Effects of Innovative Procurement Systems on the Performance of Construction Projects

Ahmet Aknar

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Prof. Dr. Mustafa Tümer
Acting Director

I certify that this thesis satisfies the requirements as a thesis for the degree of Master of Science in Civil Engineering.

Assoc. Prof. Dr.Serhan Şensoy
Acting Chair, Department of Civil Engineering

We certify that we have read this thesis and that in our opinion, it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Civil Engineering.

Assoc. Prof. Dr. İbrahim Yitmen
Co-Supervisor

Dr. Tolga Çelik
Supervisor

Examining Committee

1. Prof. Dr. Tahir Çelik _____
2. Assoc. Prof. Dr. Khaled Marar _____
3. Assoc. Prof. Dr. İbrahim Yitmen _____
4. Asst. Prof. Dr. Umut Yıldırım _____
5. Dr. Tolga Çelik _____

ABSTRACT

The purpose of this research is to provide information on Integrated Project Delivery (IPD) as a construction procurement and delivery method and identify the factors that are affecting IPD success in design and implementation stage. Construction procurement methods helps the clients to obtain qualified construction services.IPD is the only delivery method that involves all participants in project, it is collaborative delivery method that adapts mutual respect and trust between team members, the main priority is reduce waste to bring superior projects to industry. For this research, the data was collected through questionnaires from selected experts within construction industry. The questionnaire is divided into six major categories; cultural and social, managerial and organizational, financial, technological, legal, implementation. All of these categories are elaborately examined one by one and solutions are evaluated to mitigate affecting factors. Finally, managerial issues are important affecting factors for IPD. Conclusions about the future of IPD are presented along with possible future research suggestions in order to develop further understanding of potential IPD applications.

Keywords: Procurement systems, Integrated Project Delivery, Construction Industry

ÖZ

Bu çalışmanın amacı, proje temin/teslim yöntemlerinden biri olan Bütünleşik Proje Teslimi (BPT) yöntemini ve bu yöntemi tasarım ve uygulama aşamasında etkileyen etkenleri belirlemektir. Bütünleşik Proje Teslimi yöntemi bütün paydaşları proje aşamasında biraraya toplayan tek proje teslim yöntemidir. Öncelikle, bu araştırmada, inşaat sektöründeki kuruluşlar için 6 kısımdan oluşan bir anket hazırlanmış olup, sektörde aktif olan inşaat şirketlerine/yöneticilerine gönderilmiştir. Katılımcıların sonuçları detaylı bir şekilde incelenmiş olup, yönetim şekli BPT'yi etkileyen en önemli etkenlerden biri olarak tespit edilmiştir.Araştırma sonuçları tezin son bölümü olan, sonuç ve öneriler bölümünde detaylı bir şekilde anlatılmıştır.

Anahtar kelimeler; Proje temin/teslim, Bütünleşik Proje Teslimi, İnşaat sektörü .

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LIST OF ABBREVIATIONS

AEC	Architecture, Engineering and Construction
BIM	Building Information Modeling
CPD	Continuing Professional Development
IPD	Integrated Project Delivery
IT	Information Technology
KMO	Kaiser-Meyer-Olkin Measure of Sampling Adequacy
TC	Target Costing
TVD	Target Value Design

This thesis is dedicated to my family..

Chapter 1

INTRODUCTION

1.1 Overview

Project success in the construction industry is mainly dependent on management and project procurement. Project management requirements can be briefly defined as, usage of tools and techniques or having specific knowledge and skills about project to meet project specifications (PMBOK, 2000). Project procurement methods and project delivery systems are important for project success (Rashid, R.A et.al, 2006). Construction procurement methods help the client in obtaining competent construction services. The designer will prepare bid packages for proposal or qualifications and support the selection, negotiation, and awarding contract processes. (AIA, Construction Procurement, 2000).

Architecture, Engineering and Construction (AEC) industry can be defined as, the sector of the construction industry that provides the qualified services on the architectural or engineering design and construction services. It is a sector which is very active in the adoption of innovative technology. In AEC industry, generally speaking, an appropriate procurement method is chosen for client's needs and project requirements. In separated procurement methods, the sequences such as design and implementation are independent from each other. Information sharing and managerial problems can occur in separated methods due to separation of parties (Sorra et.al 1996). In Integrated Project Delivery (IPD) method, all project participants are involved in early stage, it means, all phases are linked to each other.

Participants or team members' common priority is project success. IPD is only the method that involves all project participants in early stages, it means, IPD eliminates gaps between parties. (Taylor & Levitt, 2007).

IPD is initiated to address the issues of fragmental and hostile relationships within inter-organizational teams and to integrate all participants as a whole team. The main priority of the team is reduce waste and increase efficiency on construction projects (Sun, W., 2013). In addition, team members' cultural adaptability to new methods, usage of technological tools or experience level may affect IPD success. The mentioned factors can be affecting factors for IPD success. For instance, team members should have enough knowledge about Building Information Modeling (BIM) to use it on IPD projects (Azhar, N. et al 2014). This type of factors can be identified having interviews or conduct a survey with AEC companies.

1.2 Problem Statement

Generally construction sector is adapted traditional procurement methods. According to traditional methods, the responsibilities of the design team and construction team are separated and conducted by different groups. This means the delivery of a project is a sequential process. In some cases, separation can cause lack of communication and information sharing between parties(Sun,W.,2013).In construction industry, experts are dissatisfied on aforementioned issues; they believe that, these problems cause cost overruns, schedule overruns in project outcomes (Lichtig, 2006).

Integrated system is the next phase for project delivery to reduce cost and increase project efficiency. American Institute of Architects (AIA) called this method with a name Integrated Project Delivery (IPD). IPD method is adapted teamwork approach and systematic thinking; it optimizes team, sharing information between team

members for effective collaboration. In traditional methods, team work approach is not adapted. It can cause lack of information transfer between members; it is crucial issue for project success. In order to reduce the mentioned issues, integrated project delivery method can be preferred by AEC sector instead of traditional methods.

1.3 Scope and Objectives

The construction procurement methods play an important role in design and implementation phase. Project success is dependent on chosen procurement method. Each procurement method has pros and cons. The main objective of this research is to identify the factors affecting IPD success. Further, the critical benefit of IPD is that it provides a contractual mechanism to enhance collaboration between all the major stakeholders in a project. However, this requires a change in approach as to how projects are delivered. Owners need to devote more time and incur expenditure at an earlier time in the delivery of an integrated project when compared with delivery on a design and construct basis. Nevertheless, this early investment of time and money means that design issues are resolved before construction is commenced, design alternatives and their cost implications can be explored earlier with the constructor and, as a consequence, a far more robust construction schedule and cost is established (Stirton, L.,2015). The factors are determined after literature review and questionnaires are prepared to send AEC companies. All the processes are summarized as following;

- To investigate procurement systems and their attributes and how them affects the project performance.
- To examine Integrated Project Delivery principles to find out strengths and weaknesses of IPD.
- To investigate affecting factors of IPD success.

- To propose a solution to mitigate affecting factors on IPD.

1.4 Methodology

This study aims to conduct a quantitative research strategy for factor analysis. A series of factors are written according to literature review. A table is created to show each factor and definitions. The chapter 3 presents detailed information about each factor and it includes a figure for factors. For quantitative research, a questionnaire is prepared for respondents. It has been sent to construction companies. According to respondent's responses, the following sequences were created.

- A series of pie chats is drawn for binary questions according to respondent's responses.
- The likert scale coded questions are further investigated statistically with SPSS software.
- Reliability analysis is done to find Cronbach's Alpha value.
- KMO test is done to find the values sampling adequacy.
- Bartlett's Test of Sphericity is done for hypothesis testing and correlation matrix.
- Results of factor matrix shows the factor loadings of each item retained in the analysis against each factor.

1.5 Achievements

The achievements of this research are listed below;

- Procurement methods were examined deeply and Integrated Project Delivery method were further investigated.

- A questionnaire was prepared and sent to construction companies to determine which factors were significantly important in Integrated Project Delivery method.
- Affecting factors of IPD were determined, the actions taken to solve identified issues and suggestions written.
- Considering respondent's responses, the results shows that managerial issues are affecting factors of Integrated Project Delivery.

1.6 Thesis Outline

Chapter 1 includes; introduction, problem statement, scope and objectives, methodology about research.

Chapter 2 includes; literature review about construction procurement systems and integrated project delivery.

Chapter 3 includes; methodology, research approach, factors and definitions, statistical information's about used methods.

Chapter 4 includes; questionnaire analysis and results, analysis of responses, reliability test, KMO and Bartlett's test, correlation matrix and factor matrix and discussions of results.

Chapter 5 includes; Conclusions and recommendations about research.

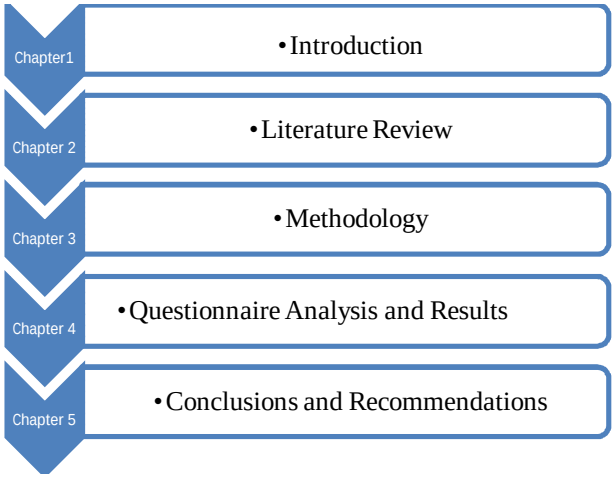

Figure 1.1. Thesis Outline

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Project design and implementation processes are generally complicated. Many problems can occur during construction or implementation. Thus, efficient project procurement methods and project delivery systems are crucial for project success. Today, clients demand more efficient procurement delivery systems from those used in the past. Companies look for a suitable procurement method which can optimize time usage and maximize project success in an economically efficient manner. As its name implies, “procurement system” is concerned with an organized approach or procedure (Rashid R.A., et al, 2006). A procurement system is needed to build construction projects such as flats, houses, health centers, bridges, shopping centers, roads, dams, etc., for clients. Procurement systems are divided into four main categories: separated, integrated, management, and discretionary systems. This study will first examine these categories in turn. Following this, an integrated project procurement system, in which participants collaborate to meet project scope and objectives, will be explored in detail in this study.

2.2 Procurement Systems in Construction

The selection of building procurement method depends on project complexity and client needs. Each method has advantages and disadvantages but the important criterion is which method is suitable for each specific project. Procurement systems can be categorized in four groups:

1. Separated Procurement Systems
2. Integrated Procurement Systems
3. Management Oriented Procurement Systems
4. Discretionary Procurement Systems

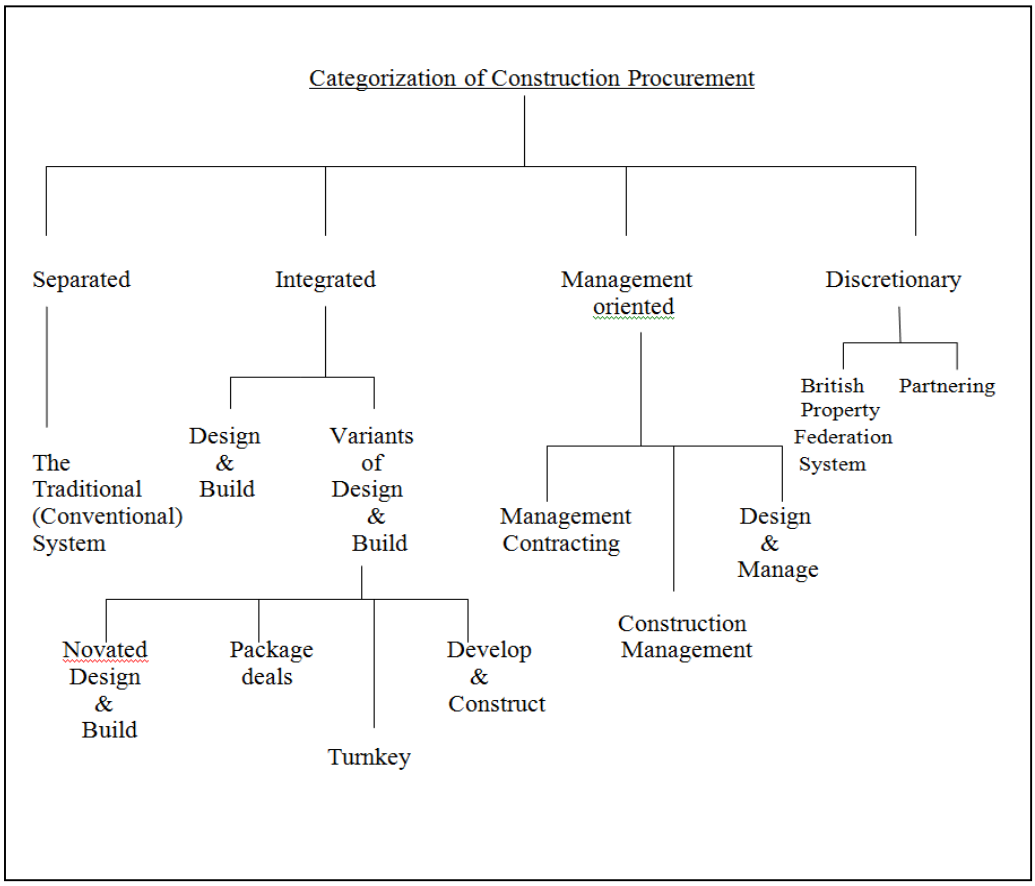

Figure 2.1. Categorization of Construction Procurement

(Source; Masterman J W E, Introduction to Building Procurement Systems second edition, 2002)

2.2.1 Separated Procurement Systems

2.2.1.1 Definition of Separated Procurement Systems

The particular parameter of this procurement system is the separation of the duty of project design team from contractor. As can be seen in figure 2.1, the separated procurement system includes the conventional method and is also known as " The Traditional Method " in literature and industry. Under this method, responsibilities of the design team and construction team are separated and conducted by different groups. This means the delivery of a project is a sequential process. The organization and management processes of the project depends on the contractor and the project owner`s consultants. The client`s consultants are responsible for project design and preparing tender documents. The project design and tender documents will be completed before awarding a contract to the contractor. Generally, this process begins with a feasibility study followed by a preliminary design, and finally awarding the contract to the contractor. (Greenhalgh,B.,Squires,G., 2011)

2.2.1.2 The Processes of Separated Procurement Systems

a- Preparation Process

Preparation stage is the beginning stage of the project. A consultant project manager who has experience with design and construction phases will be hired by the client. The consultant project manager is responsible for creating a team which includes an architect, engineer and other specialists to meet client needs. The team is responsible for project, technical, and financial contracts.

b- Design Process

Design stage is the second stage of the project and where every detail and client need will be identified. The consultant manager and team are responsible for informing the client about project phases such as: feasibility study, design, tender documents, legal

or environmental obligations, as well as issues that may occur during the construction phase. Such issues, for instance, may be where consultants delay establishing a work schedule and this in turn results in financial issues which may affect the project's success. It is therefore important that every issue that has arisen is dealt with during the design phase.

c- Preparing and Obtaining Tenders Process

Traditional/Conventional procured projects entail tender documents of drawings, requirements, bill of quantities and a time schedule. Selection of a contractor is dependent on their bid offer. The representative person or consultant project manager with the lowest bid is awarded the contract and must adhere to the project requirements during construction stage; otherwise consultants can take legal action against relevant contractor.

d- Construction Process

Construction process is the most important process of Separated Procurement system. When problems arise during the construction process, it can negatively affect project performance. Lack of management experience can delay onsite activities and potentially cause technical and financial problems. Inspections are crucial during construction to reduce difficulties. This is the stage where incorrect price calculations of quantitites, poor cost estimates, and shortcomings in "buildability", is paid. Thus, experienced consultant(s) and manager(s) each have a very important role during the construction stage.

