THE REPUBLIC OF TURKEY
İSTANBUL KÜLTÜR UNIVERSITY
INSTITUTE OF GRADUATE STUDIES

PREFABRICATED BUILDING COMPONENTS AS AN ALTERNATIVE TO CAST IN PLACE CONCRETE PROJECTS IN KABUL AFGHANISTAN

MASTER OF SCIENCE THESIS

by MOHAMMAD SHARIF HAYAT FORMULI

Department: Industrial Engineering

Program: Engineering Management

Supervisor: Assist. Prof. Duygun Fatih DEMİREL

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ACC	Associated Cement Companies
IOS	International Organization for Standardization
HCC	Harirod Construction Company
NDC	National Development Corporation
HDC	Housing Development Corporation
UNOCA	United Nations Regional office for Central Africa
HDC	Housing Development Corporation
PVC	Polymer of Vinyl Chloride
PCP	Prefabricated Construction Projects
ADB	Asian Development Bank
CCT	Cross Cover Timber
PCI	Precast Concrete Institute
UK	United Kingdom
HPL	Hindustan Prefab Limited
BIM	Building Information Modelling
PCA	Principal component analysis
SPSS	Statistical Package for the Social Sciences
KMO	Kaiser-Meyer-Olkin
DW	Durbin Watson

Üniversite	**: İstanbul Kültür Üniversitesi**
Enstitü	**: Lisansüstü Eğitim Enstitüsü**
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Tez Türü ve Tarihi	**: Yüksek Lisans – Şubat 2022**

ÖZET

PREFABRICATED BUILDING COMPONENTS AS AN ALTERNATIVE TO CAST-IN-PLACE CONCRETE PROJECTS IN KABUL AFGHANISTAN

MOHAMMAD SHARIF HAYAT FORMULI

Afganistan’ın Kabul şehrinde inşaat faaliyetlerinin çoğu, geleneksel inşaat yöntemiyle gerçekleştirilmekle birlikte şu anda şehirde büyük bir konut talebi mevcuttur. Bazı uzmanlar, artan nüfus için konut inşa etmenin en iyi ve en hızlı yöntemlerinden birinin prefabrik yapılar olduğunu öne sürmektedirler. Prefabrike beton yapılar bir fabrikada tasarlanabilmekte ve daha sonra şantiyelere kurulabilmektedir. Bu çalışmada, Afganistan'ın başkenti Kabul'de prefabrike betonarme yapıların geleneksel yapı malzemelerine alternatif olarak değerlendirilmesinde uzmanların algılarını etkileyen faktörler, kamu ve konut projelerinin sanayileşmesi için incelenmiştir. Çalışma kapsamında Kabul inşaat sektöründeki uzmanlar arasından Google Form aracılığıyla toplanan toplam 164 anket çıktıları SPSS 28 yazılımı ile analiz edilmiştir. Önerilen hipotezleri incelemek için betimsel analiz, temel bileşenler analizi, güvenirlik analizi, regresyon ve korelasyon analizi yapılmıştır. Sayısal bulgulara ve regresyon analizine dayalı olarak, uzmanların prefabrike beton yapılar hakkındaki görüşlerini etkileyen üç temel faktörün olduğu belirlenmiştir. Bu faktörler; prefabrike betonun kısa sürede inşa edilebilirliği, prefabrike yapı maliyetinin yerinde dökme malzeme maliyetinden daha düşük oluşu, prefabrik yapıların yönetimi kalite, üretim ve yerinde uygulama açısından daha kolay olması şeklindedir.

Anahtar Kelimeler: Prefabrik ve Konvansiyonel Yapı, Çok Değişkenli Regresyon Analizi, Temel Bileşen Analizi, Güvenilirlik Analizi.

