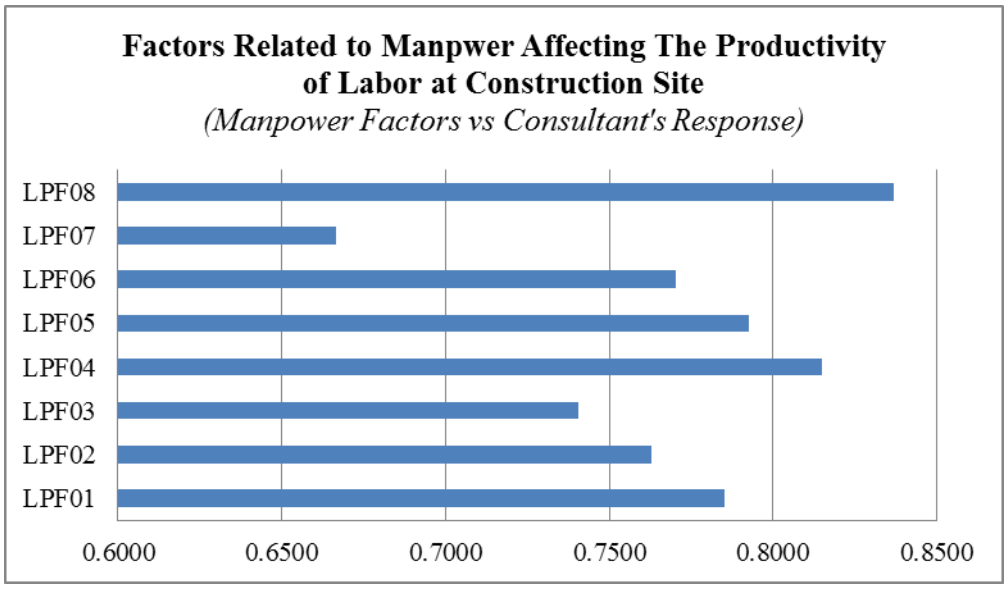

Figure 4.13 : Consultant's Response to Man Power Factors

4.5.3.2 Consultant's response to External Factors

The questionnaire contained 8 factors that were related to External factors. The consultant ranked *Incomplete Drawings* highest RIF of 0.8074, *Inspection Delays from Authorities* at the second with RIF of 0.8000, *Payment Delays of Labor* at Third place with RIF 0.7926, *Training Sessions for Labors* at lowest place with RIF of 0.7111. The overall response shown by the consultant is shown in Table 4.28 and Figure 4.14.

Table 4.28 : Consultant's Response to External Factors

Sr. #	External Factors	RIF	Ranked within the group
1	LPF09	0.7111	8
2	LPF10	0.7926	3
3	LPF11	0.8000	2
4	LPF12	0.7407	6
5	LPF13	0.7704	4
6	LPF14	0.7556	5
7	LPF15	0.7259	7
8	LPF16	0.8074	1

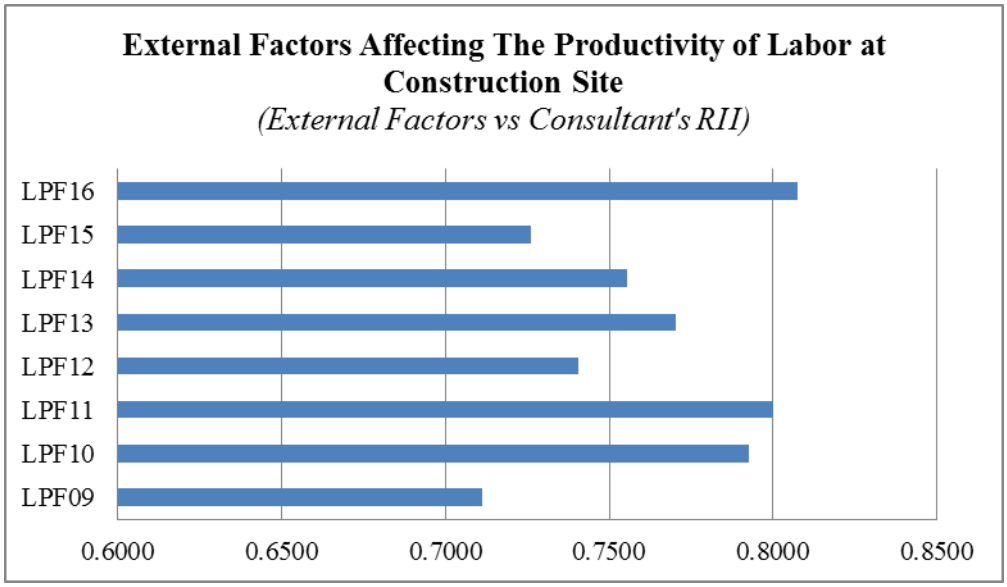

Figure 4.14 : Consultant's Response to External Factors

4.5.3.3 Consultant's response to Communication Factors

The questionnaire contained 5 questions that were related to the Communication factors. The consultant ranked *effect of Misunderstanding Among Labors, Lack of Proper Planning of the Succeeding activities for the completion of task or Work break down Structure, Poor Management of Supervisor* at the top with RIF of 0.7704, *effect of Vague or Incomplete Instructions* at Second with RIF of 0.7556. It is also very important to mention that the consultant ranked *effect of Good Management of Supervisor* at the last place with RIF of 0.7333. The response of client is shown in Table 4.29 and Figure 4.15.

Table 4.29 : Consultant's Response to Communication Factors

Sr. #	Communication Factors	RIF	Ranked within the group
1	LPF17	0.7333	5
2	LPF18	0.7556	4
3	LPF19	0.7704	1
4	LPF20	0.7704	2
5	LPF21	0.7704	3

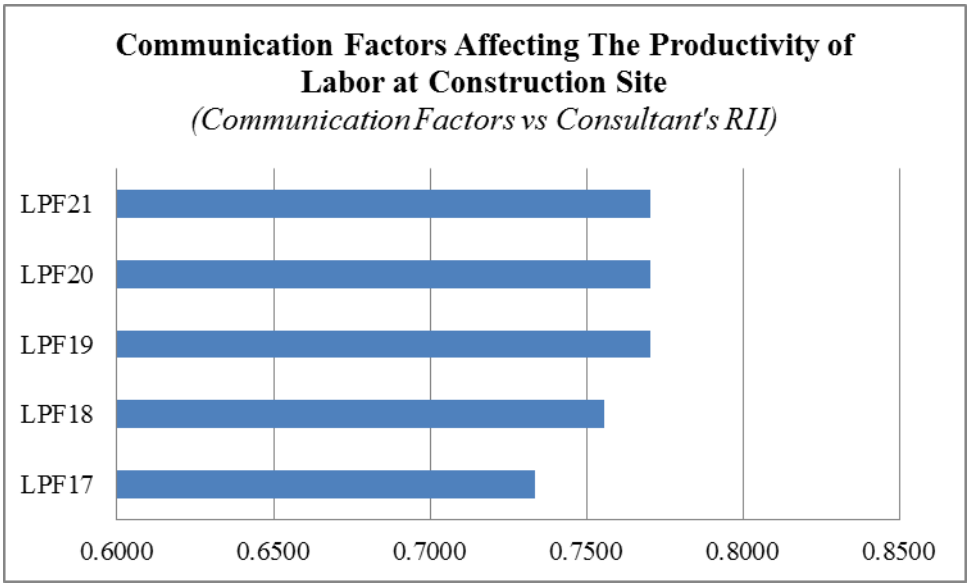

Figure 4.15 : Consultant's Response to Communication Factors

4.5.3.4 Consultant's response to Resource Related Factors

The questionnaire contained 10 questions that were related to the Resource related factors. The consultant ranked *effect of Poor Access within construction job site* at the top with RIF of 0.8370, *effect of Lack of required tools and/or equipments* at Second with RIF of 0.8296. It is also very important to mention that the consultant ranked *effect of Incompetent Construction Companies in Pakistan* at the last place with RIF of 0.7407. The response of consultant is shown in Table 4.30 and Figure 4.16.