2.2.2 Integrated Procurement Systems

Integrated Procurement Systems include all the procedures and responsibilities of design, construction, and management. Generally, one organization or contractor takes responsibility of a specific project. The contractor allocates the specified needs

to team-members. Both the budgeting and the management are undertaken by one organization.

This category of procurement system is divided into two parts. Design and Build procurement system is the first part. Variants of Design and Build is the second part, as is shown in figure 2.1.The Variants of Design and Build include subsections: Package Deal, Turnkey, and Develop and Construct. These methods will be explained in the next sections.

2.2.2.1 Design and Build System

The concept 'Package Deal' is acknowledged as design-and-build, and is generally understood as"an arrangement where one contracting organisation takes sole responsibility, normally on a lump sum fixed price basis, for the bespoke design and construction of a client's project" (Masterman, J., 2002)

Three points characterize this system: one organization is responsible for design and construction, payment is a pre-determined fixed price, and the project is customized to the client's requirements.

2.2.2.2 Variants of Design and Build

The Variants of Design and Build are: Novated Design and Build, Package Deal, Turnkey method, and Develop and Construct. In this section these systems and their benefits will be examined.

a- Novated Design and Build

In Novated Design and Build, clients find consultants to carry out the visionary design and tender documentation for their specific projects. Once the decision to go ahead has been made, a qualified contractor is appointed. The tendering stage is important to select a suitable bidder for the project. The appointed contractor, together with the client's team/consultants, is responsible for the project. The client

is responsible to pay his/her consultants. Difficulties can occur during the design stage. For instance, the contractor might create his/her own team instead of choosing to working with the client's consultants. This problem can affect the communication and relationships among team members. However, when followed properly, working as one team through all stages of the project diminishes conflict between parties and as consequence assists in achieving the design parameters and meeting client's needs (Masterman, 2002).

b- Package Deal Method

Package Deal, is a procurement method that encompasses the whole project and is also known as "all-in" type of contract. Generally, unique projects such as collective housing are an example of package deals, where the client can see actual examples of the project and get an idea of the esthetics and project specifications. If the project satisfies their needs, a single-price contract can be arranged which embraces everything required for project completion (Rashid R.A et al.).

c- Turnkey Method

Originating in the USA, Turnkey is an agreement whereby the contractor undertakes the entire project from initial construction to final completion and handing-over to the client. Hence, the contractor prepares the project brief, gets the go-ahead, designs, finances, builds, furnishes, decorates, and submits a completed project ready for use (Allen, 2001).

d- Develop and Construct

Develop and Construct system is similar to Design and Build system. In this method, the contractor is responsible for every stage of the project. However, the main difference is that, in the Develop and Construct method, the client's consultants or project managers prepare a summary of the client's needs or they create a design

concept according to client's expectations. The contractor is responsible for developing the design, specifying project requirements and then sending their proposal to the client for approval.

2.2.3 Management Oriented Systems

There has been a significant surge in popularity of management-oriented procurement methods in the past 30 years in the UK. Due to an increase in project size and the complexity of building techniques over the past 50 years, there emerged a need to improve time efficiency and costs. Hence, a strategic management of this process was required.

Three systems were formed: *management contracting*, *construction management,* and *design and manage*. These three systems will be discussed in turn. All three facilitate projects to follow client needs, particularly improving start and finish times far more than traditional procurement methods.

2.2.3.1 Management Contracting

The main features of this structure are:

1- The contractor holds an equal status with others on the design team.

2 - Payment is based on a fixed-fee or percentage for management and cost of construction.

3- Actual construction is undertaken by builders who are hired and managed by the design team contractor (Masterman, 2002).

2.2.3.2 Construction Management

According to the Construction Round Table's guide *Thinking About Building* (Masterman, 2002), this system is where a fee-based consultant, usually a contractor, ensures that all construction contracts are approved *directly* between the client and the individual package contractors.

The main difference from Management Contracting is that in Construction Management the owner actually hires and forms direct contracts with the individual package contractors, and the construction manager then functions as the owner's agent, managing each of the individual contractors and ensuring that all agreed objectives are met.

2.2.3.3 Design and Manage

The main features of this procurement method are:

1 - One company is hired to both design and manage the project.

2 - This company can be a contractor or a consultant.

3 - The actual project construction is undertaken by package contractors; if the hired company is a contractor, these package contractors are hired by the company; whereas if the company is a consultant, these package contractors are hired directly by the owner.

2.2.4 Discretionary

2.2.4.1 The British Property Federation System

In existence for almost 20 years, this method was created to:

…change attitudes; produce good buildings more quickly and at a lower cost; create a fully motivated, efficient and cooperative building team; remove overlap of effort…which is prevalent under the existing systems; redefine the risks so that the commercial success of the designer and the contractor depends more on their abilities and performance; reestablish awareness of real costs…and eliminate practices which absorb unnecessary effort and time and obstruct progress towards completion.

(British Property Federation Operating Manual,)

It is, however, not popular with clients and therefore hardly ever used.

2.2.4.2 Partnering

Partnering aspires for genuine collaboration, partnership and equal status for all participants of the project group, thereby aiming for a collective drive to achieve the project objectives. A project is undertaken using any procurement method to execute the funding, design, and construction of the project.

Two types of Partnering presently exist,“ *project partnering*, where the relationship is put in place on one specific project and terminated once the project is completed, and *strategic partnering*, where a long-term relationship is established which relates to a series of future projects spread over time”. (Int.to Build. Procurement Greenhalgh B., Squires G.)

2.3 Integrated Project Delivery in the Construction Industry

2.3.1 Meaning of Integrated Project Delivery

Integrated Project Delivery (IPD) is a project delivery method where all employed participants share the risk and responsibilities.

According to American Institute of Architects, “IPD is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize the project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.” (AIA 2007)

Project delivery methods reflect on the most significant parameters that affect project achievement. The American Institute of Architects definition emphasize that IPD processes are completely dependent on the parties. IPD is the only

delivery method that is adapted to a project teamwork approach. Collaboration, transferring, and sharing knowledge is crucial for the project team to achieve project objectives and success.

2.3.2 Principles of Integrated Project Delivery

Integrated Project Delivery is newer than the other delivery systems and mainly focuses on the collaboration of all parties. It is based largely on teamwork and trust. Principles and procedures are important for efficient implementation of IPD. Collaboration and participation are crucial to meet project objectives. According to AIA, nine principles are necessary to implement IPD efficiently:

- Mutual Respect and Trust
- Mutual Benefit and Reward
- Collaborative Innovation and Decision Making
- Early Involvement of Key Participants
- Early Goal Definition
- Intensified Planning
- Open Communication
- Appropriate Technology
- Organization and Leadership

The American Institute of Architects (AIA) principles are significant in IPD design sequences. Written principles can affect project outcomes directly. Generally speaking, all stages are important for project success.

2.3.2.1 Mutual Respect and Trust

Mutual respect and trust is one of the principles of the IPD. It mainly focuses on collaboration between owner, design team, construction firms etc. It is crucial principle that, increase project efficiency, collaboration and teamwork.

2.3.2.2 Mutual Benefit and Reward

In Mutual Benefit and Reward all team members benefit from IPD. In Integrated Project Delivery method, early involvement of parties is important criteria that affect the project performance or efficiency. Participants adopt "what`s best for project" behavior and team members dedicate themselves to increase project success. It can only be succeeded with strong collaboration. Participants reward is project success.

2.3.2.3 Collaborative Innovation and Decision Making

Decision making is an important factor for every kind of business. In IPD, the participant's ideas are evaluated on their benefits, every idea is important and team manager or any person in the team, their position is not change anything in decision making phase. Key decisions are evaluated by the participants or project team and, the greatest one is chosen unanimously.

2.3.2.4 Early Involvement Key Participants

IPD achievement directly depends on the collaborative participation of the team members, also known as the "core group". Project team members take on the project from initial stages of design, construction and operation. Participation is one of the most important parameters of IPD (AIA California Council, 2007).

The "core group" is composed of the owner, architect, and general contractor. The purpose of the core group is to act as "the decision making body and the go-between from the owner to the remainder of the design/construction parties" (AIA California Council, 2007). When a particular decision cannot be reached by the core group, the client will intervene and reach a decision (Post, 2010; The American Institute of Architects& AIA California Council, 2007). The crucial

principles for team members are open communication, cooperation and collaboration, decision-making, mutual respect, and trust.

2.3.2.5 Early Goal Definition

According to Early Goal Definition principle, project phases and goals are developed early and approved by team or participants. Participation is crucial and participants or team ideas will be evaluated in this stage to increase project performance.

2.3.2.6 Intensified Planning

The project planning phase is one of the extremely important criteria that affects project success and efficiency. Integrated project delivery concept consider that increased effort in project planning phase outcomes in increased project efficiency. In intensified planning phase the IPD approach is improving design to reduce delay in project time and waste in construction stage.

2.3.2.7 Open Communication

According to Integrated Project Delivery team success and performance is rely heavily on honest, respectful and open communication between all team members or participants. Responsibilities of team members are openly defined and no-condemnation culture brings on specify and finding solution of obstacles. The controversial issues between participants are instantly resolved.

2.3.2.8 Appropriate Technology

Generally IPD projects are based on new technologies. New software or tools can minimize design completion time and maximize project functionality. Appropriate technology not only increase IPD project efficiency, it also increase traditional delivery methods efficiency.

2.3.2.9 Organization and Leadership

The project team is group or organization in their own right and participants or team members are dedicated to team`s aim and goals. In project team the most capable team member is chosen for leadership. Leader is responsible of every project phases. Leader is also responsible to assign participants or team members, according to project needs or basis.

2.3.3 Application of Integrated Project Delivery

Certain concepts are vital in creating a core group for a project. These are shared risks and rewards, intensified planning, organization and leadership, multiparty agreement, early involvement of key participants, and early goal definition. (Kent & Becerik-Gerber, 2010).

The first, shared risk and reward, serves to provide an incentive for all participants to produce an excellent project in an efficient manner. Kent and Becerick-Gerber explain that participants are able to cover " budget overages with each entity's overhead and profit, but if the project is under budget the team may receive a compensation bonus" (Kent & Becerik-Gerber, 2010). This bonus would normally be a portion of the actual money saved. Understandably, this can further contribute to increasing cooperation among participants in a manner perhaps not witnessed before in the industry. According to The American Institute of Architects and AIA California Council, IPD success relies on project cooperation to meet the objectives set by the core group (2007). "Shared rewards and risks among stakeholders create incentives for exceptional results; reduce waste through better planning and shared costs" (Kent & Bercerik-Gerber, 2010, p. 817). In other words, IPD relies on team-effort and as such the team is collectively accountable to the project's failure or success thus, the reasoning of the concept of shared risks and rewards.

The next principle, “early involvement”, is very crucial. IPD is rooted in the belief that all disciplines and participants must be engaged in the decision-making procedures from the project’s start.

“Early goal definition” follows naturally from early involvement. When goals are established from the outset, expectations of all participants are communicated from the start. However, if participants are not fully committed and share common ideals within the group from the start, IPD cannot proceed properly.

Hence, all of these IPD principles must occur from the start of a project in order to secure successful implementation of IPD.

2.3.4 Merits of Integrated Project Delivery

The IPD methodology adopts a teamwork approach to achieve project objectives. This study focuses only on the benefits or advantages of IPD. The benefits can be separated into two stages: Design stage and Construction stage. These stages are important to estimate project time, cost, and efficiency. Both stages are also important for the core group and team to achieve positive results. The Design stage and Construction stage have distinct benefits that will be examined in the following part.

2.3.5 Design Stage Benefits

The IPD Design stage is when the scaled plans and specifications of the project take place. What is unique is that in IPD “all parties are present and involved from the earliest design phase” (Kent & Bercerik-Gerber, 2010, p. 816), and this is an enormous benefit. Importantly, this team spirit helps “foster economical decision making” (DeBernard, 2007, p. 2). Both of these qualities of the IPD Design stage contribute to highly efficient work. When communication among all participants is

established from the start and information-sharing occurs during the design phase, permitting monetary decisions to be made at this early stage, it naturally follows that the degree of innovation and cost efficiency of design would be far improved over the other, more traditional procurement systems.

2.3.6 Construction Stage Benefits

The advantage of the IPD Construction stage is that it reduces waste and construction time. This is due to the early interaction and collaboration between contractors and the design team (The American Institute of Architects & AIA California Council, 2007). In addition, because of the collaboration among all participants' expertise, there is a reduction in installation conflicts and change orders (DeBernard, 2007). Furthermore, this IPD stage "reduces the likelihood of construction delay, because problems are solved by the team before the problems reach the field" (Post, 2010, p. 1).

Overall, during both the IPD Design as well as the IPD Construction stage, a "sink-or-swim" spirit is fostered, where all work diligently together to create an end-result in which all benefit through highly effective work and minimal "padding costs" (Post, 2010, p. 1)

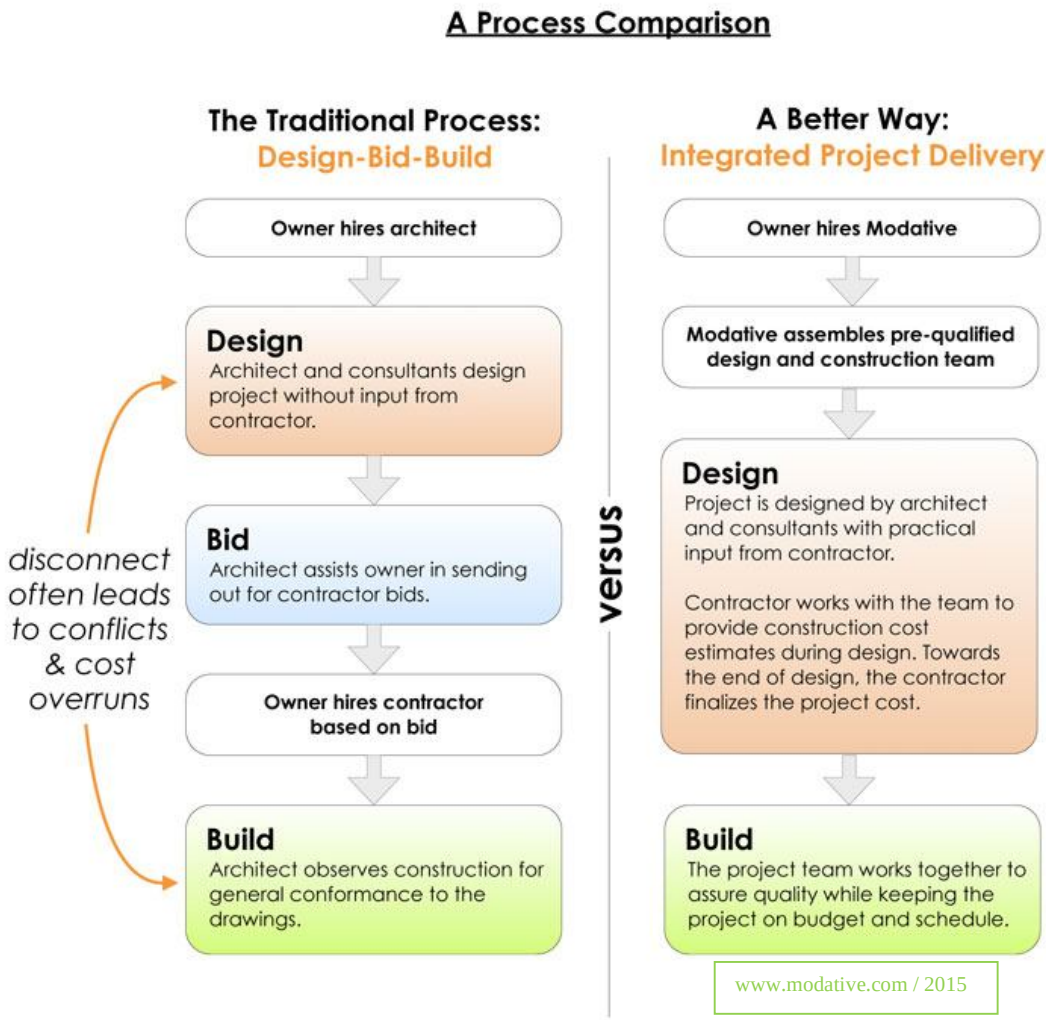

Figure 2.2. Comparison of Traditional System and Integrated Project Delivery

According to Figure 2.2, the main weakness of traditional method is distinction of parties. It may result conflicts and time, cost overruns. On the other hand, Integrated Project Delivery includes all parties in design stage, the problems that may occur in implementation phase are solved by the project team before the problems reach the field.