University	**: İstanbul Kültür University**
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ABSTRACT

PREFABRICATED BUILDING COMPONENTS AS AN ALTERNATIVE TO CAST-IN-PLACE CONCRETE PROJECTS IN KABUL AFGHANISTAN

MOHAMMAD SHARIF HAYAT FORMULI

Most of the construction activities in Kabul Afghanistan take place by the conventional method of construction, but currently, there is a huge demand housing in Kabul Afghanistan. Some experts claim that one of the best and fastest methods to build housing for population is prefabricate constructions. Prefabricated concrete structures can be designed in a factory and then installed on construction sites. In this study, the factors influencing the perceptions of experts in considering prefabricated concrete structures as an alternative to the conventional construction materials in Kabul Afghanistan, is examined for the industrialization of public and residential buildings projects. In total 164 valid questionnaires were collected through Google Form from experts in construction sector in Kabul Afghanistan, and the survey outputs are analyzed through SPSS 28 software. To examine the suggested hypotheses, descriptive analysis, principle component analysis, reliability analysis, regression and correlation analysis were performed. Based on the numerical findings and regression analysis, it is observed that there are three key factors affecting the opinions of experts on prefabricated concrete structures, prefabricated concrete can be built in a short time, the cost of prefabricated building is lower than cost of cast in place materials,

and management for prefabricating buildings are easier according to quality, production and implementation on site.

Keywords: Prefabricated and Conventional Construction, Multivariate Regression Analysis, Principal Component Analysis, Reliability Analysis**.**

1. INTRODUCTION

1.1. Background and history of prefabricated

In developing countries, prefabricated construction, also known as prefab building, has become increasingly popular. Material is manufactured off-site in a warehouse, then transported and assembled on-site to form a frame, whether it is for public projects, residential projects, or another type of project.

Frank Lloyd Wright, a well-known architect, developed prefabricated homes in 1911. He invented a way to build the dwellings in pieces at a factory and then transport each piece to the construction site. The homes he built were unique to his design style and extremely different from Sears & Roebuck's assembly-line homes. His approach made homes more affordable by reducing labor costs (Sönmez, 2006).

Following the Second World War, countries such as France, Germany, Japan, and others had to build a great number of houses and apartments in a short period of time. Prefabricated concrete construction grew rapidly in Europe as housing industrialization grew rapidly. Prefabricated concrete building projects were first industrialized in France. During 1960, the French science and technology center recognized the large-scale construction method defined by the industrial construction method. In 1977, the (ACC) Company was founded in France, further promoting the industrialization of prefabricated housing (Wang, 2018).

Overall, the world's population is growing at a rapid rate, so faster construction is necessary at this time. Building, bridges, and any other construction projects are becoming more viable with the use of prefabricated building methods. Prefabricated construction has many benefits. Construction speed and time reduction, waste management, and cost-effective construction are all factors to consider. A prefabricated component can be cast in a regulated setting, and precast elements can be assembled easily to complete a structure.

1.2. Definition of prefabricated in development country

The construction industry uses prefabrication to describe assemblies that are built in a manufacturing facility and shipped to construction sites to be assembled. Historically, prefabrication has been revered for its ability to increase productivity and efficiency without sacrificing quality. Developed countries such as Europe, Japan, and the United States adhere to primary, quicker, and less expensive ideals. Developing countries that are beginning to rely on prefabricating, such as India, Africa, China, and South America, can realize housing quickly and affordably, though they focus on building quality, production, and increasing the productivity of prefabricated components (Wang, 2018).

Japanese structural design standards "Design guide and explanation of assembly structure similar to cast-in-place structure" define the assembly structure's bearing capacity and specifications for regular use (Ozawa, 2014).

1.3. History of prefabricate component in Afghanistan

In Afghanistan, the Directorate of Housing Construction Enterprise was established in 1962 with an initial budget of 262 million Afghanis. A 48-hectare factory was built to produce prefabricated construction parts with a monthly production capacity of 2500 square meters. By 1977, the production capacity of block building had increased to 610,000 square meters. The enterprise employed 5000 people in different departments (Ministry of Urban Development, 1975).

In presidential decree No.28, dated 03/02/2020, the National Development Corporation was established as a state-owned corporation (NDC). The corporation's primary mission is to revitalize the state-owned components that have been incorporated and formerly maintained the status of state-owned enterprises. As a result of the merger, the company was modernized and mechanized in order to achieve a high level of infrastructure delivery and construction. Another important goal is to refine the process involved in the implementation of critical infrastructure in the fields of agriculture, water, electricity, production, exploration, and development. As a result of the presidential decree for the below department, the following state-owned companies have become state-owned corporations and are incorporated into NDC as a result of the change (www.ndc.gov).