Table 4.30 : Consultant's Response to Resource Related Factors

Sr. #	Resource Factors	RIF	Ranked within the group
1	LPF22	0.7556	8
2	LPF23	0.7630	7
3	LPF24	0.7926	4
4	LPF25	0.8296	2
5	LPF26	0.8148	3
6	LPF27	0.7407	10
7	LPF28	0.7778	6
8	LPF29	0.7481	9
9	LPF30	0.8370	1
10	LPF31	0.7852	5

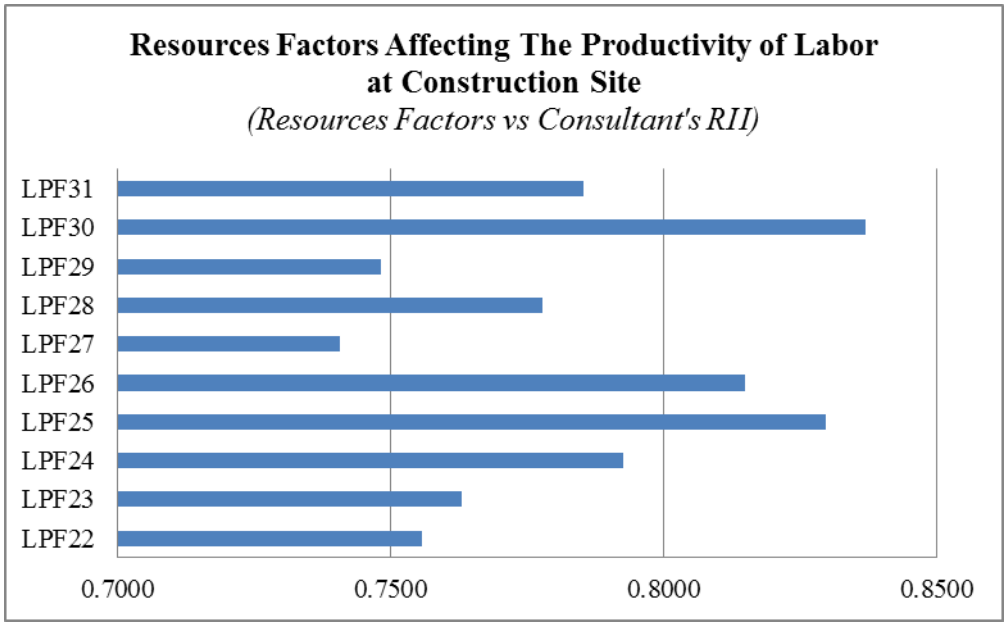

Figure 4.16 : Consultant's Response to Resource Related Factors

4.5.3.5 Consultant's response to Miscellaneous Factors

The questionnaire contained 7 questions that are related to the Miscellaneous. The consultant ranked *effect of Accidents During Construction* at the top with RIF of 0.8074, *effect of By Motivating Labor* at Second with RIF of 0.8000. It is also very important to mention that the consultant ranked *effect of Better Facilities Provided to Labor* at the last place with RIF of 0.6815. The response of consultant is shown in Table 4.31 and Figure 4.17.

Table 4.31 : Consultant's Response to Miscellaneous Factors

Sr. #	Miscellaneous Factors	RIF	Ranked within the group
1	LPF32	0.6815	7
2	LPF33	0.7926	3
3	LPF34	0.8000	2
4	LPF35	0.8074	1
5	LPF36	0.6889	6
6	LPF37	0.7333	5
7	LPF38	0.7778	4

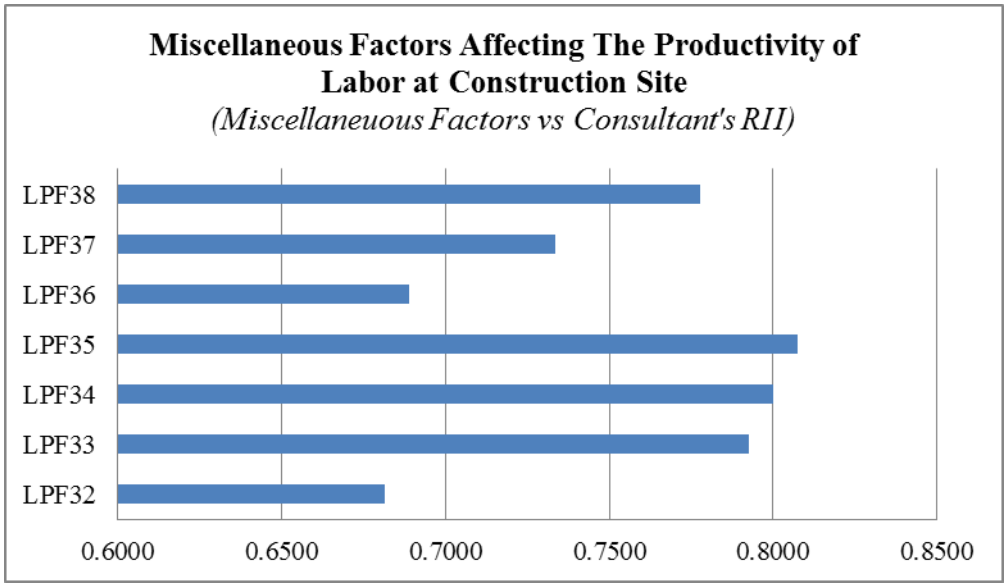

Figure 4.17 : Consultant's Response to Miscellaneous Factors

4.5.4 Overall Ranking within the Group

The three stakeholders of the construction industry client, consultant and contractor have registered their responses in order to rank the most key factors that affect labor construction productivity in Pakistan. The individual responses of each stakeholder, is analyzed to calculate the combined relative importance factor correlating the responses of three stakeholders of construction industry in Pakistan. The combined RIF of each delay factor within the group are as under:

4.5.4.1 Overall Ranking of Man Power Factors

The three stakeholders of construction industry registered their responses for the Man Power factors affecting construction Labor Productivity. The result can be justified as there may be many reasons due to which labor can disloyal. Some of them are rude behavior of supervisor, low motivation level, lack of education, family problem and financial problem etc. Supervisor can play a vital role in converting disloyal behavior of labor into loyal by motivate and guide him. Incentives on good performance were ranked 2nd and have positive affect. It gives courage and passion to labor. It also increase competition among labors, hence it is justified factor. Permanent induction of labor was ranked at 3rd and has a negative impact on labor productivity so labor should be hire at daily wages. Use of drugs may affect other workers working on site. Usage of drugs can cause accident, reduce speed of work and rework. In Pakistan, normally trainings are not arranged for labors. They learn work at construction site and hence speed becomes slow. Age was ranked at 6th and this is also justified as strength and speed required completing some task is reduced with time. Lack of

experience is ranked at 7th in human group. Mental level and abilities are improved as experienced increased. In Pakistan there is a significant rate of unemployment therefore competition exists between labors and hence positively affects productivity. The ranking of Man Power Factors are shown in the Table 4.32 and Figure 4.18.