Chapter 3

METHODOLOGY

3.1 Introduction

Research is to see what everybody else has seen, and to think what nobody else has thought (Szent-Gyorgyi, A.). Project procurement can be described as a well organized process or method for clients to acquire construction products (Oladinrin et al 2012). The scope of this research is to find out the factors that affects IPD success. In order to identify these factors, a well structured questionnaire is prepared after completion of literature review part. The results were analyzed by Microsoft Excel and SPSS (Statistical Package for the Social Sciences) software. (Appendix B, p80)

3.2 Research Approach

The research approaches were divided five categories in social science; experiment, survey, archival, history and case study (Yin, 2003). According to type of research question, research approach is developed. Survey and archival analysis approaches can be used to examine the research question “what.” The experiment, history, or case study approach can be used to investigate the research question “how”. The questionnaire approach is based on respondent’s responses and it needs statistical analysis to evaluate results (Sun W. ,2013). In this study, the factors affecting IPD success has been divided six categories. Each category has been examined deeply, a table and a frame are composed.

3.3 Factors Affecting Integrated Project Delivery

Integrated Project Delivery is one of the project delivery method that collaborates all participants for every stage of the project. Team members are specialist in their division and their common point is project success. On the other hand, some factors might affect project or IPD success. In this section affecting factors will be defined and examined. The figure 3.1 depicts, the main factors that affect IPD success.

Figure 3.1. Factors Affecting IPD

3.3.1 Cultural and Social

3.3.1.1 Cultural Fit

An organization's success depends on their employees experiences, knowledge and observations during implementation phase (Klein and Sorra 1996). In collaborative study, peer review is crucial part to analyze participants performance on project. It depicts organization's and participants culture in integrative work. Incentive rewards are essential part of teamwork for adopting integrative works. It has been mentioned before, Integrated Project Delivery method focuses on collaboration between participants. According to this information an organization's team members can not adopt to work as a team, IPD method can not be used in that organization. (Korkmaz et.al 2012)

3.3.1.2 Major Project Participants on IPD and Previous Cooperation Experience

According to American Institute of Architects case studies book, previous project cooperation experience is essential in every project procurement system. Each team member has adequate knowledge about procurement methods and integrated project delivery to keep up with experienced ones. Participants or team members shall work together in the spirit of cooperation and mutual respect for the benefit of the project (AIA 2012 case studies).

3.3.1.3 Education and Training

The company size and budget are determinants of teams size in the organization. The efficient and effective implementation process requires skilled employees or specialists according to proposed work (Klein and Sorra 1996). Only well educated and trained employees can handle implementation complexities. The inexperienced team members can incease their knowledge with CPD (Continuing Professional

Development) programs. The CPD program priority is to educate beginners to handle difficulties in implementation stage. Researchers have found that climate for technical updating is related to engineers' performance (Kozlowski & Hults, 1987), and that climate for service is related to customers' perceptions of the quality of service received (Schneider & Bowen, 1985).

3.3.2 Managerial and Organizational

3.3.2.1 Confidence in Project Management

In construction sector, many project manager or construction manager are working to create teamwork in their departments or units. Managers can work for values of shared vision and concern for people and productivity, structure group procedures and incentives to foster cooperative interaction (Tjosvold, 1986). Researchers believe that organizational success is directly depends on strong collaboration between participants (Kanter 1983, Porter 1985).Many study focuses on orientation to people, shared vision , procedures to exchange, and cooperative interaction to increase project success (Tjosvold 1986).

3.3.2.2 Team Management

According to Managerial Leadership study (Yukl 1989), influencing team members or participants involves motivating, recognizing, educating and rewarding members. Researchers have found that, product development participants performance was directly linked to leader and team external boundary activities, especially "ambassadorial activities" involving actively persuading outsiders to support the team, protecting the team from outside pressure, and lobbying for resources (Ancona and Caldwell, 1992).

3.3.2.3 Decision Making System

Generally speaking, project manager has decision making responsibility. According to project type and selected procurement method decision making responsibility is changeable. In project procurement, project or construction manager is empowered to make decisions to solve problems on project or team (Yukl 1989). In some cases, self-managing teams are empowered to make own-work related decisions (Klein et al. 1984)

3.3.3 Financial

3.3.3.1 Market Advantage

Integrated Project Delivery is the newest procurement method in construction procurement systems. According to characteristic properties, IPD is more appropriate for industry to satisfy the clients demands. For industry leaders, client satisfaction is the most important criteria in construction industry. (AIA 2012 case studies)

3.3.3.2 Cost Predictability

Every type of project would like to meet specified budget, however, for some the predictability of cost is a notably driving factor. (AIA 2012 case studies)

3.3.3.3 Risk Management

Mitigating or managing risks are important criteria for cost and schedule overruns. Project complexity or lack of technical staff problems are critical factors that can increase cost of the project or it can delay project finish time. According to characteristics of IPD, shared risks and reward is important for risk management, to reduce unnecessary cost or schedule overruns (AIA 2012 case studies).

3.3.3.4 Target Value Design

Target value design (TVD) is an adaptation of the original target costing concept to the construction industry peculiarities. Target costing (TC) is the original cost and profit management concept developed in manufacturing. TC appeared in the manufacturing industry in the early 1930s (Feil et al., 2004) and has proved to be a powerful strategic instrument for management and profit planning (Cooper and Kaplan, 1999). Similarity in manufacturing product development and construction project delivery processes opens an opportunity for target costing in construction. (Ballard G. et al. 2012)

3.3.4 Technological

3.3.4.1 Technical Complexity

The degree of complexity is usually challenging factor for construction procurement systems. In traditional methods, design team and construction team are separated.

Collaboration and integration can occur in any project delivery method, but integrated project delivery method structure is more appropriate for complex projects. Because in integrated project delivery every step will be evaluated by the team, therefore unnecessary costs or delay will be prevented (AIA 2012 case studies).

3.3.4.2 Building information modeling – BIM

Today, Building Information Modeling (BIM) is essential in Architecture, Engineering and Construction (AEC) industry. It has benefits for building procurement systems. It is one of the driving factor for project success, it reduces design time and facilitates to save money. BIM usage plays an important role in construction sector in future (Yan H. , Damian P. 2008).

3.3.4.3 IT Infrastructure

IPD project mainly based on efficient communication skills and collaboration, also requires sufficient knowledge about IT infrastructure. In IPD projects efficient information exchange is crucial for project performance, IT infrastructure is the most suitable way for receiving, coding and information stroring to handle managerial needs for real and virtual environments. IT infrastructure is not essential for IPD projects in some conditions but experts believe that, it has benefits to all IPD projects. (Azhar et al. 2014)

3.3.4.4 Information Management Protocols

IPD projects generally relies on information sharing between team members or participants, the crucial criteria is the selection of management protocols between parties. These management protocols should include information about ownership, format or type of representation, documentation and tracking, responsibilities. These protocols helps hierarchical classification in organization (Azhar et al. 2014).

3.3.4.5 Interoperability

Information Technology systems are designed for company's needs. Interoperability problems begins due to inconsistency of data format and structures. Resolving these problems to ease uninterrupted information sharing and transfer is essential. Information transfer is crucial in collaborative works and Integrated Project Delivery (Azhar et al. 2014).

3.3.5 Legal

3.3.5.1 Different criteria for services procurement

In traditional method, design and construction teams are separated. Integrated project delivery includes all stages of design and construction. In some countries, there is a legal gap that obstruct usage of IPD. The main problem is combination of design and construction phases and also contractual problems occurs in underdeveloped countries. It is the important criteria that affects application of IPD in some countries (Azhar et al. 2014).

3.3.5.2 Risk Allocation Mechanism

Risk allocation means, every party in the project has equal responsibility of project success. If the team faced any cost overruns or delay in project time etc. they can not blame the parties or members in the team. Risk allocation mechanism derived from shared risk and rewards which is characteristics of Integrated Project Delivery. It a one of the important factor that separates IPD from other procurement methods (Azhar et al. 2014).

3.3.6 Implementation

3.3.6.1 Team Member Skill Level

Technological or innovative tools such as; BIM requires fundamental theoretical knowledge and practical computer usage. Team members or participants skill level to adopt innovations can affect project performance and productivity in positive or negative way. The innovative features of IPD depends on each team member performance in technology usage. Today, IT usage is crucial factor for project success, this is the main reason each team member must improve their knowledge with CPD programs (Klein et al. 1990).

3.3.6.2 Commitment to IPD projects

Researhers have found that, a variety of technological, organizational, financial, managerial and implementation issues are determinant factor of procurement systems success. (Fleischer et al. 1989) Each parameter can affect team collaboration. Collaboration is essential in IPD projects, team members or project participants must devote time to improve their knowledge to handle potential problems in early stages, that may occur in implementation stage.

Table 3.1. Factors Affecting IPD

1.Cultural and Social	
1.1 Cultural Fit	Korkmaz et.al 2012
1.2 Major project participants IPD experience and previous cooperation experience	AIA et al. 2012
1.3 Education and Training	Klein et al. 1996

2. Managerial and Organizational	
2.1 Confidence in project management	Tjosvold et al. 1986
2.2 Team Management	Druskat & Wheeler 2003, Morgeson et al. 2010
2.3 Decision Making System	(Klein, 1984; Manz & Sims, 1984; Wall et al., 1986).

3.Financial	
3.1 Market advantage	Cohen J. 2010
3.2 Cost predictability	AIA et al. 2012
3.3 Risk Management	AIA et al. 2012
3.4 Target Value Design	Ballard G. et al 2012

4. Technological	
4.1 Technical complexity	Eastman C. et al 2008
4.2 Building information modeling – BIM	Yan H. , Damian P. 2008
4.3 IT infrastructure	Eckblad S. et al 2007
4.4 Information management protocols	Azhar N. et al 2014
4.5 Interoperability	Moses S., et al 2008

5.Legal	
5.1 Different criteria for services procurement	Azhar N. et al 2014
5.2 Risk allocation mechanism	Azhar N. et al 2014

6. Implementation	
6.1 Team Member Skill Level	Klein and Sorra 1996
6.2 Commitment to IPD projects	Korkmaz et.al 2012

(Source: Sun W.,2013)

3.4 Data Collection

In this research, since a questionnaire is conducted to measure the IPD, a quantitative data is obtained. There are two steps in any data analysis in general which are namely; descriptive statistics and inferential statistics. In descriptive statistics, the general information about the data is obtained. For instance, pie charts are drawn to get the information about the responses for each question. This will provide an overall image about how the data gathered looks like. Even the descriptive statistics is very simple step which shows the overall image of the whole data, it is an important step to know what the data looks like, so that a suitable statistical method can be chosen to apply on the available data to perform the statistical analysis and testing using inferential statistics. Descriptive statistics also shows if the data needs any data cleaning before moving on to inferential statistics such as missing responses.

Here, in this research, firstly, the responses given by each person is entered so that each row is representing a single person and each column is representing the response given for each question. This questionnaire is conducted for totally 104 people and if there is any missing data for a single responder for any question, all of the responses provided by that person is not taken into account in the further analysis. Therefore total number of responders is reduced to 88 people after data cleaning process.

In this questionnaire, there are 43 questions in total and response for every question is scaled as 1: being strongly disagree 2: being disagree 3: being neutral 4: being agree 5: being strongly agree. After the results obtained from descriptive statistics

(shown in chapter 4), it can be concluded that every question is in the same scale, so that there is no negative questions where the recoding of the scale is required.

In this research, the quantitative data which is obtained from the questionnaire is used to conduct reliability analysis and factor analysis for further statistical analysis. In this chapter, information about each of these analysis are given where the actual results obtained from this data is given in chapter 4.

3.5 Reliability Analysis

When the outcome measure cannot be measured directly or difficult to observe directly such as IPD, several questionnaire items are conducted to a group of subjects where the relationship between those items are investigated. Thus, if the relationship between those items in reliability analysis is high, this means that the scale yields consistent results and therefore the sample obtained from the questionnaire will be a reliable sample to be used for further analysis. (Büyüköztürk,Ş., 2010)

There are four different approaches in Reliability analysis;

3.5.1 Test-Retest approach

In this type of approach, respondents are directed same sets of scale items but at two different times where the circumstances of two different times are exactly the same. Then, correlation coefficient is evaluated to measure the degree of association between the two measurements. Higher correlation coefficient means greater reliability in this approach. This approach have some limitations which can be the time interval between two testing.

3.5.2 Internal Consistency Reliability Approach

In this approach, items are summed to form a total score and reliability of each item is measured based on the total sum. Therefore this approach mainly concentrates on the internal reliability based on the total score.

3.5.3 Split Half Reliability Approach

As like internal consistency reliability approach, this approach also focuses on internal reliability. However, this approach is not based on total sum score, instead, in this approach scale items are divided into halves and correlation is measured between the resulting half scores. Higher the correlation coefficient, higher the internal reliability. Division of scale items into halves is based on the odd and even number items. Limitation of this approach is how the scale items are halved because the result obtained for correlation coefficient can change depending on how the scale items are halved. Thus, in order to overcome this limitation, Cronbach's alpha is used in this type of reliability analysis. In this research, reliability analysis is performed in SPSS where the split half reliability approach is used and Cronbach's alpha is evaluated.

3.5.4 Inter Rater Reliability Approach

In this type of approach, reliability of the controllers are evaluated. This is when the tool is tested on same group of people where the responders are controlled and managed by different people.

In all types of reliability approaches, same set of assumptions are made which includes;

- Uncorrelated errors
- Same coding for the scales of each item

- In split half test, items are halved randomly
- Responses obtained are independent from each other
- In split half test, equal variances are assumed for each halved sample.

3.5.5 Cronbach's alpha

Cronbach's alpha is evaluated when several responders are available for the items. In this way, variance is calculated for each item and also for the sum of scale. In theory, the variance for the sum of scale will be less than the sum of each item's variance only when the items measure the identical variability between responders.

The variance for the sum of scale is equal to the sum of variances of each of the two items minus the covariance where the covariance is the true score variance that is mutual for the two items (Büyüköztürk,Ş., 2010).

Alpha is calculated by;

$$\alpha = \left(\frac{k}{k-1}\right) \times \left[1 - \frac{\sum s_i^2}{s_{sum}^2}\right]$$

Where;

s_i^2 is the variance for k items, this is the variance of each item separately

s_{sum}^2 is the variance for the sum of all items

The result obtained from the coefficient of Cronbach's alpha is between 0 to 1. If there is no true score and items are not correlated across responders, then the coefficient will be 0. If the items all measure the same true score and perfectly reliable, then the coefficient will be 1.