- Bana-i-Development Corporation
- Helmand Development Corporation
- Afghani Development Corporation
- Housing Development Corporation
- Ghouri Cement Factory
- Jabal Siraj Cement Factory
- Northern Coal Corporation
- Arzaq Corporation
- Nangarhar Valley Agriculture Corporation
- Metal Corporation
- Central Freight Corporation

The projects were completed at extremely low costs. In addition, some of the fundamental characteristics of NDC construction activities, such as the construction of a 100-bed hospital in Herat, the construction of Samangan hospital, and any other projects currently being carried out by the NDC's prefabricated factory department. (www.ndc.gov).

1.4. Prefabricated construction which is built-in Afghanistan

As per the preview discussion, Afghanistan started prefabricated construction in 1962, and it remained in progress until 1977, when the capacity production in Housing Development Corporation reached 610,000 square meters. Alternatively, it could explain the industrial factory's ability to produce construction areas for 15 to 20 families per day. The factory had been closed since 1977, and they had no products in the last four decades due to some problems. Construction and renovation of the prefabricated construction factory was reconstructed in 2017 by the Afghani Development corporation of Housing and Urban Development. The Afghan government stated at the time that the factory is primarily used to manufacture prefabricated construction parts.

The factory mentioned above has been producing prefab buildings for public construction since 2018, for example, they constructed over 100 public projects in the last two years, such as schools, hospitals, and clinics. Among the projects built are a 100-bed hospital in Herat city, a 100-bed hospital in Helmand city, a 50-bed hospital in Samangan city, a five-bed clinic in UNOCA Camp, and several schools, ranging from 10 to 16 classrooms in various cities of Afghanistan. (www.ndc.gov).

1.5. Statement of problem

A lack of affordable housing is the most pressing issue in Kabul city, today. As Afghanistan's population grows rapidly, the government's delivery system is weak, urban growth rates are high, and urban migrants are a large source of poverty, particularly in Kabul. These factors contribute to poverty in Afghanistan.

A new technology should be adopted to transform the traditional construction process into a more advanced, faster, and cost-effective method to develop these areas of manufacturing. One of the best technologies must be use of prefabricated. This technology used for a long time and has proven to be effective in the construction of large-scale housing projects around the world for future populations.

1.6. Aim of the research

The main aim of this research is to evaluate whether prefabricate concrete construction can be viewed as an effective alternative to cast in place construction for urban development projects in Kabul Afghanistan or not. In addition, the following aims are also considered:

- To evaluate whether there is a relationship between the time, construction material, scope for implementation, quality control, production elements, durability, prefabricate construction, traditional concrete projects, affordable, cost, more investment, excellent performance, precast housing, feeble quality, urban development, cast in place concrete projects and the perceptions of experts on prefabricated materials as an alternative to cast-in place materials.

- To evaluate whether there is a relationship between the gender, age, education, profession, experience, and the perceptions of experts on prefabricated materials as an alternative to cast-in place materials.

1.7. Thesis question/Hypotheses

This thesis is trying to test whether the following hypotheses are true or not:

- The time of the experts affects respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- In terms of perceived benefits of prefabricated materials over cast-in-place, the construction material of the experts is a major factor.
- Scope for implementation is a significant determinant of respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- The quality control dedicated to the experts has a significant influence on respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- The production elements of the experts are a significant factor that influences respondents' perception of the advantages of prefabricated materials over cast-in-place ones.
- Durability is a significant factor in respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- Prefabricated materials are perceived as being more affordable than cast-in-place materials because of their affordability.
- Prefabricated construction has a significant impact on respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- Traditional concrete projects have not a significant impact on respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- The cost of prefabricated materials is a significant factor affecting respondents' perceptions of cast-in-place materials as an alternative.
- More investment affects respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- The performance of prefabricated materials has a significant impact on respondents' perceptions of them as an alternative to cast-in-place materials.

- Precast housing is perceived as a superior option to cast-in-place materials based on their excellent performance.
- Feeble quality does not significantly affect respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- Urban development has a significant impact on respondents' perception of prefabricated materials as alternatives to cast-in-place materials.
- Age of the experts is a significant factor affecting the perceptions of respondents on prefabricated materials as an alternative to cast-in-place materials.
- Prefabricated materials as an alternative to cast-in-place materials are perceived differently depending on the gender of the experts.
- According to respondents, education is a significant factor affecting their perceptions of prefabricated materials in comparison with cast-in-place materials.
- The profession of experts was an important factor affecting respondents' perceptions of prefabricated materials as an alternative to cast-in-place materials.
- According to the survey, experts' experience greatly affects their perceptions of prefabricated materials in comparison to cast-in-place materials.