Table 4.32 : Overall Response to Man Power Factors

Sr. #	Man Power Factors	RIF	Ranked within the group
1	LPF01	0.8020	2
2	LPF02	0.8000	3
3	LPF03	0.7446	8
4	LPF04	0.7465	7
5	LPF05	0.7941	4
6	LPF06	0.7822	5
7	LPF07	0.7822	6
8	LPF08	0.8535	1

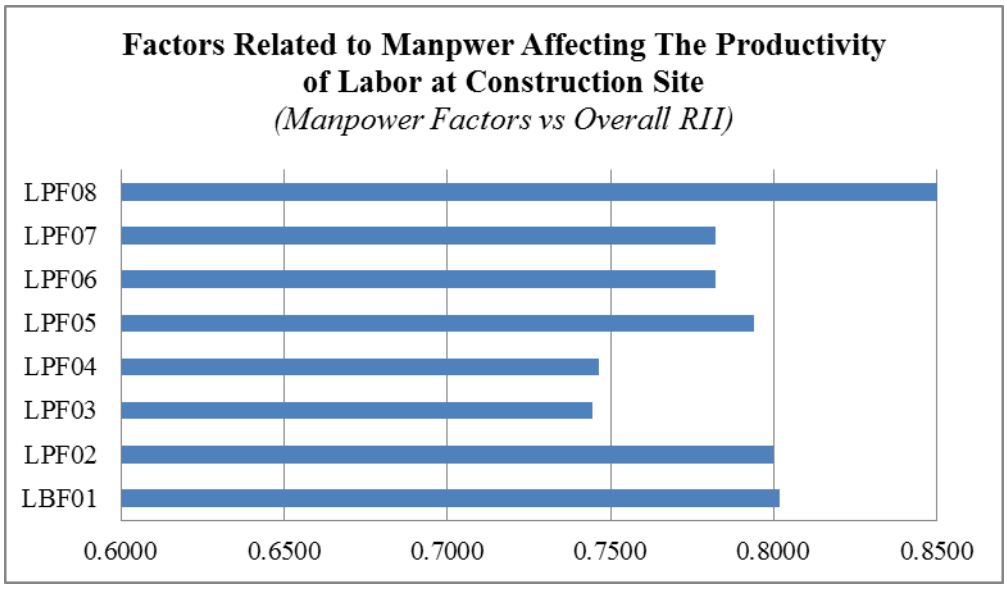

Figure 4.18 : Overall Response to Man Power Factors

4.5.4.2 Overall Ranking of External Factors

The three stakeholders of construction industry registered their responses for the External factors affecting construction Labor Productivity. Hence, inspection delay causes delay in work activities. Supervision delays are ranked at 4th and they also affects productivity e.g. concrete is cast if supervisor is there in the field for

supervision.The ranking of External Factors are shown in the Table 4.33 and Figure 4.19.

Table 4.33 : Overall Response to External Factors

Sr. #	External Factors	RIF	Ranked within the group
1	LPF09	0.7050	8
2	LPF10	0.8059	1
3	LPF11	0.7624	3
4	LPF12	0.7505	4
5	LPF13	0.7406	6
6	LPF14	0.7406	7
7	LPF15	0.7505	5
8	LPF16	0.7861	2

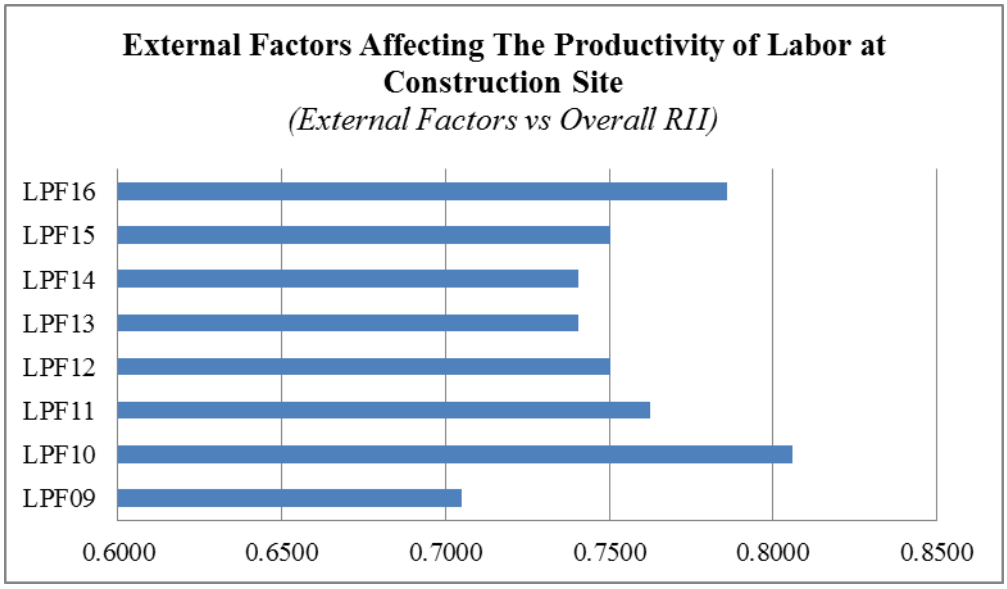

Figure 4.19 : Overall Response to External Factors

4.5.4.3 Overall Ranking of Communication Factors

The three stakeholders of construction industry registered their responses for the Communication factors affecting construction Labour Productivity. Incomplete instructions were ranked at 1st in communication group. Incomplete instructions are the main reason of rework and negatively affect labor productivity. Misunderstanding can be the reasons of mistakes in work and can affect productivity of labor. Lack of proper planning was ranked at 3rd in communication factor. Poor and good

management were ranked at 4th and 5th in communication factor respectively. The ranking of Communication Factors are shown in the Table 4.34 and Figure 4.20.