In order to say that the sample is reliable, the coefficient of Cronbach's alpha should be 0.7 or higher.

3.5.6 Split-Half Reliability

Another way of calculating the reliability of sum scale is to evaluate Spearman-Brown split half coefficient by;

$$r_{sh} = \frac{2r_{xy}}{1 + r_{xy}}$$

Where;

r_{sh} is the split-half reliability coefficient

r_{xy} is the association between the two halves.

This is when the sum scale is divided into two halves randomly and the correlation coefficient is calculated for each halve separately. When the two halves are reliable, the two halves are expected to be correlated.

3.5.7 Kaiser-Meyer-Olkin Measure of Sampling Adequacy

The result obtained from this measure is between 0 and 1, and values closer to 1 are considered to be better. Suggested minimum value for this measure is 0.6.

3.5.8 Bartlett's Test of Sphericity

This is an hypothesis test where the null hypothesis suggests that the correlation matrix is an identity matrix in which all the diagonal elements are equal to 1 and off diagonal elements equal to zero. The ideal sample should reject this null hypothesis because otherwise this will suggest that there is no correlation between each item and underlying latent factor.

In order for a sample to be valid, both of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity should be considered. In the case when both criteria met, the sample will be valid. In this research, after the sample is validated by reliability analysis, significantly important factors are then determined by checking the values where the factors having values are greater than

0.35 are taken to be significantly important factor. When the researcher determined which factors are important to be taken for further analysis, further analysis such as to conduct factor analysis will be conducted by using those factors.

3.6 Factor Analysis

If the responses observed from each responder is similar, then the question is whether is there any latent variable which cannot be measured directly such as IPD that cause this similarity between the responses. In order to investigate this type of question, factor analysis is performed on this data.

Here, each significant question is taken as an item which is interpreted as a factor. Each factor measures some percentage of the overall variance. Eigenvalue is a measure which shows whether the observed variable explains significant amount of variance or not. Initially, the number of factors will be equal to the number of items (variables). Then, factors are eliminated based on the eigenvalues. If the eigenvalue of the factor is equal to or greater than 1, it means that the factor describes greater amount of variance than a single observed variable, so the factor is retained in the analysis, otherwise factor is reduced from the analysis. (Çokluk,Ö. et al 2010)

Scree plot is a graph drawn that shows the eigenvalues of each factor against factor numbers. Useful factors with eigenvalues ≥ 1 can also be seen visually by using this graph.

Factor loadings can be seen from the factor matrixes produced in this analysis. Factor loadings can be interpreted like standardized regression coefficients. This shows how much relationship exists between each item (factor) and underlying latent variable.

The higher the factor loading, the stronger the association is between the factor and the latent variable, explaining greater percentage of the total variation.

Assumptions of Factor Analysis includes;

1- Error is assumed to have constant variance
2- It is assumed that there is no relationship between errors and no relationship between measurement error and the factor
3- For each factor, observations from different responders are assumed to be independent from each other.

Factor Analysis can be used on different purposes such as to investigate;

1- Interdependency and patterns
2- Data Reduction
3- Basic structure
4- Classification or description
5- Scaling
6- Hypothesis testing
7- Data transformation
8- Data Exploration
9- Data Mapping

While performing factor analysis, rotated factor matrix will also be produced based on the type of the rotation chosen. Rotation can be chosen as orthogonal rotation or oblique Rotation. Using different types of rotation does not change the fit of the factor analysis model produced, so the “uniquenesses” remains the same whether the researcher uses orthogonal rotation or oblique rotation.

Choosing which type of rotation depends on the assumption made on factors. The main difference between the two types of rotation is orthogonal rotation assumes that the factors are independent whereas in oblique rotation, factors are assumed to be not independent.

Orthogonal rotation includes varimax and quartimax options. Varimax maximize the squared factor loadings variance across variables whereas quartimax maximize the squared factor loadings variance across factors.

Oblique rotation includes oblimin and promax options. Oblimin minimize the squared factor loadings variance between factors whereas promax simplify orthogonal rotation by creating small loadings which will be closer to zero. Oblimin type oblique rotation is chosen for this research.

Chapter 4

QUESTIONNAIRE ANALYSIS AND RESULTS

4.1 Introduction

In this section questionnaire analysis and results are examined. The questionnaire is prepared to find out which factors affect Integrated Project Delivery success. The questionnaire was sent to 300 companies in AEC industry and academicians. The google form was used to distribute questionnaire to respondents. According to google form results, 104 responses was received. The questionnaire results are in Microsoft Excel and it has been transferred to SPSS software. According to SPSS analysis, the Cronbach's Alpha value is 0.872, it depicts that the analysis is reliable.

4.2 Analysis of Responses

The questionnaire was divided in two sections. The first section includes general questions about respondents and the second section is prepared to identify respondent's response about IPD and affecting factors. The pie charts are used to illustrate the percentage of respondent's responses. SPSS software is used to evaluate likert scale questions.

Section 1: General Questions

Table 4.1. Educational qualification level of respondents.

Educational Qualification Level	Number of people
Bsc	59
Msc	37
Phd	8

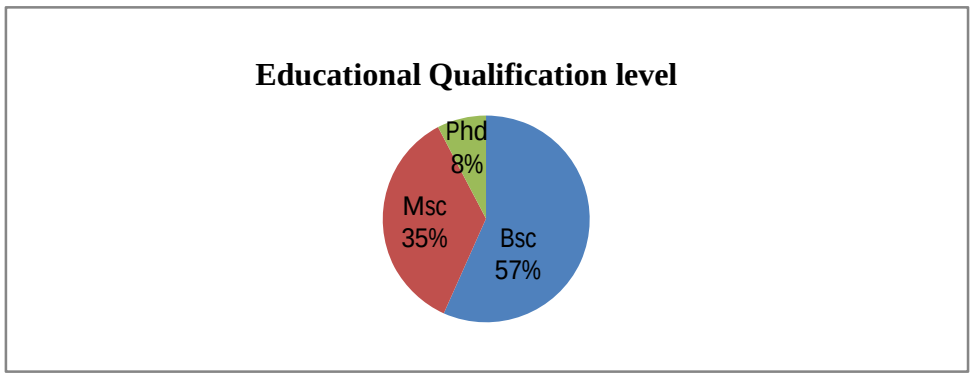

Figure 4.1. Respondent's Qualification Level

As can be seen from the figure 4.1, the highest percentage of responders has a Bachelor degree (57%) whereas the lowest percentage of responders has a PhD degree qualification (8%).

Table 4.2. Respondent's Profession

Respondent's Profession	Number of People
Civil Engineer	60
Architect	32
Interior Architect	6
Mechanical Engineer	2
Electrical Engineer	1
Industrial Engineer	1
Material Science Engineer	1
Business Administration	1

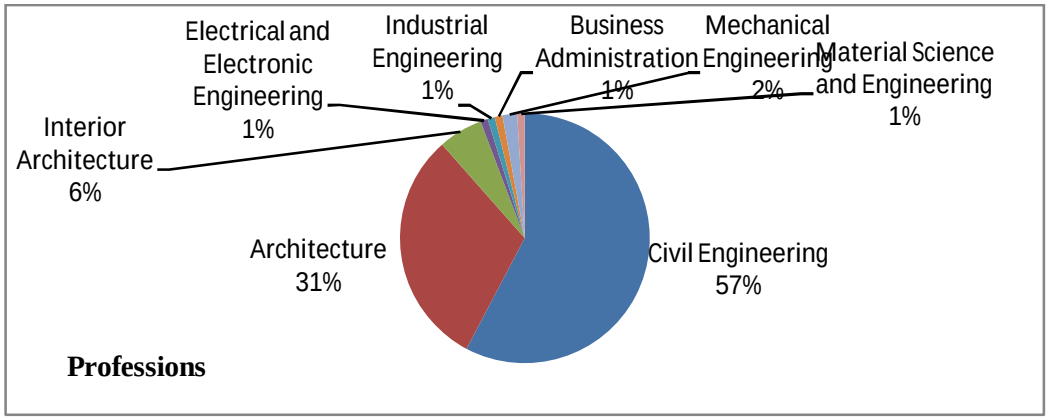

Figure 4.2. Respondent's profession

According to Figure 4.2 more than half of the respondents are civil engineers (57%) and just under a third portion of respondents are architect (31%) which are corresponding to the top two categories as a profession for responders. The rest, which consists a small proportion of this chart shows other professions in questionnaire.

Table 4.3. Respondent's position in their organization

Respondent's Position	Number of People
Engineer	29
Architect	22
Director	19
Construction Manager	18
Project Manager	10
Consultant	4
Other	0

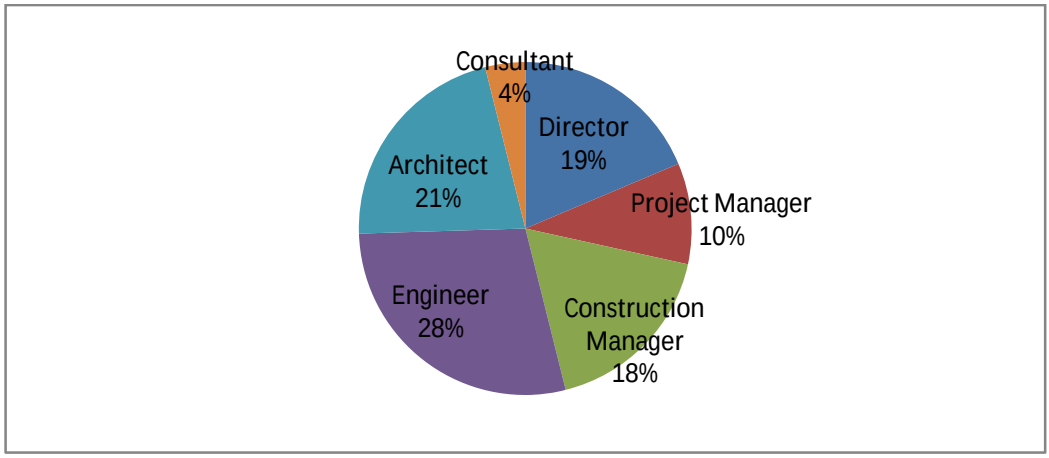

Figure 4.3. Respondent's position in their organization

The figure 4.3 depicts that, respondents' positions in their organization, the 28 per cent of the respondents which is the highest percentage in the chart, are engineers in their organization. The 4 per cent of the respondents which is the lowest number in the figure are consultants.

Table 4.4. Number of Employees in Organization

Number Of Employees In Organization	Respondent's Response
0-10	20
10-20	41
20-50	20
50-100	12
100+	9

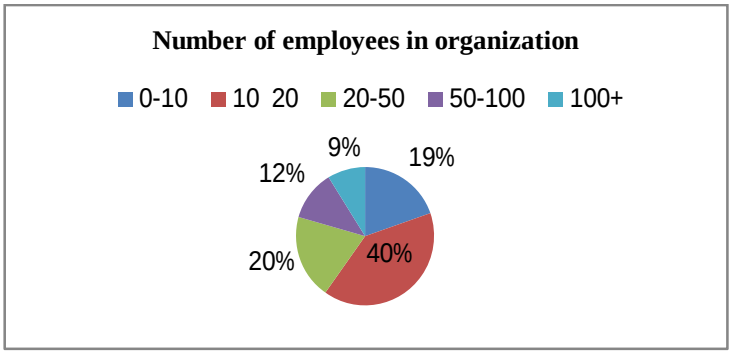

Figure 4.4. Number of employees in organization

The presented figure 4.4, describes the number of employees in organization. 40% of an this sample is coming from the organization where the total number of employees is between 10-20 people. This is the highest proportion for this questionnaire. If we call this group of organizations to be medium size organization, following this group, there are two second highest groups which are consisting 20-50 employees and 0-10 employees respectively meaning that large organizations (20-50) and small organizations (0-10) are the second highest groups in this research. This research does not consist large amount of bigger organizations with number of employees greater than 100 (9%).

Table 4.5. Company's area of specialization

Company's Area Of Specialization	Respondent's Response
Construction	74
Other	14
Infrastructure	7
Transportation	5
Management	1

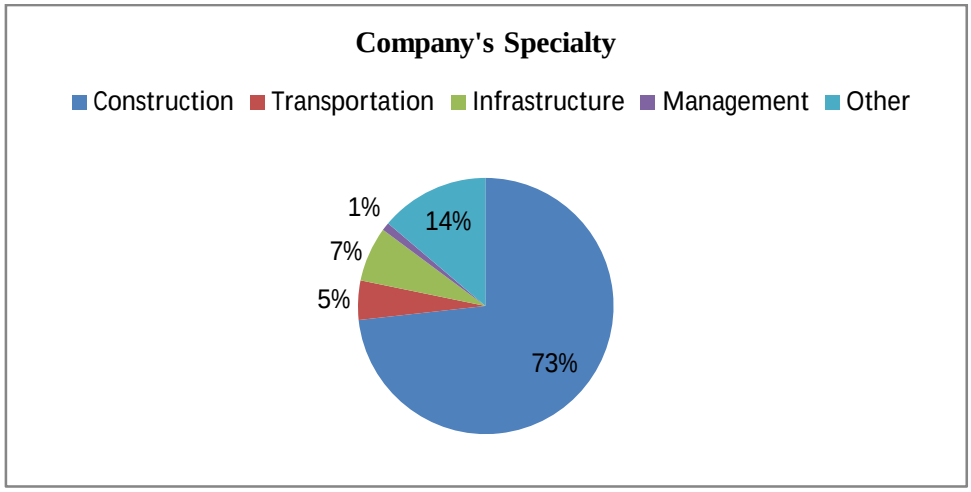

Figure 4.5. Company's area of specialization

The given figure 4.5 represents the proportion of company's specialty. It has divided five categories in questionnaire. The vast majority of the responses show the company's specialty is construction. The 14 per cent of responses indicates their company's specialty is not mention the questionnaire.

Table 4.6. Respondent's years of work experience

Years Of Work Experience	Respondent's Response
0-10	38
10-15	33
15-20	16
20+	16

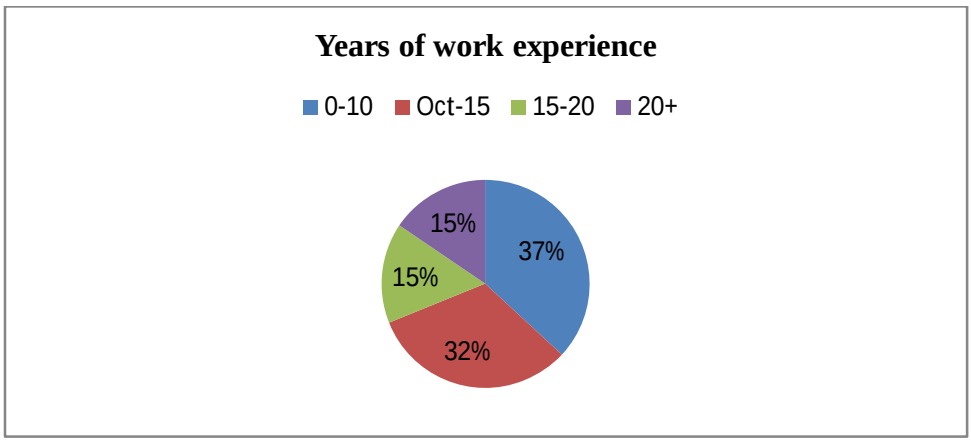

Figure 4.6. Respondent's years of work experience

The figure 4.6 depicts that, in this research, the highest proportion of responses shows that respondent's years of work experience is mainly 0-10 years (37%). However, group of respondents having 10-15 years of experience is nearly as high as respondents having 0-10 years of experience (32%). On the other hand, the rest of the groups which are 15-20 years of experience and group which was having more than 20 years of experience resulted to have equal percentages (15%).