1.8. Contribution of this study to literature

This contribution modifies, the prefabricated concrete construction projects for urban development have proven to be an effective alternative to cast-in-place elements, which were used in Kabul city.

This is the first study of its kind in Kabul city, explaining how prefabricated concrete components can replace cast-in-place concrete in Kabul Afghanistan, which has a significant impact on future research in Kabul city. The main finding of our study, according to our analysis, is that prefabricated construction is more cost effective. Furthermore, prefabricated buildings can be constructed in a shorter amount of time, and the different findings with this study are significant for prefabricated concrete for urban development in Kabul city. One of the key reasons for the study is to make construction projects more affordable in Kabul city.

1.9.Scope and structure of study

In this dissertation, we examine the use of prefabricated concrete in a residential building project, to analyze prefabricate construction, and assess scope, cost, and time for prefabricated construction. This chapter was discussed introduction section which modified brief information about prefabricated concrete, aims and hypothesis of research, section two is discussed the literature review which modifies completed research about prefabricates, section three will discuss the methodology which modifies the quantitative methods with questionnaire survey and flowchart, section four will discuss implementation and result which modifies the numerical findings, section five will discuss about numerical finding and section six modifies the conclusion which explain the main result of the research.

2. LITERATURE REVIEW

It is a summary of what has been published by certified academics and scholars on a particular subject. An academic article contains existing knowledge, as well as academic and methodological contributions to a particular topic. In contrast, a literature review is a brief overview of previous publications on a specific subject, such as an entire academic journal or a section of a book, research paper, conference paper, or article.

2.1. Survey based studies in construction sector

2.1.1. Construction industry

The construction industry builds and maintains infrastructure. In addition to demolition, remodeling, maintenance, and repair, the construction industry covers everything from design and surveying to structural construction and finishing. The industry also builds roads, bridges, ports, railroads, sewers, and tunnels. As well as maintaining and repairing all of those structures, the government also produces the basic materials used to build them, such as concrete and other construction materials (Moodley & Preece, 2008).

Construction refers to the act of constructing something, the process of creating the composition of the building (Fanego, 2019 & Sharma).

2.1.2. Definition of prefabricate projects

Prefabrication is the process of assembling elements of a construction in a plant or other industrial facility, and then transporting them to a building site where the project is fabricated.

The prefabrication of concrete is a construction innovation where concrete is manufactured in a reused shape or precast. It is used in many parts of construction, such as slabs, beams, columns, foundations, exteriors, and interior walls, as well as in boundary wall construction. It is possible to connect prefabricated concrete components to another component to form a complete form for many types of construction projects, from public to residential projects (Zhao & Mbachu, 2019).

2.1.3. Current statuses of prefabricated which is under progress in Afghanistan

Prefabricate construction started in Afghanistan at 1962, and it was under progress since 1977. The capacity of produced in Housing Development Corporation had increased to 610,000 square meters. Moreover, the industrial factory was able to produce construction area for (15 to 20) families per day, after 1977 the factory had been closed till 2017 and they did not have any product in the last 40 years. Nowadays the construction and renovation of the prefabricated construction factory which was rebuild in 2017 by Ministry of Housing and Urban Development.

Currently it changed by National Development Corporation NDC, they are producing prefabricate building for public construction in Afghanistan, for instance they build in last two years more than 100 public projects, such us school, hospitals and clinics, the project which were build consist in (www.ndc.gov).

2.1.4. Herat Hospital

A 100-bed hospital in response to the COVID-19 virus outbreak has been successfully constructed. Herat was not only the first province to report COVID-19 cases but has now turned into the epicenter of the virus in Afghanistan. The groundbreaking of the hospital was done on the 17th of February 2020, with a plan of completion for 30 days but with a team of engineers and workers expanding to the number of 350, the National Development Corporation team managed to deliver the infrastructure (www.ndc.gov).

Figure 2.1: Herat hospital

Figure 2.1 show the construction of prefabricated 100-bed hospital COVID-19 in Herat city which is implemented by NDC National Development Corporation.

Figure 2.2: Herat hospital

Figure 2.2 show the construction of prefabricated 100-bed hospital COVID-19 in Herat city which is implemented by NDC National Development Corporation.