Table 4.34 : Overall Ranking of Communication Factors

Sr. #	Commuincation Factors	RIF	Ranked within the group
1	LPF17	0.7366	5
2	LPF18	0.8079	1
3	LPF19	0.7881	2
4	LPF20	0.7822	3
5	LPF21	0.7406	4

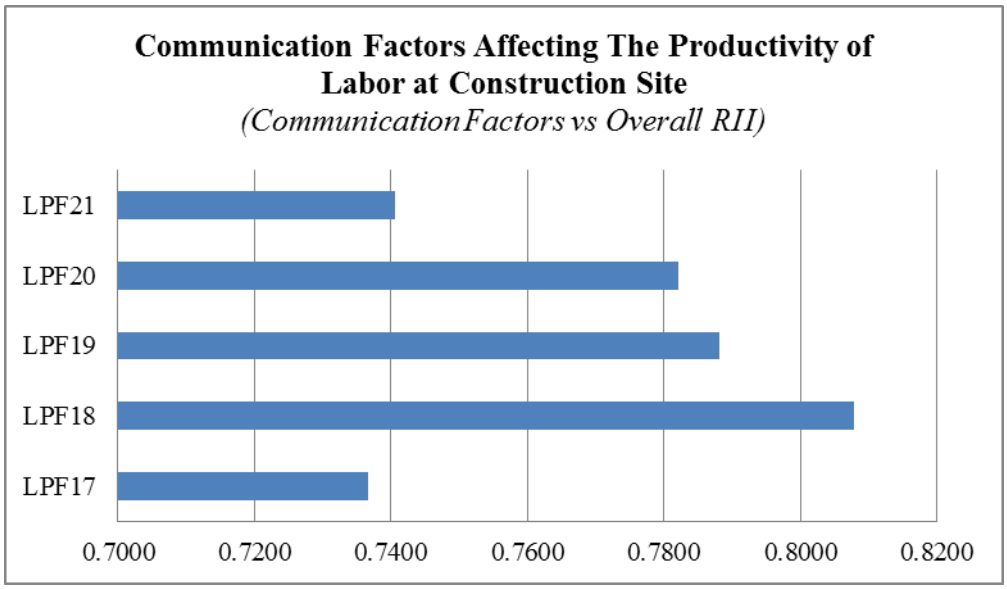

Figure 4.20 : Overall Response to Communication Factors

4.5.4.4 Overall Ranking of Resource Related Factors

The three stakeholders of construction industry registered their responses for the Resource related factors affecting construction Labour Productivity. Incompetent construction companies in Pakistan and lack of control over registration of construction companies were ranked at 2nd and 3rd in this group. Companies hire diploma holders on low wages rather than to hire engineers which highly affect the whole project. Inadequate construction method ranked at 4th. Material storage location near to site ranked at 5th and it affects positively as near the location site takes less time in shifting material. Lack of material was ranked at 6th in resource groupThe ranking of Resource related Factors are shown in the Table 4.35 and Figure 4.21.

Table 4.35 : Overall Response to Resource Related Factors

Sr. #	Resource Factors	RIF	Ranked within the group
1	LPF22	0.7465	10
2	LPF23	0.7881	5
3	LPF24	0.7842	4
4	LPF25	0.8198	1
5	LPF26	0.7782	6
6	LPF27	0.7941	2
7	LPF28	0.7941	3
8	LPF29	0.7584	9
9	LPF30	0.7604	8
10	LPF31	0.7683	7

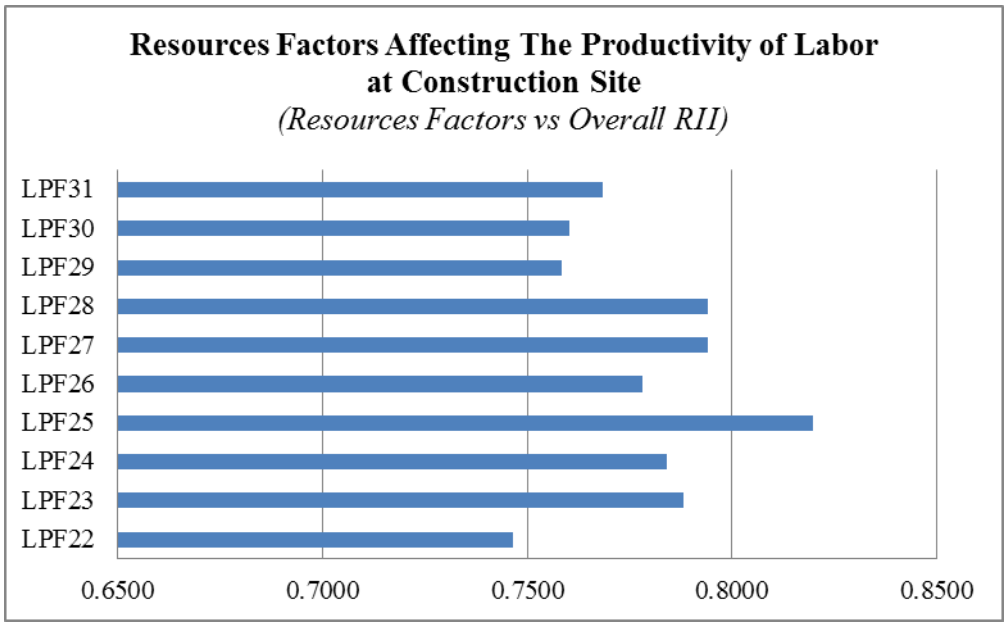

Figure 4.21 : Overall Response to Resource Related Factors

4.5.4.5 Overall Ranking of Miscellaneous Factors

The three stakeholders of construction industry registered their responses for the Miscellaneous factors affecting construction Labour Productivity. Safe environment ranked at 1st in miscellaneous category. Safe environment reduces the rate of accidents and injuries, hence positively affect labor productivity. Accidents during construction ranked at 2nd. Accidents during construction have negative affect on construction labor productivity. It can completely stop work for many days in case of

death of workers, in case of injuries productivity also decreased. Labor's union also affects labor productivity and ranked at 3rd. Motivation is the factor which can play a key role in positively affecting productivity. It is ranked at 4th in miscellaneous category. Weather conditions ranked at 5th. Mostly labor have to work in open air so weather conditions also affect labor productivity. Working overtime was ranked last in the miscellaneous category The ranking of Miscellaneous Factors are shown in the Table 4.36 and Figure 4.22.

Table 4.36 : Overall Response to Miscellaneous Factors

Sr. #	Miscellaneous Factors	RIF	Ranked within the group
1	LPF32	0.7208	6
2	LPF33	0.8178	1
3	LPF34	0.7861	4
4	LPF35	0.8000	2
5	LPF36	0.7089	7
6	LPF37	0.7426	5
7	LPF38	0.7921	3