Table 4.7. Respondent's Procurement System Experience

Respondent's procurement system experience	Respondent's Response
YES	35
NO	68

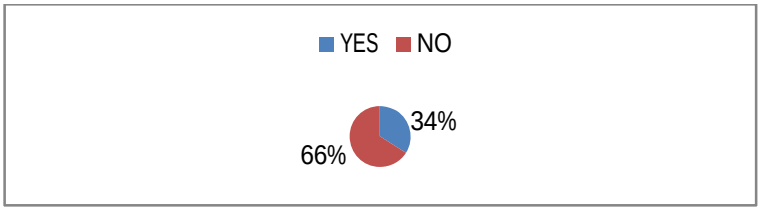

Figure 4.7. Respondent's procurement system experience

According to figure 4.7, 66 per cent of respondents don't have any experience about construction procurement systems.

Table 4.8. Respondent's IPD Experience

Respondent's IPD experience	Respondent's Response
YES	49
NO	54

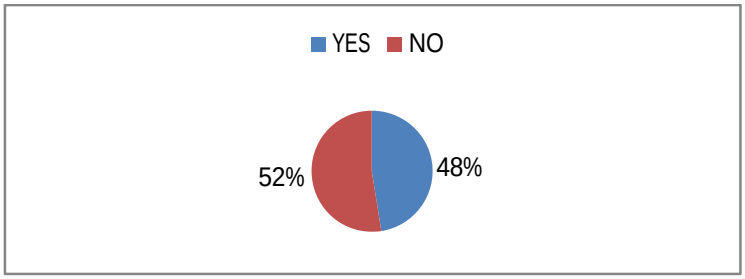

Figure 4.8. Respondent's IPD experience

Additionally, 52 per cent of respondents haven't heard Integrated Project Delivery method.

Table 4.9. Project Type

Project Type	Respondent's Response
Other	46
Residential Projects	25
Industrial Projects	11
Commercial Projects	9
Transport Infrastructure Projects	6

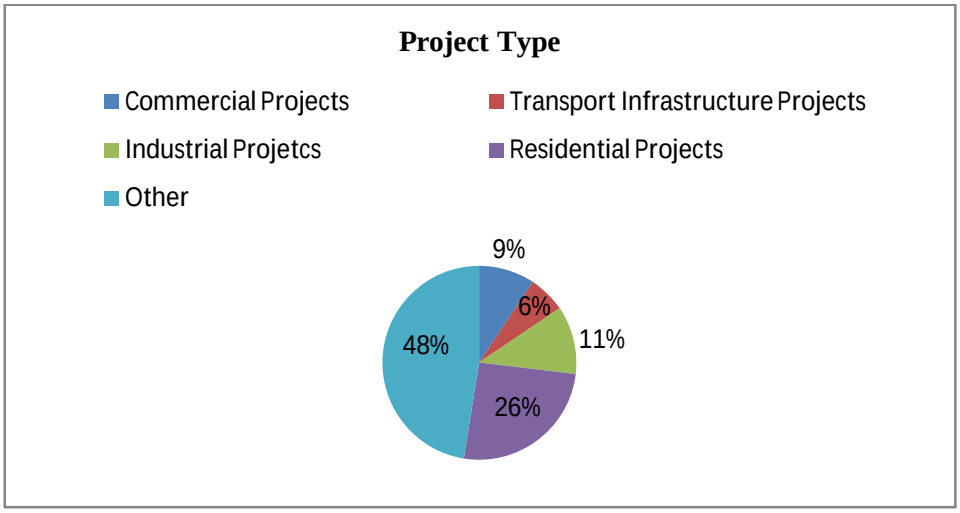

Figure 4.9. Project Type

The Figure 4.9 shows that, respondent's gain their IPD experience in different project types. 48 per cent of respondent which is the highest number in pie chart did not mention that what kind of project they involved. 26 per cent of respondent's gain

their IPD experience in residential projects, 9 per cent of respondent work in commercial projects,

Table 4.10. Procurement Methods

Procurement Methods	Respondent's Response
YES	100
NO	4

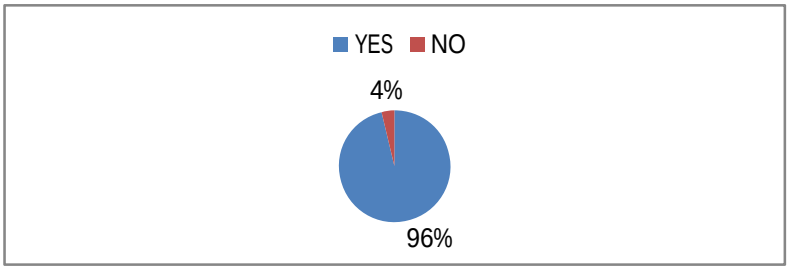

Figure 4.10. Procurement Methods

According to Figure 4.10, the vast majority of respondent's agree that procurement methods are important parameter for project success.

Section 2 : Questionnaire

A- Binary Coded Questions

The binary coded questions are q3, q4, q5, q6, q9, q24, q28 and q30 from part 2. The questions are examined in written order. The rest of the section 2 questions are examined in SPSS software.

Table 4.11. Continuing Professional Development for IPD

Continuing Professional Development(CPD)	Respondent's Response
YES	14
NO	90

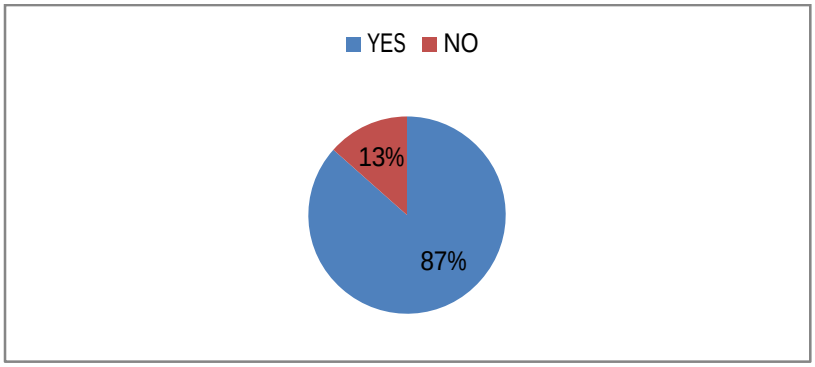

Figure 4.11. Continuing Professional Development for IPD

Figure 4.11 shows that, 87 per cent of respondents haven't attended Continuing Professional Development program for IPD while the other 13 per cent have attended Continuing Professional Development program for IPD before.

Table 4.12. Cooperation Experience

Cooperation Experience	Respondent's Response
YES	92
NO	12

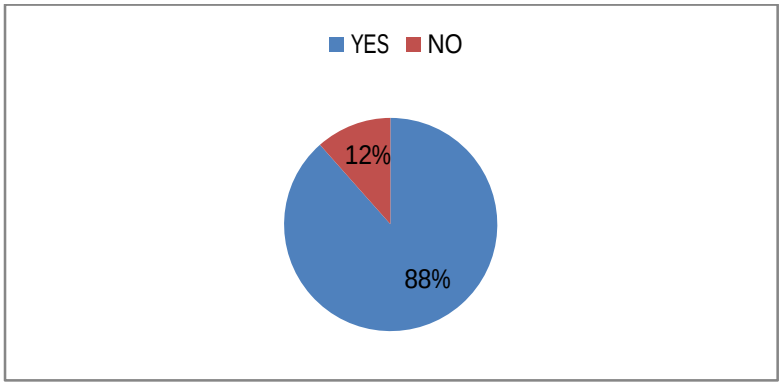

Figure 4.12. Cooperation Experience

According to figure 4.12, 88 per cent of respondents have cooperation experience in company or organization.

Table 4.13. Motivation to join IPD projects

Motivation to join IPD projects	Respondent's Response
YES	17
NO	86

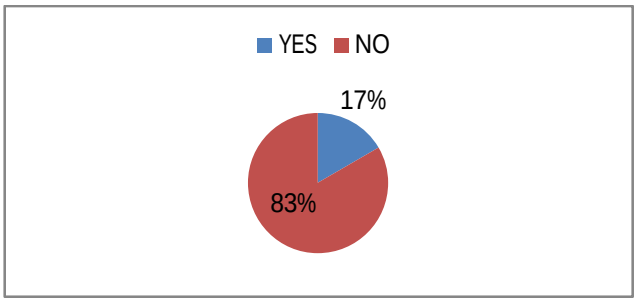

Figure 4.13. Motivation to join IPD projects

As can be seen from figure 4.13, 83 per cent of the respondents mentioned that, in their organizations, there is no motivation to join IPD projects.

Table 4.14. Persuasion of team members

Persuasion of team members	Respondent's Response
YES	94
NO	10

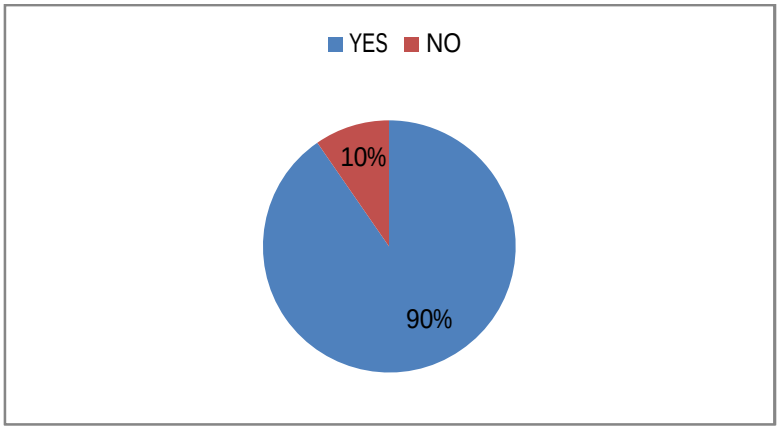

Figure 4.14. Persuasion of team members

Figure 4.14 depicts that, 90 per cent of respondents believe that, they persuade team members or participants to follow their beliefs or opinions.

Table 4.15. Technological tools improves management efficiency

Technological tools improves management efficiency	Respondent's Response
YES	102
NO	2

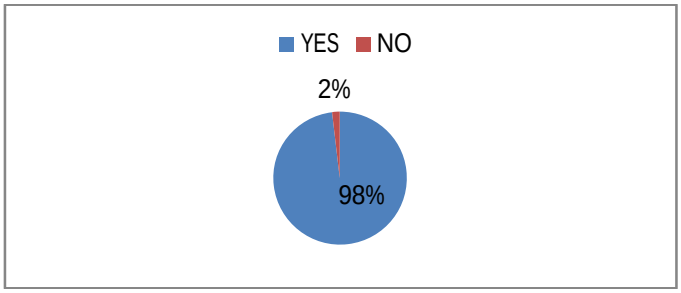

Figure 4.15. Technological tools improves management efficiency

Figure 4.15 shows that, 98 per cent of respondents agree that technological tools improves management efficiency.

Table 4.16. Usage of Building Information Modeling (BIM)

Usage of Building Information Modeling	Respondent's Response
YES	88
NO	15

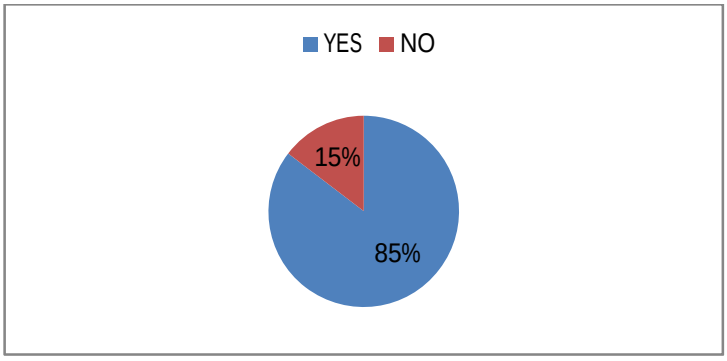

Figure 4.16. Usage of Building Information Modeling (BIM)

According to Figure 4.16, 85 per cent of respondents use Building Information Modeling tool in their projects.

Table 4.17. Cloud Platform for information sharing on IPD projects

Cloud platform for information sharing on IPD projects	Respondent's Response
YES	100
NO	2

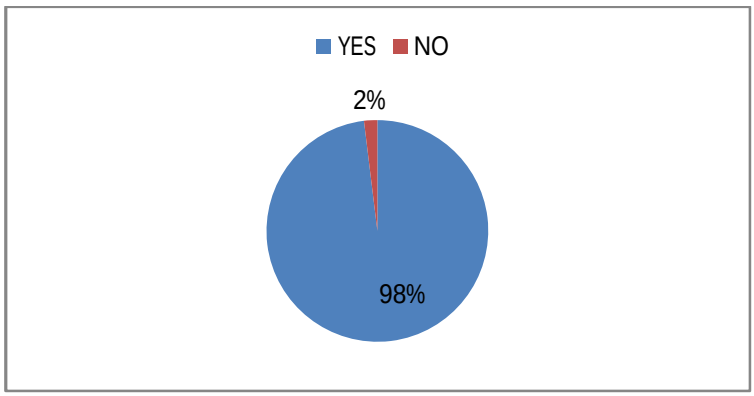

Figure 4.17. Cloud Platform for information sharing on IPD projects

Figure 4.17 depicts that, 98 per cent of respondents agree that cloud platform improves information sharing process in IPD projects.

Table 4.18. Country Laws and Regulations

Country Laws and Regulations	Respondent's Response
YES	23
NO	80

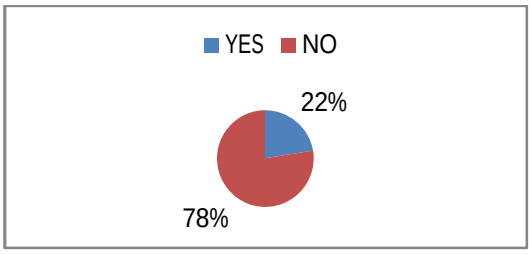

Figure 4.18. Country Laws and Regulations

According to figure 4.18, 78 per cent of respondents mention that, there is no obstacle to implement IPD method in their country.

B - Likert Scale Questions

The likert scale coded questions are further investigated statistically. In total, 25 questions are in likert scale. Each question is represented as an item, so initially 25 items are taken into consideration.

Firstly, sample has to be validated before moving on for further analysis. In order to test the adequacy of the sample, reliability analysis is performed on the data obtained from the questionnaire. In this research, the split half reliability approach (Ch3 p39) is performed in SPSS where cronbach's alpha is calculated.

Table 4.19. Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
0,869	25

Table 4.20. Item-Total Statistics

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
q1_part2	83,73	104,556	0,564	0,860
q2_part2	84,24	107,095	0,446	0,865
q7_part2*	83,68	116,728	0,139	0,875
q8_part2	82,63	112,364	0,534	0,862
q10_part2	82,74	114,399	0,380	0,866
q11_part2	82,57	113,513	0,503	0,863
q12_part2	82,65	115,192	0,438	0,865

q13_part2	83,07	113,893	0,376	0,866
q14_part2	83,75	110,392	0,425	0,865
q15_part2	83,94	110,692	0,387	0,866
q16_part2	83,11	108,177	0,579	0,859
q17_part2	83,04	112,568	0,437	0,864
q18_part2	83,11	112,101	0,458	0,863
q19_part2	84,31	108,496	0,476	0,863
q20_part2	83,46	110,277	0,613	0,859
q21_part2	83,34	111,011	0,617	0,860
q22_part2	83,57	116,247	0,453	0,865
q23_part2	82,90	110,977	0,661	0,859
q25_part2	82,50	112,025	0,496	0,862
q26_part2	82,25	112,823	0,528	0,862
q27_part2	82,84	113,657	0,459	0,864
q29_part2*	83,52	117,442	0,265	0,868
q31_part2*	83,43	117,589	0,210	0,870
q32_part2	82,77	112,784	0,404	0,865
q33_part2*	82,75	118,873	0,163	0,870

The reliability test has been done with SPSS software; results of the 25 items are shown in the previous table. From this table, corrected item correlation column for each item has to be checked. Values from this column can be interpreted as standardized regression coefficients that are measuring the correlation between each item and the latent variable. For a factor to be a significantly important factor, the regression coefficient is suggested to be a minimum of 0.35. Therefore q7, q29, q31, and q33 are reduced from the factor list. Then, reliability analysis is repeated with number of items being equal to 21.