2.1.5. Samangan Hospital

The fifty-bed hospital of COVID-19 in Aibak Samangan city has been built using prefabricated parts produced by the National Development Company, which will be commissioned soon. At the same time, hospitals in the form of 50 beds are being built in 9 other provinces of Afghanistan (www.ndc.gov).

Figure 2.3: Samangan Hospital

Figure 2.3 show the construction of prefabricated 50-bed hospital COVID-19 in Samangan city which is implemented by NDC National Development Corporation.

2.2. Usage of prefabricate materials in construction

Prefabricated construction elements are used in construction projects such as, aluminum, wood, fiberglass, steel, and concrete are some of the most commonly used prefabricated building elements that are constructed outside and transported to the construction site. This protects the building against rust, corrosion, and fire. Almost every component of a metal structure, including columns, beams, frames, walls, and roofs, is made from steel. The bulk of prefabricated military constructions use steel or aluminum frames (Tam, 2014).

2.2.1. Usage of prefabricate in construction projects

A prefabricated building is made and assembled using prefabricated techniques. The structure is constructed from factory-produced components that are delivered and installed on-site. Concrete and metal prefabrication used in constructions that rest elements or forms multiple times is the most extensively used form of prefabrication in architecture and civil engineering. Filling concrete parts at a plant has the advantage of reusing shape and allowing concrete to be mixed on-site rather than having it transported to and pumped wet on a crowded construction site. Using prefabricated steel pieces eliminates the costs and risks associated with cutting and welding onsite (Gabea & Rachimac, 2017).

In the building industry, prefabrication is an important part of industrialization. The quality of prefabricated housing sections has improved to a point where individuals living in them may not be able to distinguish them from traditionally built units. The method is also used in office buildings, warehouses, and plant structures (Azman, 2012).

2.2.2. Advantage of prefabricated Components

Using the mold, make as many identical panels as you need with precast concrete. The process moves quickly, and the factory environment helps establish good quality control arrangements, resulting in consistently high-quality products (Mei & Fujiwara, 2016). As soon as the building is complete, precast concrete can be easily delivered to the site. The precast concrete may then be readily integrated into the structure. Another benefit of prefabricated structures is that they can be assembled quickly. Because each element is preassembled, construction crews can erect structures quickly and easily (Islamaj, 2018).

- Transporting pre-production supplies to each location is typically less expensive than moving partial assemblies from a plant.
- The design and building stages of a project, precast concrete delivers durability, adaptability, and versatility.
- Deploying resources on site can increase expenses prefabricating gathering can reduce on site effort and save money.
- Jigs, cranes, conveyors, and other factory tools can speed up and improve the precision of manufacturing.
- Factory equipment, such as shake tables and hydraulic testers, can provide further quality assurance.
- Factory conditions that are consistent eliminate the majority of the effects of weather on production.
- Cranes manufacturing supports can allow for complex shapes and sequences without the need for costly on-site fabrication.
- Factory machines with higher accuracy can help building heat and air are moved more efficiently, resulting in lower energy usage and healthier structures.
- Factory production may help with more efficient material consumption, recycling, noise reduction, and dust collection, among other things.
- Construction safety can be improved by machine mediated part movement and the absence of wind and rain.
- The labor necessary in the manufacturing process of precast units may be readily trained.
- The transportation and storage of various concrete components for cast in situ work is eliminated when precast members are employed.
- The project can be completed rapidly when precast components are employed.
- The amount of scaffolding and formwork necessary for constructing precast structures is significantly decreased.

2.2.3. Disadvantage of prefabricated Components

Producing prefabricated concrete in a construction project has some disadvantages. In the event of handling and shipment, members may break, so extra precautions must be taken. As a result, a non-monolithic building results from the connection of precast units (Mei & Fujiwara, 2016). The disadvantage of prefabricated material is listed below as follows.

- The volume of prefabricated parts may have higher transportation costs than their constituent elements, which can frequently be packed more densely.
- To set large prefabricated components in place, heavy-duty cranes and precise measurement and handling may be required.
- The precast units may be destroyed during shipment if they are not handled appropriately.
- It becomes difficult to make satisfactory connections between the precast.
- Members, and special equipment for lifting and transporting the precast sections must be arranged.