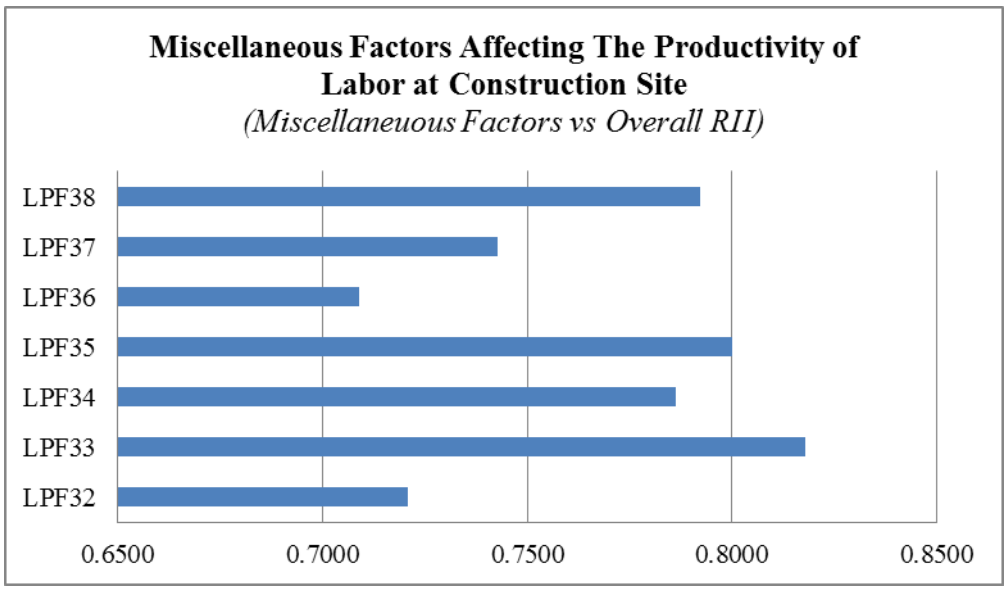

Figure 4.22 : Overall Response to Miscellaneous Factors

4.5.5 Top 10 Most Critical Factors Affecting Construction Labour Productivity

The top Ten most Critical factors affecting construction labor Productivity in Pakistan are shown in Table 4.37.

Table 4.37 : Top Ten Factors Affecting Construction Labor Productivity

Sr. #	Top Ten Factors	Combined RIF	Ranking
1	Disloyalty with Work	0.8535	1
2	Lack of required tools and/or equipments	0.8198	2
3	Safe Environment	0.8178	3
4	Vague or Incomplete Instructions	0.8079	4
5	Payment Delays of Labor	0.8059	5
6	Incentives on Good Performance	0.8020	6
7	Accidents During Construction	0.8000	7
8	Permanent Induction of Labors	0.8000	8
9	Lack of Control Over Registration of Construction Companies	0.7941	9
10	Alcoholism/Addiction of Drugs	0.7941	10

4.5.6 Correlation Between Stakeholder's Responses

The correlation between the responses shown by the stakeholders has been calculated in order to check whether the responses have a good degree of agreement between one another. The correlation coefficient calculated to determine the mutual agreement is shown in Table 4.38.

Table 4.38 : Correlation between Stake holder's Responses

Sr. #	Groups	Agreement	Correlation Coefficient
1	Man Power	Client - Consultant	0.8178
		Client - Contractor	0.7959
		Consultant - Contractor	0.4868
2	External	Client - Consultant	0.5359
		Client - Contractor	0.6020
		Consultant - Contractor	0.5618
3	Communication	Client - Consultant	0.0285
		Client - Contractor	0.5009
		Consultant - Contractor	0.3241
4	Resource Related	Client - Consultant	0.0010
		Client - Contractor	0.7055
		Consultant - Contractor	0.2793
5	Miscellaneous	Client - Consultant	0.7378
		Client - Contractor	0.7212
		Consultant - Contractor	0.8876

4.6 COMPARATIVE ANALYSIS OF THE CURRENT AND OTHER COUNTRIES RESEARCH WORK

Survey results of other countries are compared with this research. From Table 4.39 it is clear that results of each study is different from others. Differences in results of studies performed in different countries are due to different types of project (industrial, commercial, residential, and highways) and geographical location. It is also concluded that these unssimilarities are produced due to differences in construction methods, weather conditions, materials utilization and access of modern technology. Common factors are also observed in these studies, which include time wastage in approving the design and drawings, owners negligence to give pays onn time to contractors, delays in equipments , loop holes in construction methods, rework to remove faluts during construction, ineffectual planning and scheduling by the contractor, delyas related to labor , a lack of communication among all parties, delays in "in time material access" , harsh conditions of weather , and laziness in the owner's determination to accept the design. Table 4.39 lists the top ten factors having impact on productivity of labor in different countries.

Table 4.39: Comparative Analysis of the Current Study with Other Countries Studied in the Past

Rank	**Pakistan (Present Study)**	**USA (Gundecha 2012)**	**Palestine (Ibrahim 2013)**	**Zimbabwe (Benviolent and Tirivavi 2014)**	**Indonesia (Soekiman, Pribadi et al. 2008)**	**Egypt (Enshassi, Mohamed et al. 2007)**
1	Disloyality with Work	Lack of required construction material	Political situation	Unavailability of Material	Lag of material	Material shortage
2	Lack of required tools and/or equipments	Shortage of power and/or water supply	Equipments shortage	Late Payment of Salaries and Wages	Labor strikes	Lack of labor experience
3	Safe Environment (as per OSHA's standards)	Accidents during construction	Lack of labor experience	Suitability/Adequacy of Plant and Equipment	Delay in arrival of materials	Lack of labor surveillance
4	Vague or Incomplete Instructions	Deficiency in provision of construction tools/equipment	Inmproper site management	Supervisory Incompetency	Financial difficulties of the owner	Misunderstanding between laborers and superintendents
5	Payment Delays of Labor	Insufficient lighting	Poor communication and	Lack of Manpower Skills	Unclear instruction to laborer	Drawings and specifications change during

			coordination between construction parties			execution
6	Incentives on Good Performance	Poor site condition	Delay payments by the owner	Lack of labour experience	High absenteeism of labors	Payment delays
7	Accidents During Construction	Weather condition	Low wages	Plant Breakdown	Bad weather	Labor disloyalty
8	Permanent Induction of Labors	Differing site condition from plan	Rework	Late Deliveries of Material	Indiscipline labor	Inspection delays
9	Lack of Control Over Registration of Construction Companies	Material storage location	Misuse of time schedule	Shortage of Tools and Equipment	Use of alcohol and drugs	seven working days without any holiday
10	Alcoholism/Addiction of Drugs	Working overtime	Lack of training sessions for labors	Low remuneration	No supervision method	Tool and equipment shortages

4.7 INTERVIEW

4.7.1 Characteristics of Respondents & Nature of Project

All projects are building projects which were selected for interviews. Most of the interviewers are contractors. The main reason to take interviews from contractors is that they directly in touch with labors. Three interviews were also taken from the labors. Interviews which are also taken from labors in the projects are project serial number 4,10 and 13.

4.7.2 List of Projects

The name of Projects and their location are given in Table 4.40.

Table 4.40 : List of Projects

Sr.#	Projects	Location
1	Ambulatory Care Building, Agha Khan University Karachi	Karachi
2	Bachelors Hostel Building, AIOU	Islamabad
3	Badminton Courts And Gymnasium Building, Islamabad Club	Islamabad
4	D-Type House PAF Complex Islamabad	Islamabad
5	Construction of Multistory Car Parking Plaza	Lahore
6	Storage Shed (Steel Infrastructure) PAEC	Islamabad
7	Construction of Police Station Building	Karachi
8	Officer Mess PAEC	Islamabad
9	Construction of 104 Additional family suits for Parliamentarians	Islamabad
10	Cadet College Admin Building (Hassan Abdal)	Hassan Abdal
11	Construction of Residential Block at Cadet college Hassan Abdal	Hassan Abdal
12	Construction of 20 Marla House	Wah Cantt
13	Construction of 2 Kanal House, DHA	Karachi
14	Construction of 2 Kanal House, DHA	Karachi
15	B-Type House (D/S) PAF Complex	Islamabad

Following are the locations of the projects.