Table 4.21. Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
0,873	21

Table 4.22. Item-Total Statistics

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
q1_part2	70,62	89,133	0,607	0,863
q2_part2	71,08	91,111	0,496	0,868
q8_part2	69,50	98,371	0,491	0,867
q10_part2	69,66	98,720	0,389	0,870
q11_part2	69,43	98,389	0,536	0,867
q12_part2	69,52	99,970	0,450	0,869
q13_part2*	69,97	100,105	0,308	0,873
q14_part2	70,65	95,642	0,417	0,870
q15_part2	70,83	95,769	0,404	0,871
q16_part2	69,99	93,235	0,592	0,863
q17_part2	69,90	98,307	0,421	0,869
q18_part2	69,98	97,576	0,452	0,868
q19_part2	71,10	92,989	0,500	0,867
q20_part2	70,30	95,908	0,607	0,864
q21_part2	70,20	96,796	0,600	0,864
q22_part2	70,42	101,799	0,373	0,871
q23_part2	69,76	97,222	0,587	0,865
q25_part2	69,36	97,527	0,495	0,867
q26_part2	69,12	98,410	0,500	0,867
q27_part2	69,71	99,338	0,406	0,870
q32_part2	69,62	98,545	0,382	0,870

Results of the second reliability analysis is given in table 4.21, from this table, Corrected Item Total Correlation column is checked again with the same criteria taken and q13 is further deleted since the value is less than 0.35. Analysis will be repeated for the third time with number of items being equal to 20.

Table 4.23. Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
0,872	20

Table 4.24. Item-Total Statistics

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
q1_part2	66,88	83,191	0,610	0,861
q2_part2	67,32	84,679	0,521	0,866
q8_part2	65,74	92,149	0,499	0,866
q10_part2	65,89	93,182	0,357	0,870
q11_part2	65,66	92,503	0,525	0,866
q12_part2	65,77	93,879	0,423	0,868
q14_part2	66,89	89,918	0,406	0,870
q15_part2	67,09	89,486	0,409	0,870
q16_part2	66,20	87,429	0,590	0,862
q17_part2	66,14	92,395	0,411	0,868
q18_part2	66,20	91,820	0,435	0,868
q19_part2	67,33	86,959	0,509	0,866
q20_part2	66,53	89,838	0,605	0,862
q21_part2	66,43	90,708	0,595	0,863
q22_part2	66,66	95,653	0,361	0,870
q23_part2	66,00	90,943	0,602	0,863
q25_part2	65,59	91,348	0,508	0,865
q26_part2	65,36	92,165	0,503	0,866
q27_part2	65,95	92,848	0,429	0,868
q32_part2	65,83	92,695	0,367	0,870

Results shown in table 4.23, since all values are above 0.35 in Corrected Item Total Correlation column, no more reliability analysis is performed. For the final analysis, The Cronbach's Alpha value is 0.872 which is above 0.7, meaning that the test result

is reliable. According to these results, affecting factors are identified as can be seen below table;

Table 4.25. Affecting Factors

	Mean	Std. Deviation
q1_part2	2,89	1,334
q2_ part2	2,44	1,380
q8_ part2	4,02	0,742
q10_ part2	3,88	0,855
q11_part2	4,10	0,679
q12_ part2	3,99	0,669
q14_ part2	2,88	1,123
q15_ part2	2,67	1,162
q16_ part2	3,56	1,027
q17_ part2	3,63	0,848
q18_ part2	3,56	0,869
q19_ part2	2,43	1,201
q20_ part2	3,23	0,813
q21_ part2	3,33	0,754
q22_ part2	3,10	0,548
q23_ part2	3,76	0,727
q25_ part2	4,17	0,805
q26_ part2	4,40	0,736
q27_ part2	3,81	0,771
q32_ part2	3,93	0,894

Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity are important tests for statistical analysis. According to test results, KMO measure of sampling adequacy value is 0.797, it is greater than 0.6, it means the samples are adequate. According to Bartlett's test results, the value is lower than 0.05, it means factor analysis can be done.

Table 4.26. KMO and Bartlett’s Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0,797
Bartlett's Test of Sphericity	Approx. Chi-Square	733,230
	df	190
	Sig.	0

It is concluded that the sample is adequate. Thus, further analysis is performed on the sample such as factor analysis. Factor analysis is done for affecting factors to find out how much it affects the test. Firstly Correlation matrix is calculated providing the relationship between each item.

Correlation Matrix

	Q1p2	Q2p2	Q8p2	Q10p2	Q11p2	Q12p2	Q14p2	Q15p2	Q16p2	Q17p2	Q18p2	Q19p2	Q20p2	Q21p2	Q22p2	Q23p2	Q25p2	Q26p2	Q27p2	Q32p2
Q1p2	1																			
Q2p2	0.565	1																		
Q8p2	0.270	0.270	1																	
Q10p2	0.229	0.125	0.348	1																
Q11p2	0.191	0.246	0.383	0.616	1															
Q12p2	0.230	0.130	0.347	0.439	0.635	1														
Q14p2	0.251	0.081	0.362	0.235	0.198	0.212	1													
Q15p2	0.361	0.178	0.182	0.201	0.262	0.143	0.373	1												
Q16p2	0.508	0.392	0.345	0.159	0.297	0.277	0.310	0.435	1											
Q17p2	0.226	0.114	0.269	0.204	0.287	0.154	0.192	0.293	0.388	1										
Q18p2	0.402	0.309	0.194	0.157	0.234	0.288	0.084	0.116	0.241	0.286	1									
Q19p2	0.547	0.466	0.131	0.064	0.227	0.149	0.245	0.400	0.483	0.138	0.218	1								
Q20p2	0.448	0.504	0.353	0.141	0.228	0.110	0.195	0.190	0.329	0.175	0.274	0.499	1							
Q21p2	0.346	0.377	0.315	0.154	0.293	0.099	0.226	0.283	0.280	0.357	0.225	0.412	0.739	1						
Q22p2	0.048	-0.03	0.249	0.224	0.250	0.066	0.245	0.162	0.082	0.430	0.265	0.107	0.438	0.558	1					
Q23p2	0.398	0.393	0.330	0.081	0.353	0.372	0.231	0.273	0.334	0.226	0.340	0.396	0.462	0.460	0.178	1				
Q25p2	0.243	0.293	0.320	0.165	0.262	0.217	0.215	0.085	0.287	0.280	0.241	0.137	0.397	0.361	0.273	0.384	1			
Q26p2	0.269	0.334	0.278	0.226	0.355	0.359	0.172	0.021	0.190	0.315	0.261	0.077	0.366	0.341	0.326	0.416	0.718	1		
Q27p2	0.180	0.254	0.128	0.033	0.126	0.174	0.251	0.146	0.268	0.239	0.334	0.116	0.273	0.388	0.320	0.347	0.442	0.360	1	
Q32p2	0.234	0.239	0.314	0.244	0.334	0.287	0.278	0.011	0.230	-0.004	0.182	0.124	0.148	0.119	0.038	0.311	0.319	0.269	0.331	1

In correlation matrix, the relevancy between questions will be tested. According to this correlation matrix Items are classified within three group;

1- Strong Correlation (Above 0.60)

According to correlation matrix, there is strong correlation between q20 and q21, q25 and q26, q10 and q11, q11 and q12.

2- Weak Correlation (Between 0.4 and 0.6)

According to correlation matrix, there is weak correlation between q1 and q2, q16 and q1, q18 and q1, q19 and q1, q20 and q1, q19 and q2, q20 and q2, q15 and q16, q15 and q19, q16 and q19, q17 and q22, q19 and q20, q19 and q21, q20 and q22, q20 and q23, q21 and q22, q21 and q23, q23 and q26, q25 and q27.

3- No Correlation (values near 0)

According to correlation matrix, it has been assumed that the values which are below 0.4, there is no correlation.

Results obtained from Factor Analysis

Initially the number of factors are equal to the number of items, so 20 factors are created in the beginning.

Table 4.27. Total variance explained

Total Variance Explained						
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,251	31,254	31,254	3,085	15,427	15,427
2	1,948	9,738	40,992	3,986	19,930	35,357
3	1,758	8,790	49,782	1,388	6,940	42,297
4	1,507	7,533	57,316	1,125	5,624	47,921
5	1,139	5,695	63,010	0,977	4,883	52,804
6	1,051	5,256	68,267	0,659	3,296	56,100
7	0,872	4,359	72,626			
8	0,797	3,984	76,609			
9	0,703	3,513	80,122			
10	0,639	3,194	83,317			
11	0,533	2,666	85,983			
12	0,502	2,512	88,495			
13	0,441	2,206	90,701			
14	0,394	1,968	92,669			
15	0,327	1,635	94,304			
16	0,301	1,504	95,808			
17	0,276	1,382	97,190			
18	0,212	1,061	98,252			
19	0,180	0,900	99,152			
20	0,170	0,848	100,000			

Factors will be reduced based on the eigenvalues. If the eigenvalue is equal or greater than 1, as a result, 6 factors met this criteria which are retained in the analysis.

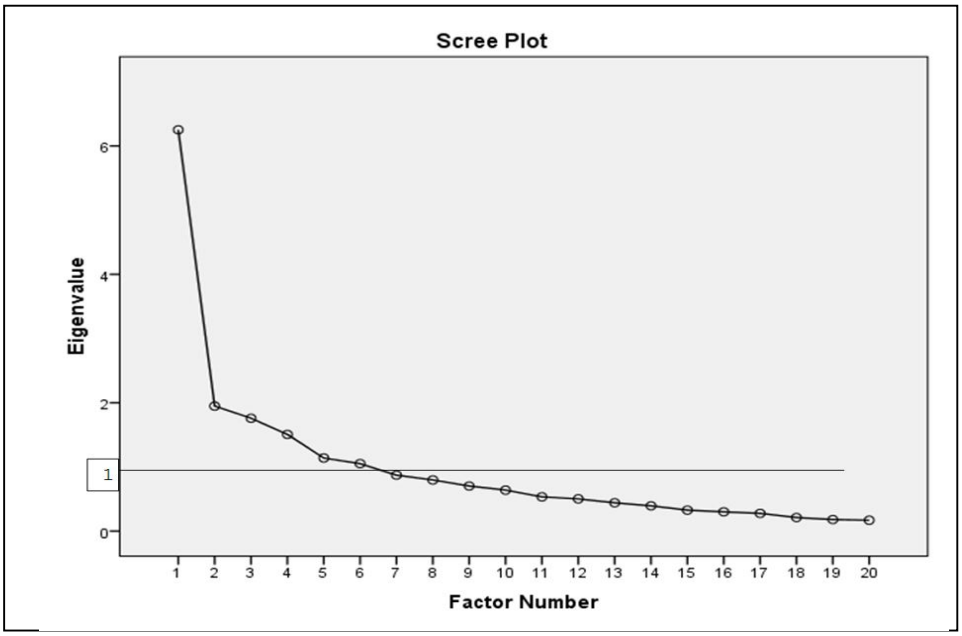

Figure 4.19. Scree Plot

As can be seen from the screeplot, 6 factors are concluded to have eigenvalues greater than 1 meaning that 6 factors are produced in the final model.

Table 4.28. Factor Matrix

Factor Matrix[a]						
	Factor					
	1	2	3	4	5	6
q1_part2	0,194	0,562	0,387	0,274	0,169	-0,079
q2_ part2	0,249	0,523	0,327	0,309	-0,140	-0,198
q8_ part2	0,386	0,336	-0,024	0,060	0,113	0,206
q10_ part2*	0,617	0,005	-0,031	-0,006	0,090	0,125
q11 _part2*	0,999	-0,006	0,001	-0,001	-0,001	0,000
q12 _part2*	0,636	0,027	-0,028	0,252	0,078	0,100
q14 _part2	0,201	0,313	0,030	0,028	0,361	0,554
q15 _part2	0,264	0,276	0,285	-0,099	0,411	0,095
q16 _part2	0,300	0,440	0,283	0,183	0,392	-0,039
q17 _part2	0,290	0,369	-0,263	-0,181	0,548	-0,307
q18 _part2	0,236	0,356	-0,008	0,112	0,117	-0,129
q19 _part2	0,230	0,495	0,518	0,008	0,064	-0,026
q20 _part2	0,233	0,788	0,146	-0,167	-0,301	0,022
q21 _part2	0,297	0,729	0,004	-0,346	-0,128	-0,004
q22 _part2	0,253	0,457	-0,376	-0,494	0,064	0,098

q23 _part2	0,356	0,511	0,067	0,176	-0,023	0,026
q25 _part2	0,266	0,543	-0,414	0,344	-0,051	0,038
q26 _part2	0,359	0,493	-0,492	0,363	-0,095	-0,062
q27 _part2	0,129	0,464	-0,221	0,110	0,086	0,117
q32 _part2	0,335	0,172	-0,015	0,335	-0,025	0,296

Results of factor matrix shows the factor loadings of each item retained in the analysis against each factor. Factor 1 has the highest eigenvalue on the screeplot (6.251) and explaining the highest percentage of total variance (31.254), therefore factor loadings of each item is investigated against this factor 1. It can be concluded that q11, q10, q12 are the items which has the highest impact on affecting factor 1.

4.3 Discussions of Results

As an overall summary for the discussion of results, since the questionnaire contains several different types of questions (Appendix 1), the analysis of those questions have been performed separately. Firstly, several pie charts are created on the general questions to understand the data and sample of respondents. This shows the characteristics of the highest proportion of respondents and hence provides information about the data used in this research. As can be seen from the above pie charts created on general questions which are the questions in section 1, a general respondent has a characteristics to be graduated from a Bachelor of Science degree, to be specialized in civil engineering profession, working as a Civil engineer in a medium size organization with a number of employees being equal to between 10-20, working in the construction specialty and doing mostly residential projects with having 0-10 years of experience on average, having no experience on IPD and having no experience on procurement system but knowing and agreeing that procurement system is important for the organization. For the questions in section 2,

since there are two separate types of questions such as binary coded questions and likert scale questions, two different types of analysis have been performed.

For the binary coded questions, pie charts are created again to understand more about the data and for the likert scale questions, the factors affecting IPD are measured and analyzed statistically using reliability analysis and factor analysis. Pie charts from the binary coded questions conclude that highest percentage of respondents have not attend continuing professional development (CPD) program before and have not any motivation in the organization to join IPD. However, highest percentage of respondents have cooperation experience in the organization, using technological tools to improve management efficiency, using the Building Information Modeling (BIM) in their organizations where the organizations are persuading the respondents to follow their belief and opinions and agreeing that the cloud platform improves information sharing in IPD. As well as this, there is no obstacle to implement IPD in laws and regulations. On the other hand previous studies has found that, contractual issues are main obstacles in IPD implementation (Fish, A., 2011). Contract types are linked to laws and regulations.

For the likert scale questions, firstly there are 25 questions which are in likert scale type. All of these 25 questions are taken and reliability analysis is performed on all of these questions. From the result of the first reliability analysis, it has been concluded that questions numbered 7, 29, 31 and 33 are not reliable since the Corrected Item Total Correlation (CITC) values are less than 0.35 meaning that there is no or very little correlation between these questions and the latent variable which is IPD. Therefore, after the first reliability analysis, these questions are removed and analysis is repeated. Results from the second reliability analysis performed on totally

21 questions showed that question 13 is also not reliable and therefore removed in the same way from the pool of questions that will be analyzed further. After the questions which do not have any relationship with IPD are removed, 20 questions are remained for further analysis. The last reliability test also proves that the sample taken from the questionnaire of these 20 questions is statistically valid and associations between these questions and IPD can be analyzed further using the factor analysis. In factor analysis, firstly 20 factors are created, creating one factor per question, analyzing the association of each question with IPD. Then, factors having eigen-values greater than 1 are taken meaning that these are the factors explaining the variation in the IPD. From the factor analysis, 6 factors are found to have eigen-values greater than 1, explaining the variation occurred in IPD, explaining totally 68.267% of the total variation. Factor 1 is found to explain the highest percentage of variation in IPD (31.254%). Therefore, correlation coefficients of each of these 20 different questions are computed for factor 1, measuring the affect of each of these 20 questions on factor 1. It can be seen from the table 4.28 that questions numbered 10, 11 and 12 have the highest impact on factor 1 and hence have the highest impact on explaining the total variation occurred in IPD. These questions are;

Q10.The team manager cooperate with members to solve differences between members/participants.

Q11.Team manager monitors team and team members performance.

Q12.Team manager contributes ideas to improve how the team performs its work.

According to these results, team manager is extremely important for IPD projects. On the other hand, previous studies shows that, *effective team communication and good climate facilitates* are the crucial parameters for IPD implementation (Sun, W., 2013). Team communication issues are linked to managerial sytems.

Chapter 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The aim of this research was about to identify affecting factors on IPD projects. Primarily, literature review is done for Procurement Systems and Integrated Project Delivery Method. According to literature review part, affecting factors on IPD projects are identified. Subsequently, an appropriate methodology is chosen for this research and factors are written in order. A table is created to show identified factors. In the meantime a questionnaire is prepared for respondents and construction firms. The questionnaire was consisting of two parts; general and IPD part. An online platform was used to distribute questionnaires to respondents. After one month waiting time, expected number of responses was received.

Statistical methods were used to analyze respondents' responses. The quantitative data which is obtained from the questionnaire is used to conduct reliability analysis and factor analysis for further statistical analysis. The pie charts are used to illustrate the percentage of respondent's responses. SPSS software is used to evaluate likert scale questions. According to SPSS analysis, the Cronbach's Alpha value is 0.872, it depicts that the analysis is reliable. For the likert scale questions, firstly there are 25 questions which are in likert scale type. All of these 25 questions are taken and reliability analysis is performed on all of these questions. From the result of the first reliability analysis, it has been concluded that 4 questions are not statistically reliable for test. After extraction of these questions, the second reliability analysis performed

on totally 21 questions. The results showed that only 1 question is also not reliable and therefore removed in the same way from the pool of questions that will be analyzed further. After the questions which do not have any relationship with IPD are removed, 20 questions are remained for further analysis. The last reliability test Cronbach's Alpha value is 0.872 and KMO test result is 0,797 these results proves that the sample taken from the questionnaire of these 20 questions are statistically valid. After having factor analysis, the highest % of variance value is 31.254 which is Factor 1, according to these results, the values which are greater than 0.6 in Factor 1 column on Factor matrix table, it shows us the most important affecting factor questions in questionnaire is *"managerial and organizational"* questions shows the highest impact on the factor analysis. According to these results, it can be concluded that managerial issues are the most important affecting factors for Integrated Project Delivery.

5.2 Recommendations for Further Studies

According to research results, managerial issues are main factors on IPD implementation. Researchers ought to pay more attention to following issues;

- Web-based management can increase team members performance on IPD.
- Training issues for members, contractors, engineers and architects.
- Information sharing issues between manager and participants.

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APPENDICES

Appendix A: IPD Questionnaire

I. Introduction

This questionnaire is prepared for postgraduate research in Eastern Mediterranean University Civil Engineering department. The aim of this questionnaire is to find out the factors affecting IPD (Integrated Project Delivery) success. The questionnaire gives brief information about IPD for respondents. It is divided to six categories; Cultural and Social, Managerial and Organizational, Financial, Technological, Legal, Implementation. The questions prepared after literature review about procurement systems. Respondents answers will only be used for research.

Definition of Integrated Project Delivery

Integrated Project Delivery (IPD) is a project delivery method where all employed participants share the risk and responsibilities.

According to American Institute of Architects,

> "IPD is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize the project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction." (AIA 2007)

Project delivery methods reflect on the most significant parameters that affect project achievement. The American Institute of Architects definition emphasize that IPD processes are completely dependent on the parties. IPD is the only delivery method that is adapted to a project teamwork approach. Collaboration, transferring, and sharing knowledge is crucial for the project team to achieve project objectives and success.

II. Questions

The first part of questionnaire includes general questions about respondents, the following part is about IPD. In first part questions are open-ended and close-ended. In the following part, all questions are close-ended. For two point questions (Yes or No) and scaled questions place a circle of your answer.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

1. General Questions

1- What is your educational qualification level?
- Bsc
- Msc
- Phd

2- What bachelor degree do you have?
……..

3- What is your position in your organization?
- Director
- Project Manager
- Construction Manager
- Engineer
- Architect
- Consultant
- Other

4- What are the number of employees in your organization?
- 0-10
- 10-20
- 20-50
- 50-100
- 100+

5- What is the specialty of your firm?
- Construction
- Transportation
- Infrastructure

- Management
- Other

6- How long have you been working in construction industry?
   - 0-10 years
   - 10-15 years
   - 15-20 years
   - 20+ years

7- Do you have any experience about construction procurement systems?
   - YES
   - NO

8- If you have experience about procurement systems, have you ever heard IPD method?
   - YES
   - NO

9- If you have experience, what type of projects you were involved?
   - Commercial Projects
   - Transport Infrastructure Projects
   - Industrial Projects
   - Residential Projects
   - Other

10- Do you think procurement methods are important parameters for project success?
   - YES
   - NO

2. Questionnaire

1- Cultural and Social

Q1.Features of IPD fit the culture of your organization	1	2	3	4	5
Q2.I have prior experience of working on IPD project.	1	2	3	4	5

Q3.Have you done any Continuing Professional Development (CPD) program about IPD?
- YES
- NO

Q4. Do you have previous cooperation experience with participating organization?
- YES
- NO

Q5.Were there any motivation to join IPD projects?

- o YES
- o NO

2- **Managerial and Organizational**

Q6.Do you believe you persuaded participants or team members to follow your beliefs or opinions?

- o YES
- o NO

Q7. Different ideas in the project team will negatively influenced the collaboration of the team. 1 2 3 4 5

Q8. The controversies that occured in the project were handled by the project manager. 1 2 3 4 5

Q9.Do you think technological tools improve management efficiency?

- o YES
- o NO

Q10. The team manager cooperate with members to solve differences between members/participants. 1 2 3 4 5

Q11. Team manager monitors team and team members performance. 1 2 3 4 5

Q12. Team manager contributes ideas to improve how the team performs its work. 1 2 3 4 5

Q13. Team manager obtains and allocate resources for the team. 1 2 3 4 5

Q14. Team manager encourage the team to make of its own work-related decisions. 1 2 3 4 5

Q15. Information sharing process is effective in our organization 1 2 3 4 5

Q16.Information sharing improves collaboration between parties. 1 2 3 4 5

Q17.IPD collaborates all participants and team members, and it helps with the decision making. 1 2 3 4 5

Q18. Every participant in project team unifies their different opinions to attain final decision on the project. 1 2 3 4 5

3. Financial

Q19. IPD is applicable in our country. 1 2 3 4 5

Q20. IPD is more accurate than other procurement methods, in the overall cost of the project. 1 2 3 4 5

Q21. IPD is stronger delivery method than other delivery methods that mitigating risk in cost and schedule. 1 2 3 4 5

Q22. In IPD, Target Value Design is performed to control project cost and meet owner's requirements. 1 2 3 4 5

4. Technological

Q23. IPD is more appropriate than other delivery methods in large and complex projects. 1 2 3 4 5

Q24. Have you ever used BIM for any project?
- o YES
- o NO

Q25. I believe that BIM can increase usage of IPD. 1 2 3 4 5

Q26. IT infrastructure is essential to implement IPD projects. 1 2 3 4 5

Q27. IPD projects greatly relies on effective communication and collaboration. 1 2 3 4 5

Q28. In IPD projects, information sharing and communication are essentially required. In this case, Can cloud platform increase Information Management on IPD Projects?
- o YES
- o NO

Q29. Interoperability issues helps continuous information transfer between project participants in IPD projects. 1 2 3 4 5

5. Legal

Q30. According to your country laws and regulations,
Is there any criteria that precludes the use of IPD for procuring design and construction services?

- o YES
- o NO

Q31. Risk allocation mechanism obstruct the possibility of liability waivers among key participants in IPD. 1 2 3 4 5

6. Implementation

Q32.Each team member has adequate knowledge about
Procurement methods and IPD to keep up with experienced ones.
1 2 3 4 5

Q33. Project participants devote time resources and energy to IPD projects.
1 2 3 4 5

Appendix B: SPSS output

Reliability Statistics

Cronbach's Alpha	N of Items
,869	25

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	**Corrected Item-Total Correlation**	Cronbach's Alpha if Item Deleted
q1_part2	83,73	104,556	,564	,860
q2_part2	84,24	107,095	,446	,865
q7_part2	**83,68**	**116,728**	**,139**	**,875**
q8_part2	82,63	112,364	,534	,862
q10_part2	82,74	114,399	,380	,866
q11_part2	82,57	113,513	,503	,863
q12_part2	82,65	115,192	,438	,865
q13_part2	83,07	113,893	,376	,866
q14_part2	83,75	110,392	,425	,865
q15_part2	83,94	110,692	,387	,866
q16_part2	83,11	108,177	,579	,859
q17_part2	83,04	112,568	,437	,864
q18_part2	83,11	112,101	,458	,863
q19_part2	84,31	108,496	,476	,863
q20_part2	83,46	110,277	,613	,859
q21_part2	83,34	111,011	,617	,860

q22_part2	83,57	116,247	,453	,865
q23_part2	82,90	110,977	,661	,859
q25_part2	82,50	112,025	,496	,862
q26_part2	82,25	112,823	,528	,862
q27_part2	82,84	113,657	,459	,864
q29_part2	**83,52**	**117,442**	**,265**	**,868**
q31_part2	**83,43**	**117,589**	**,210**	**,870**
q32_part2	82,77	112,784	,404	,865
q33_part2	**82,75**	**118,873**	**,163**	**,870**

Reliability Statistics

Cronbach's Alpha	N of Items
,873	**21**

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
q1_part2	70,62	89,133	,607	,863
q2_part2	71,08	91,111	,496	,868
q8_part2	69,50	98,371	,491	,867
q10_part2	69,66	98,720	,389	,870
q11_part2	69,43	98,389	,536	,867

q12_part2	69,52	99,970	,450	,869
q13_part2	**69,97**	**100,105**	**,308**	**,873**
q14_part2	70,65	95,642	,417	,870
q15_part2	70,83	95,769	,404	,871
q16_part2	69,99	93,235	,592	,863
q17_part2	69,90	98,307	,421	,869
q18_part2	69,98	97,576	,452	,868
q19_part2	71,10	92,989	,500	,867
q20_part2	70,30	95,908	,607	,864
q21_part2	70,20	96,796	,600	,864
q22_part2	70,42	101,799	,373	,871
q23_part2	69,76	97,222	,587	,865
q25_part2	69,36	97,527	,495	,867
q26_part2	69,12	98,410	,500	,867
q27_part2	69,71	99,338	,406	,870
q32_part2	69,62	98,545	,382	,870

Reliability Statistics

Cronbach's Alpha	N of Items
,872	20

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
q1_part2	66,88	83,191	,610	,861
q2_part2	67,32	84,679	,521	,866
q8_part2	65,74	92,149	,499	,866
q10_part2	65,89	93,182	,357	,870
q11_part2	65,66	92,503	,525	,866
q12_part2	65,77	93,879	,423	,868
q14_part2	66,89	89,918	,406	,870
q15_part2	67,09	89,486	,409	,870
q16_part2	66,20	87,429	,590	,862
q17_part2	66,14	92,395	,411	,868
q18_part2	66,20	91,820	,435	,868
q19_part2	67,33	86,959	,509	,866
q20_part2	66,53	89,838	,605	,862
q21_part2	66,43	90,708	,595	,863
q22_part2	66,66	95,653	,361	,870
q23_part2	66,00	90,943	,602	,863
q25_part2	65,59	91,348	,508	,865
q26_part2	65,36	92,165	,503	,866
q27_part2	65,95	92,848	,429	,868
q32_part2	65,83	92,695	,367	,870

	Mean	Std. Deviation

q1_part2	2,89	1,334
q2_ part2	2,44	1,380
q8_ part2	4,02	,742
q10_ part2	3,88	,855
q11_part2	4,10	,679
q12_ part2	3,99	,669
q14_ part2	2,88	1,123
q15_ part2	2,67	1,162
q16_ part2	3,56	1,027
q17_ part2	3,63	,848
q18_ part2	3,56	,869
q19_ part2	2,43	1,201
q20_ part2	3,23	,813
q21_ part2	3,33	,754
q22_ part2	3,10	,548
q23_ part2	3,76	,727
q25_ part2	4,17	,805
q26_ part2	4,40	,736
q27_ part2	3,81	,771
q32_ part2	3,93	,894

Correlation Matrix

		q1_rescale_part2	q2_rescale_part2	q8_rescale_part2	q10_rescale_part2
Correlation	q1_ part2	1,000	,565	,270	,229
	q2_ part2	,565	1,000	,270	,125
	q8_ part2	,270	,270	1,000	,348
	q10_ part2	,229	,125	,348	1,000
	q11_ part2	,191	,246	,383	,616
	q12_ part2	,230	,130	,347	,439
	q14_ part2	,251	,081	,362	,235
	q15_rescale_part2	,361	,178	,182	,201
	q16_rescale_part2	,508	,392	,345	,159
	q17_rescale_part2	,226	,114	,269	,204
	q18_rescale_part2	,402	,309	,194	,157
	q19_rescale_part2	,547	,466	,131	,064
	q20_rescale_part2	,448	,504	,353	,141
	q21_rescale_part2	,346	,377	,315	,154
	q22_rescale_part2	,048	-,030	,249	,224
	q23_rescale_part2	,398	,393	,330	,081
	q25_rescale_part2	,243	,293	,320	,165
	q26_rescale_part2	,269	,334	,278	,226
	q27_rescale_part2	,180	,254	,128	,033
	q32_rescale_part2	,234	,239	,314	,244
Sig. (1-tailed)	q1_rescale_part2		,000	,006	,016
	q2_rescale_part2	,000		,005	,122
	q8_rescale_part2	,006	,005		,000

	q10_rescale_part2	,016	,122	,000	
	q11_rescale_part2	,038	,011	,000	,000
	q12_rescale_part2	,015	,114	,000	,000
	q14_rescale_part2	,009	,227	,000	,014
	q15_rescale_part2	,000	,048	,045	,030
	q16_rescale_part2	,000	,000	,000	,070
	q17_rescale_part2	,017	,145	,006	,028
	q18_rescale_part2	,000	,002	,035	,073
	q19_rescale_part2	,000	,000	,113	,276
	q20_rescale_part2	,000	,000	,000	,096
	q21_rescale_part2	,000	,000	,001	,076
	q22_rescale_part2	,330	,390	,010	,018
	q23_rescale_part2	,000	,000	,001	,227
	q25_rescale_part2	,011	,003	,001	,062
	q26_rescale_part2	,006	,001	,004	,017
	q27_rescale_part2	,047	,008	,117	,381
	q32_rescale_part2	,014	,012	,001	,011