Table 4.41 : Location of Projects

Sr.#	Location	No. of Projects
1	Islamabad	7
2	Karachi	4
3	Lahore	1
4	Wahcantt and Hassan Abdal	3

4.7.3 Estimated and Actual Project Cost

After interviews and data collection, analysis is performed on excel. Estimated and actual project cost is calculated. It is observed that mostly all projects actual cost is more than estimated cost.

4.7.4 Estimated and Actual Project Duration

After interviews and data collection, analysis is performed on excel. Estimated and actual project duration is calculated. It is observed that mostly all projects actual duration is more than estimated duration. This is shown in Fig. 4.23.

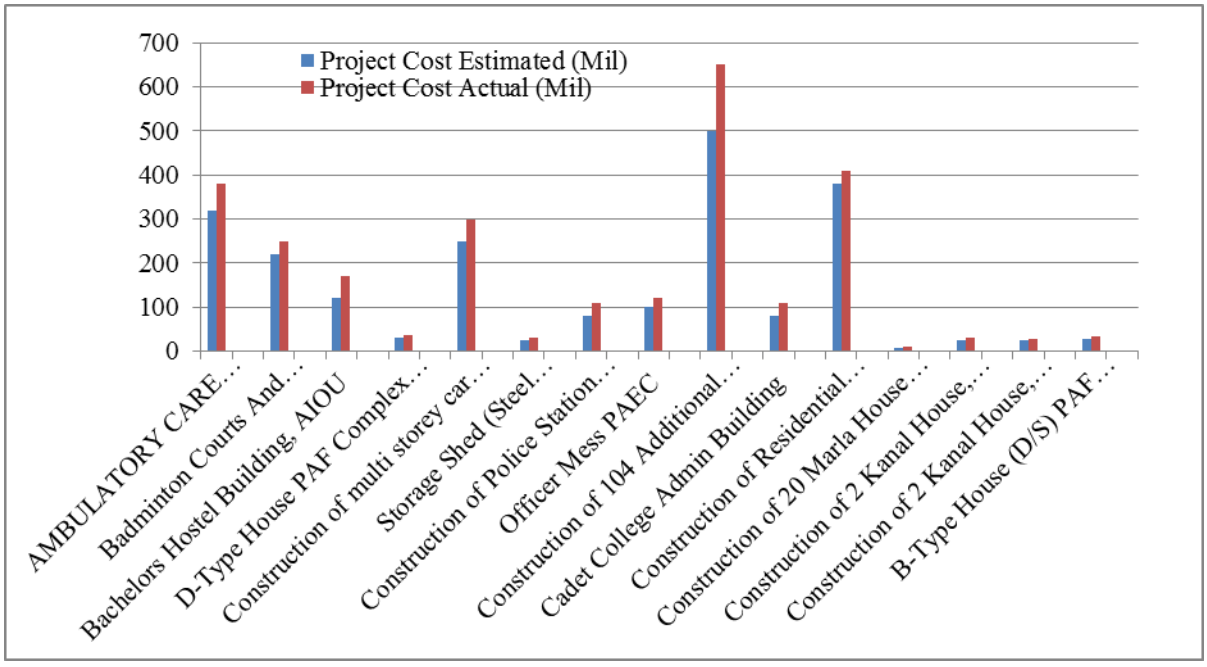

Figure 4.23 : Estimated and Actual Duration of Project

4.7.5 Average %age Leading or Lagging Duration of Each Activity

Average percentage leading or lagging duration of each activity is calculated and shown in the given Table 4.42 and Fig. 4.23. Negative percentage means the actvitiy is completed before estimated time and positive percentage means activity is completed after estimated time.

Table 4.42 : Average %age Duration

Sr.#	**Activity**	**Percentage leading or lagging**
1	Clearing & Grubbing	**-8.791111111**
2	Excavation	**-4.131372794**
3	Sand Filing	**2.211111111**
4	1:4:8 Flooring	**20.08201058**
5	Concrete in Foundation	**19.94781103**
6	Plinth Beam 1:2:4	**18.50634921**
7	Brickwork (Foundation)	**18.12698413**
8	D.P.C (1:2:4)	**14.82**
9	Brickwork in SuperStructure	**35.05133052**
10	Lintel	**13.09272727**
11	1:4 Plaster	**29.92110957**
12	1:3 Plaster	**32.43198653**
13	Slab	**-8.682936508**
14	Beam	**13.29124209**
15	Wood Work	**32.6831635**
16	Stairs	**7.830932916**
17	Bitumen	**0.875555556**
18	Underground Water Tank	**11.87380952**
19	Overhead Water Tank	**7.92037037**
20	Flooring	**29.02619048**
21	Grills	**15.93829726**
22	Paint Emulsion	**-10.91213376**
23	1:2:4 Flooring	**3.278210678**
24	White Washing	**12.65238095**
25	Windows	**19.52486772**
26	R.C.C Pipes	**15.40802988**
27	Fixtures	**8.441904762**
28	C.I Pipe & Vent (75 mm)	**5.867619048**
29	G.I Pipe	**16.60282828**

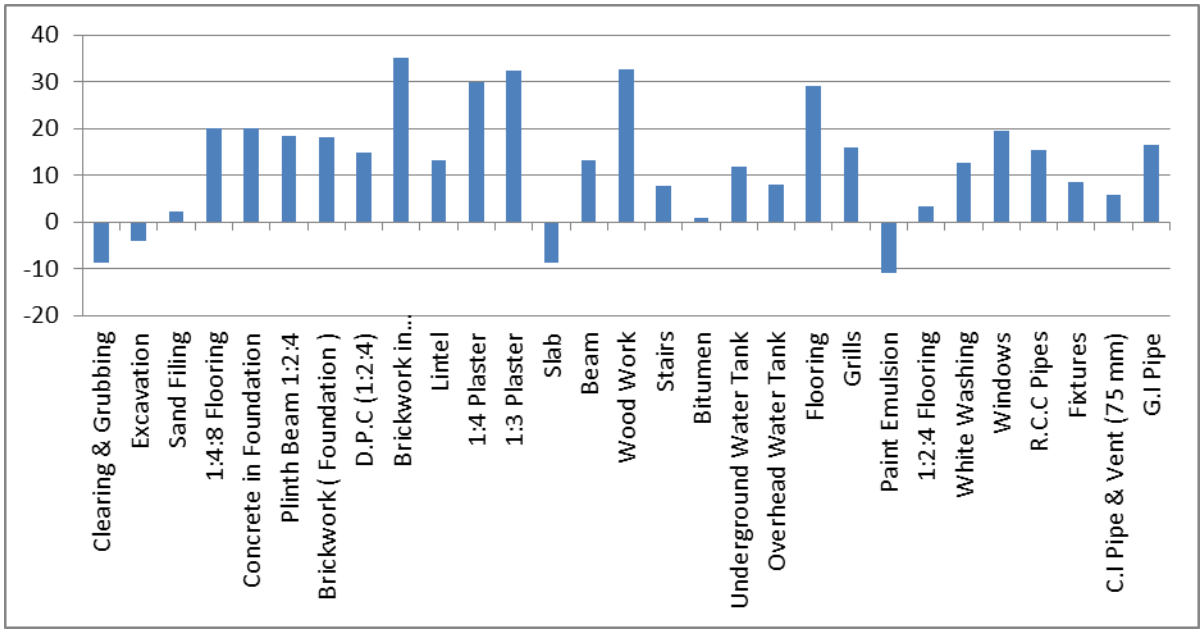

Figure 4.24 : Average Duration of Each Activity

4.7.6 Top Three Delayed Acivities

Following are the top three delayed activites with their averaged delayed percentage.

- Brick work in super structure (35.05%)
- Wood Work (32.68%)
- Plastering (32.43%)

4.8 SUMMARY

In this chapter data analysis and results has been discussed. Different statistical techniques have been used to get the output from the collected data. Thirty Eight (38) factors in five groups are analyzed using MS Excel and SPSS-17, so as to assess the factors that affects construction labot productivity in Pakistan. Data was obtained from vseveral construction companies both national and international.

Cronbach's Coefficient Alpha value (0.883) verified that the information is authentic for future research. Shapiro Wilk normality test assure that distribution of gatherd information is not normal so non para-metric test (Kruskal Wallis test) is utilized in order to testify the deviations in thinking of all related stakeholders; client, consultant and contractor, regarding different delay factors.

All the three stakeholders of construction industry in Pakistan registered their responses, in order to rank the factors affecting construction Labor Productivity which are more critical as far as the budget and delay of construction projects are concerned.

Top ten delay factors that are more important and should be given special attention in order to streamline the project and to keep it on track, in order to avoid the delays and cost overruns are as under:

1. Disloyalty with Work
2. Lack of required tools and/or equipments
3. Safe Environment (as per OSHA's standards)
4. Vague or Incomplete Instructions
5. Payment Delays of Labor
6. Incentives on Good Performance
7. Accidents During Construction
8. Permanent Induction of Labors
9. Lack of Control Over Registration of Construction Companies
10. Alcoholism/Addiction of Drugs

Top three delayed activities in results of interviews are

1. Brick work in super structure (35.05%)
2. Wood Work (32.68%)
3. Plastering (32.43%)

Top three activities which completes before estimated time are

1. Paint Emulsion (-10.91%)
2. Slab (-8.68%)
3. Clearing & Grubbing (-8.79%)

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In this chapter, different conclusions and recommendations related to the problems and issues that are the main cause of affecting construction labor productivity in Pakistan of current as well as proposed projects in future, in order to avoid the time overruns as well as costoverruns. At the start of this thesis research, different objectives were identified as the ultimate outcomes from the study. The first objective was to identify the factors affecting construction labor productivity in Pakistan. The Second objective was to propose suggestions for the improvement in productivity of labors.

5.2 CONCLUSIONS ABOUT FACTORS AFFECTING LABOR PRODUCTIVITY

The portion of the thesis deals with the conclusions about the findings made by the research work. Total number of factors that were identified for this research after extensive study related to the factors affecting construction labor productivity, which were grouped in five main factors such as Manpower, External, Communication, Resource related and Miscellaneous.

5.2.1 Manpower

Results from this research have shown that the factor “Disloyality with work” has been placed at the first place with in the sub group of Manpower. The combined RIF value assigned to this factor by stakeholders is 0.8535. “Incentives on good performance” at second by combined RIF of 0.8020. “Permanent Induction of Labor” at third by combined RIF value of .8000.

5.2.2 External

Results from this research have shown that the factor “Payment Delays of Labor” has been placed at the first place with in the sub group of External. The combined RIF value assigned to this factor by stakeholders is 0.8059. “Incomplete Drawings” at second by combined RIF of 0.7869. “Inspection Delays from Authorities” at third by combined RIF value of .7624.

5.2.3 Communication

Results from this research have shown that the factor “Vague or Incomplete Instructions” has been placed at the first place with in the sub group of Communication. The combined RIF value assigned to this factor by stakeholders is 0.8079. “Misunderstanding Among Labors” at second by combined RIF of 0.7881. “Lack of Proper Planning of the Succeeding activities for the completion of task or Work break down Structure” at third by combined RIF value of .7822.

5.2.4 Resources

Results from this research have shown that the factor “Lack of required tools and/or equipments” has been placed at the first place with in the sub group of Resources. The combined RIF value assigned to this factor by stakeholders is 0.8198. “Incompetent Construction Companies in Pakistan” at second by combined RIF of 0.7941. “Lack of Control Over Registration of Construction Companies” at third by combined RIF value of .7941.

5.2.5 Miscellaneous

Results from this research have shown that the factor “Safe Environment” has been placed at the first place with in the sub group of Miscellaneous. The combined RIF value assigned to this factor by stakeholders is 0.8178. “Accidents During Construction” at second by combined RIF of 0.8000. “Labor's Union” at third by combined RIF value of .7921.

5.2.6 Top Ten Factors Affecting Construction Labor Productivity

Top ten factors which have bad impact construction labor productivty that are perceived by the construction industry stakeholders are; “Disloyalty with Work” at 1st position, “Lack of required tools and/or equipments” at 2nd position, “Safe Environment” at 3rd position, “Vague or Incomplete Instructions” at 4th position, “Payment Delays of Labor” at 5th position, “Incentives on Good Performance” at 6th position, “Accidents During Construction” at 7th position, “Permanent Induction of Labors” at 8th position, “Lack of Control Over Registration of Construction Companies” at 9th position and “Alcoholism/Addiction of Drugs” at 10th position.

5.3 RECCOMMENDATIONS

Construction projects are pricey, which affects attaintments of projects in negative manner. The working surrounding of construction companies must be adoptable in order to execute the defined projects successfully in time accomplishment. In construction firms, it is essential to find out the deficiencies of specific task to resolve and overtake these inadequacies. Recommendations which had been considered here are essential factors to enhace progress and productivity in constructions firms.

i. Contractor should offer defined and proper schedule of provision of material for each project. It should consists the time period requirement for supply of materials and the accessibility of the market in order to obtained the needed materials in time. Extra care is needed to maintain materials quality and tools presision which are utilized projects during construction. Utilization of adequate tools and proper material not only cut down the time required for task completion but also minize the loss of materials.

ii. Organizations should assure that sufficient lighting is provided at the sites which can minimizes the chances of accidents. safety trainings sessions and meetings should be arranged on continuous bases in order to get effective progresss in productivity of labor .

iii. Recruiting team and project managers should select suitable examinee for specified job . Friendly collaboration should be managed among labors and they should made be aware of its siginificane for company.

iv. A financial incentive shoul be granted on yearly basis to bulid atmosphere of competition for employees,in order to achieve productivity in efficient manner .

v. Tests should be carried out in order to check usage of drugs or alcohol in surprising manner and strict actions should be taken against the employees who found to be involved in such type of activity .

vi. Absence of worker at site can be minimized with inclusion of adequate paid time off and holidays to all employees.

vii. Labor who work in the construction industry must be paid within 5 days after the end of the pay period.

viii. The standard hours of work should be 8 hours in a day and 40 hours in a week.

ix. Medical facilties should also provided to them and their family members.