Correlation Matrix

		q11_rescale_part2	q12_rescale_part2	q14_rescale_part2	q15_rescale_part2
Correlation	q1_rescale_part2	,191	,230	,251	,361
	q2_rescale_part2	,246	,130	,081	,178
	q8_rescale_part2	,383	,347	,362	,182
	q10_rescale_part2	,616	,439	,235	,201

	q11_rescale_part2	1,000	,635	,198	,262
	q12_rescale_part2	,635	1,000	,212	,143
	q14_rescale_part2	,198	,212	1,000	,373
	q15_rescale_part2	,262	,143	,373	1,000
	q16_rescale_part2	,297	,277	,310	,435
	q17_rescale_part2	,287	,154	,192	,293
	q18_rescale_part2	,234	,288	,084	,116
	q19_rescale_part2	,227	,149	,245	,400
	q20_rescale_part2	,228	,110	,195	,190
	q21_rescale_part2	,293	,099	,226	,283
	q22_rescale_part2	,250	,066	,245	,162
	q23_rescale_part2	,353	,372	,231	,273
	q25_rescale_part2	,262	,217	,215	,085
	q26_rescale_part2	,355	,359	,172	,021
	q27_rescale_part2	,126	,174	,251	,146
	q32_rescale_part2	,334	,287	,278	,011
Sig. (1-tailed)	q1_rescale_part2	,038	,015	,009	,000
	q2_rescale_part2	,011	,114	,227	,048
	q8_rescale_part2	,000	,000	,000	,045
	q10_rescale_part2	,000	,000	,014	,030
	q11_rescale_part2		,000	,032	,007
	q12_rescale_part2	,000		,024	,092
	q14_rescale_part2	,032	,024		,000
	q15_rescale_part2	,007	,092	,000	

	q16_rescale_part2	,003	,005	,002	,000
	q17_rescale_part2	,003	,076	,037	,003
	q18_rescale_part2	,014	,003	,218	,142
	q19_rescale_part2	,017	,083	,011	,000
	q20_rescale_part2	,016	,153	,034	,038
	q21_rescale_part2	,003	,180	,017	,004
	q22_rescale_part2	,009	,271	,011	,066
	q23_rescale_part2	,000	,000	,015	,005
	q25_rescale_part2	,007	,021	,022	,215
	q26_rescale_part2	,000	,000	,054	,424
	q27_rescale_part2	,121	,053	,009	,087
	q32_rescale_part2	,001	,003	,004	,458

Correlation Matrix

		q16_rescale_part2	q17_rescale_part2	q18_rescale_part2	q19_rescale_part2
Correlation	q1_rescale_part2	,508	,226	,402	,547
	q2_rescale_part2	,392	,114	,309	,466
	q8_rescale_part2	,345	,269	,194	,131
	q10_rescale_part2	,159	,204	,157	,064
	q11_rescale_part2	,297	,287	,234	,227
	q12_rescale_part2	,277	,154	,288	,149
	q14_rescale_part2	,310	,192	,084	,245
	q15_rescale_part2	,435	,293	,116	,400

	q16_rescale_part2	1,000	,388	,241	,483
	q17_rescale_part2	,388	1,000	,286	,138
	q18_rescale_part2	,241	,286	1,000	,218
	q19_rescale_part2	,483	,138	,218	1,000
	q20_rescale_part2	,329	,175	,274	,499
	q21_rescale_part2	,280	,357	,225	,412
	q22_rescale_part2	,082	,430	,265	,107
	q23_rescale_part2	,334	,226	,340	,396
	q25_rescale_part2	,287	,280	,241	,137
	q26_rescale_part2	,190	,315	,261	,077
	q27_rescale_part2	,268	,239	,334	,116
	q32_rescale_part2	,230	-,004	,182	,124
Sig. (1-tailed)	q1_rescale_part2	,000	,017	,000	,000
	q2_rescale_part2	,000	,145	,002	,000
	q8_rescale_part2	,000	,006	,035	,113
	q10_rescale_part2	,070	,028	,073	,276
	q11_rescale_part2	,003	,003	,014	,017
	q12_rescale_part2	,005	,076	,003	,083
	q14_rescale_part2	,002	,037	,218	,011
	q15_rescale_part2	,000	,003	,142	,000
	q16_rescale_part2		,000	,012	,000
	q17_rescale_part2	,000		,003	,100
	q18_rescale_part2	,012	,003		,020
	q19_rescale_part2	,000	,100	,020	

	q20_rescale_part2	,001	,051	,005	,000
	q21_rescale_part2	,004	,000	,017	,000
	q22_rescale_part2	,225	,000	,006	,161
	q23_rescale_part2	,001	,017	,001	,000
	q25_rescale_part2	,003	,004	,012	,102
	q26_rescale_part2	,038	,001	,007	,239
	q27_rescale_part2	,006	,012	,001	,141
	q32_rescale_part2	,016	,486	,044	,125

Correlation Matrix

		q20_rescale_part2	q21_rescale_part2	q22_rescale_part2	q23_rescale_part2
Correlation	q1_rescale_part2	,448	,346	,048	,398
	q2_rescale_part2	,504	,377	-,030	,393
	q8_rescale_part2	,353	,315	,249	,330
	q10_rescale_part2	,141	,154	,224	,081
	q11_rescale_part2	,228	,293	,250	,353
	q12_rescale_part2	,110	,099	,066	,372
	q14_rescale_part2	,195	,226	,245	,231
	q15_rescale_part2	,190	,283	,162	,273
	q16_rescale_part2	,329	,280	,082	,334
	q17_rescale_part2	,175	,357	,430	,226
	q18_rescale_part2	,274	,225	,265	,340
	q19_rescale_part2	,499	,412	,107	,396
	q20_rescale_part2	1,000	,739	,438	,462

	q21_rescale_part2	,739	1,000	,558	,460
	q22_rescale_part2	,438	,558	1,000	,178
	q23_rescale_part2	,462	,460	,178	1,000
	q25_rescale_part2	,397	,361	,273	,384
	q26_rescale_part2	,366	,341	,326	,416
	q27_rescale_part2	,273	,388	,320	,347
	q32_rescale_part2	,148	,119	,038	,311
Sig. (1-tailed)	q1_rescale_part2	,000	,000	,330	,000
	q2_rescale_part2	,000	,000	,390	,000
	q8_rescale_part2	,000	,001	,010	,001
	q10_rescale_part2	,096	,076	,018	,227
	q11_rescale_part2	,016	,003	,009	,000
	q12_rescale_part2	,153	,180	,271	,000
	q14_rescale_part2	,034	,017	,011	,015
	q15_rescale_part2	,038	,004	,066	,005
	q16_rescale_part2	,001	,004	,225	,001
	q17_rescale_part2	,051	,000	,000	,017
	q18_rescale_part2	,005	,017	,006	,001
	q19_rescale_part2	,000	,000	,161	,000
	q20_rescale_part2		,000	,000	,000
	q21_rescale_part2	,000		,000	,000
	q22_rescale_part2	,000	,000		,049
	q23_rescale_part2	,000	,000	,049	
	q25_rescale_part2	,000	,000	,005	,000

	q26_rescale_part2	,000	,001	,001	,000
	q27_rescale_part2	,005	,000	,001	,000
	q32_rescale_part2	,084	,135	,363	,002

		q25_rescale_part 2	q26_rescale_part 2	q27_rescale_part 2	q32_rescale_part 2
Correlation	q1_rescale_part2	,243	,269	,180	,234
	q2_rescale_part2	,293	,334	,254	,239
	q8_rescale_part2	,320	,278	,128	,314
	q10_rescale_part2	,165	,226	,033	,244
	q11_rescale_part2	,262	,355	,126	,334
	q12_rescale_part2	,217	,359	,174	,287
	q14_rescale_part2	,215	,172	,251	,278
	q15_rescale_part2	,085	,021	,146	,011
	q16_rescale_part2	,287	,190	,268	,230
	q17_rescale_part2	,280	,315	,239	-,004
	q18_rescale_part2	,241	,261	,334	,182
	q19_rescale_part2	,137	,077	,116	,124
	q20_rescale_part2	,397	,366	,273	,148
	q21_rescale_part2	,361	,341	,388	,119
	q22_rescale_part2	,273	,326	,320	,038
	q23_rescale_part2	,384	,416	,347	,311
	q25_rescale_part2	1,000	,718	,442	,319
	q26_rescale_part2	,718	1,000	,360	,269
	q27_rescale_part2	,442	,360	1,000	,331

	q32_rescale_part2	,319	,269	,331	1,000
Sig. (1-tailed)	q1_rescale_part2	,011	,006	,047	,014
	q2_rescale_part2	,003	,001	,008	,012
	q8_rescale_part2	,001	,004	,117	,001
	q10_rescale_part2	,062	,017	,381	,011
	q11_rescale_part2	,007	,000	,121	,001
	q12_rescale_part2	,021	,000	,053	,003
	q14_rescale_part2	,022	,054	,009	,004
	q15_rescale_part2	,215	,424	,087	,458
	q16_rescale_part2	,003	,038	,006	,016
	q17_rescale_part2	,004	,001	,012	,486
	q18_rescale_part2	,012	,007	,001	,044
	q19_rescale_part2	,102	,239	,141	,125
	q20_rescale_part2	,000	,000	,005	,084
	q21_rescale_part2	,000	,001	,000	,135
	q22_rescale_part2	,005	,001	,001	,363
	q23_rescale_part2	,000	,000	,000	,002
	q25_rescale_part2		,000	,000	,001
	q26_rescale_part2	,000		,000	,006
	q27_rescale_part2	,000	,000		,001
	q32_rescale_part2	,001	,006	,001	

KMO and Bartlett's Test

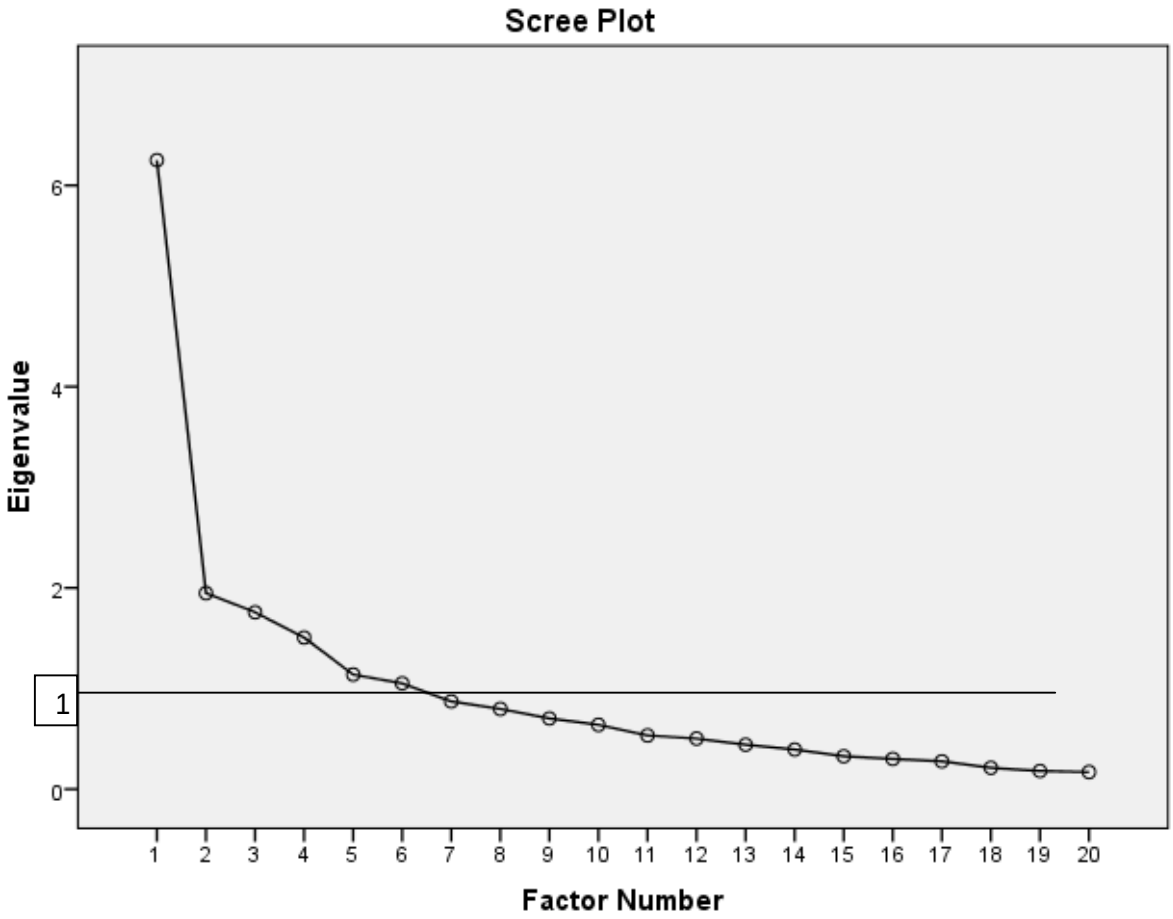
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**,797**
Bartlett's Test of Sphericity	Approx. Chi-Square	733,230

df	190
Sig.	**,000**

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,251	31,254	31,254	3,085	15,427	15,427
2	1,948	9,738	40,992	3,986	19,930	35,357
3	1,758	8,790	49,782	1,388	6,940	42,297
4	1,507	7,533	57,316	1,125	5,624	47,921
5	1,139	5,695	63,010	,977	4,883	52,804
6	1,051	5,256	68,267	,659	3,296	56,100
7	,872	4,359	72,626			
8	,797	3,984	76,609			
9	,703	3,513	80,122			
10	,639	3,194	83,317			
11	,533	2,666	85,983			
12	,502	2,512	88,495			
13	,441	2,206	90,701			
14	,394	1,968	92,669			
15	,327	1,635	94,304			
16	,301	1,504	95,808			
17	,276	1,382	97,190			
18	,212	1,061	98,252			
19	,180	,900	99,152			

20	,170	,848	100,000			



	Factor Matrix					
	1	2	3	4	5	6
q1_rescale_part2	,194	,562	,387	,274	,169	-,079
q2_rescale_part2	,249	,523	,327	,309	-,140	-,198

q8_rescale_part2	,386	,336	-,024	,060	,113	,206
q10_rescale_part2	,617	,005	-,031	-,006	,090	,125
q11_rescale_part2	,999	-,006	,001	-,001	-,001	,000
q12_rescale_part2	,636	,027	-,028	,252	,078	,100
q14_rescale_part2	,201	,313	,030	,028	,361	,554
q15_rescale_part2	,264	,276	,285	-,099	,411	,095
q16_rescale_part2	,300	,440	,283	,183	,392	-,039
q17_rescale_part2	,290	,369	-,263	-,181	,548	-,307
q18_rescale_part2	,236	,356	-,008	,112	,117	-,129
q19_rescale_part2	,230	,495	,518	,008	,064	-,026
q20_rescale_part2	,233	,788	,146	-,167	-,301	,022
q21_rescale_part2	,297	,729	,004	-,346	-,128	-,004
q22_rescale_part2	,253	,457	-,376	-,494	,064	,098
q23_rescale_part2	,356	,511	,067	,176	-,023	,026
q25_rescale_part2	,266	,543	-,414	,344	-,051	,038
q26_rescale_part2	,359	,493	-,492	,363	-,095	-,062
q27_rescale_part2	,129	,464	-,221	,110	,086	,117
q32_rescale_part2	,335	,172	-,015	,335	-,025	,296