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APPENDIX-I
Covering letter

Questionnare For “Factors Affecting Construction Labor Productivity on Building Projects in Pakistan”

Dear Sir/Madam:

Hopefully you are fine and enjoying quality time with your family. It is my pleasure to inform you that I am working on the topic mentioned above and prioritizing the factors affecting construction labor productivity in Pakistan that may cause a delay in the projects as well as cost overruns of the projects in Pakistan. The study shall greatly help to make recommendations for timely completion of the projects. It is assured that the information we will gain from your side shall be strictly kept secret and it will only be used for the academic purposes. For that purpose a questionnaire has been developed and is sent herewith for your kind response which shall be helpful for me to bring the true picture of the situation. It shall be highly appreciated if the questionnaire is filled at earliest and sent back through the return envelope with in a week or as early as possible. Thank you in anticipation.

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APPENDIX-II
Information about the Respondents

General Information about the Respondent	
Personal Details:	*(All the details will be kept confidential)*
Name: (Optional)	
Name of Company:	
Telephone: (Optional)	
Email: (Optional)	
Please encircle appropriate category for each question below.	
Education	1. Secondary 2. Certificate/Diploma 3. Graduate 4. Post graduate 5. Doctorate
Type of Construction Organization	1. Residential 2. Commercial 3. Industrial 4. Government 5. Engineering 6. Architecture 7. Owner 8. Others (Please Specify)
Position/Appointment	1. General Manager 2. Project Manager 3. Field Engineer 4. Inspector 5. Worker 6. Supervisor
Experience in Construction Industry (years)	1. Less than 5 years 2. 5-10 years 3. 10-15 years 4. 15+
How long you have worked in this company (years)	1. Less than 1 year 2. 1-5 years 3. 6-10 years 4. 11-15 years 5. More than 15 years
You belong to which stakeholder organization?	1. Owner 2. Contractor 3. Consultant 4. Subcontractor 5. Academia/Researcher 6. Others (Please Specify)
No. of Projects per Year	
Typical Size of Projects	1. > 100 Million 2. 100-500 Million 3. > 500Million
Geographical location of Project undertaken	1. Federal 2. Punjab 3. Sindh 4. KPK 5.Balochistan 6. AJK

APPENDIX-III
Questionnaire

Section 2

1. **How would you define Labor productivity in the Construction industry?**

   A) Within Budget B) Within Estimated Time

   C) Both (A) & (B) D) Depends on Project Nature

   E) Other Please mention _____

Section 3:- Please indicate to what extent following factors affect labor productivity at construction site.1 – Not applicable; **2** – Does not affect it; **3** – Somewhat affects it; **4** – Moderately affects it; **5** – Directly affects it

#	Factors Affecting Construction Labor Productivity in Pakistan	Data Measurement				
		1	2	3	4	5
		Not Applicable	Does not affect it	Somewhat affects it	Moderately affects it	Directly affects it
1	**Manpower**					
LPF1	a) Incentives on Good Performance.					
LPF2	b) Permanent Induction of Labors.					
LPF3	c) Competition between the Laborers.					
LPF4	d) Lack of Experience.					
LPF5	e) Alcoholism/Addiction of Drugs.					
LPF6	f) Lack of Training.					
LPF7	g) Age.					
LPF8	h) Disloyalty with Work.					
2	**External**					
LPF9	a) Training Sessions for Labors					
LPF10	b) Payment Delays of Labor.					
LPF11	c) Inspection Delays from Authorities					
LPF12	d) Supervision Delays.					
LPF13	e) Repeated Variation of Single Activity.					
LPF14	f) Complex Designs in the Provided Drawings.					
LPF15	g) Variations in the Drawings.					
LPF16	h) Incomplete Drawings					
3	**Communication**					
LPF17	a) Good Management of Supervisor.					
LPF18	b). Vague or Incomplete Instructions.					
LPF19	c) Misunderstanding Among Labors.					

#	Factors Affecting Construction Labor Productivity in Pakistan	Data Measurement				
		1	2	3	4	5
		Not Applicable	Does not affect it	Somewhat affects it	Moderately affects it	Directly affects it
LPF20	d) Lack of Proper Planning of the Succeeding activities for the completion of task or Work breaks Structure.					
LPF21	f) Poor Management of Supervisor.					
4	**Resources**					
LPF22	a) Use of Latest Technology.					
LPF23	b) Adequate construction method.					
LPF24	c) Material storage location near to Site.					
LPF25	d) Lack of required tools and/or equipment's.					
LPF26	e) Lack of required construction materials.					
LPF27	f) Incompetent Construction Companies in Pakistan					
LPF28	g) Lack of Control Over Registration of Construction Companies.					
LPF29	h) Poor site conditions.					
LPF30	i) Poor access within construction job site.					
LPF31	j) Inadequate transportation facilities for workers.					
5	**Miscellaneous**					
LPF32	a) Better Facilities Provided to Labor. Working overtime.					
LPF33	b) Safe Environment (as per OSHA's standards).					
LPF34	c) By Motivating Labor					
LPF35	d) Accidents During Construction.					
LPF36	e) Working Overtime.					
LPF37	f) Weather Conditions.					
LPF38	g) Labor's Union.					

4) Other Factors affecting Labor Productivity at Construction Job sites.

_____

_____

_____

5) Any Comments/Remarks.

_____

_____

_____

_____

APPENDIX-IV

Interview

Construction Company			
Name of Project			
Project Cost Estimated			
Project Cost Actual			
Project Duration Estimated			
Project Duration Actual			
	Estimated Duration	**Actual Duration**	**Productivity**
Activity			
Clearing & Grubbing			
Excavation			
Sand Filing			
1:4:8 Flooring			
Concrete in Foundation			
Plinth Beam 1:2:4			
Brickwork (Foundation)			
D.P.C (1:2:4)			
Brickwork in SuperStructure			
Plinth Beam 1:2:4			
Lintel			
1:4 Plaster			
1:3 Plaster			
Slab			
Beam			
Wood Work			
Stairs			
Bitumen			
Underground Water Tank			
Overhead Water Tank			
Flooring			
Grills			
Paint Emulsion			
1:2:4 Flooring			
White Washing			
Windows			
R.C.C Pipes			
Fixtures			
C.I Pipe & Vent (75 mm)			
G.I Pipe			

Vita

The author, Bilal Hussain Shah was born on 12th August 1989 in Mianwali. His education career started from Islamabad. He completed his Matriculation from F.G.Model School I-10/2, Islamabad in 2005. He joined I.M.C.B F-8/4, Islamabad and did FSc (Pre-Engineering) in 2007. He graduated with a degree of Civil Engineering from UET Taxila in 2011. After doing BSc he got admission in MS Construction, Engineering & Management in NUST.