2.2.4. Elements for Prefabricate concrete building

There are a variety of uses for prefabricated boards, which is why precast components can be found in a wide range of structures, including manufacturing units, bridges, and overpasses, public buildings, and residential residences. Formwork refers to the mold used to make prefabricated concrete, which is concrete that is made before it is used. Concrete is poured into the formwork and held in place until it is strong enough to stand alone. A precast concrete unit can be customized to suit the planer's requirements and can include a variety of joining and fixing options. The precast concrete requirements will differ depending on the type of building being constructed. Precast columns and long beams are most commonly used in industrial structures, whereas precast flooring and walls are used in residential buildings (Barbier et al. 2000).

2.2.4.1. Precast Footings

Precast footings are foundations that have already been cast and can be easily installed on site. They are extremely durable, and provide a level and secure platform for building. As precast footings do not require any mixing or other on-site preparation, they are not weather-dependent (Teodosio & Mendis, 2021).

2.2.4.2. Beams

Prefabricated concrete beams are common in many structures today. They are particularly useful for building floors in homes, apartments, and broadcasting structures, and they are a low-cost option. Precast concrete beams can be used for suspended beams and block floors, and Lintel beams can be used in a variety of ways to cover doorways and frames in general (Larsson & Simonsson, 2012).

2.2.4.3. Column

Columns made of prefabricated concrete offer strength and flexibility while extending the life of any structure. Columns can be designed according to the architect's specifications and can include any features or fittings not available in standard columns. Making concrete on-site is non-noisy, so they can be established at night, even in residential areas, and they can be completed with a high-quality finish (RAO & KUMAR, 2013).

2.2.4.4. Shear Walls

Shear walls can be built according to the architect's specifications and can include any additional features or fittings that are not standard. They can be built at night, even in residential areas, and a high-quality finish can be achieved. They have been used in buildings as tall as 30 stories, but they are more common in low-rise structures. The panels are simple to assemble, and the design might incorporate devices like steel edge plates that can be welded together for extra durability. Elevator shafts are a good example of sheer precast concrete wall construction (Gabea & Rachimac, 2017).

2.2.4.5. Partition Walls

They worked together to create a wall-to-ceiling partition wall solution that could be slid into place or the panels could be raised into place and bonded on-site. Compared with traditional brickwork, panels have a strong sound insulation advantage, which makes them ideal for use in hotels, kitchens, hospitals, and schools, as well as flats, where privacy is important or where noise from machines must be muted.

2.3. Evaluation of Prefabricate concrete with cast in place buildings

In the current context, for the building industry is replacing its traditional methods of implementation with a variety of new innovations in the construction process and material choices. This creates a more systematic and automated structure, which is referred to as an industrialized building system, this novel technique. Through the employment of better construction machinery, the productivity and quality of work in the construction industry can be improved (Rong & Desai, 2017).

2.3.1. Usage of prefabricate material in construction industry

Prefabricate construction components are used for construction that is built off-site and then transported to their final destination for assembly. The most commonly used prefabricated construction components include steel, aluminum, wood, fiberglass, and concrete. Steel, wood, concrete, and fiberglass are used to construct small prefabricated houses. The materials used in these structures are plastic or aluminum, which are less expensive than traditional brick and concrete structures. Among the prefabricated sports structures are steel, fiberglass, wood, and aluminum. These materials are chosen for stadium and gym structures and accessories such as stands and seats since they are flexible (Gunawardena & Alfano, 2014).

2.3.2. Concrete

Around 60% of the built environment is made up of concrete, which has been molded by society since the ancient Roman Empires, and is essential for the development of infrastructure, industry, and housing. Concrete provides significantly better strength, durability, and even elegance than many manufactured alternatives (Koespiadi, et al. 2018). The use of concrete in construction is well documented, however, it is also possible to build structures with extremely complex profiles. Precast concrete panels can also be used as a building block for large multistory structures (Limantara, et al. 2018).

Figure 2.4: Prefabricate concrete project

Figure 2.4 show the construction project, which all elements are designed in factory and then installed on construction site.

2.3.3. Wood

Wood is the popular material in prefabricated buildings, it can be used, as heavy timber, which mention to column and beam buildings, or as mass timber, which mention to its use as panel systems. Wood's fire opposition is typically a source of anxiety. They can be a cost-effective alternative to standard solid sawn lumber when used in highly repetitive designed systems (Sandberg & Andersson, 2016).

Wood can also be bringing about into composites with excellent material qualities, even rivaling steels. Cross cover timber (CCT), glued cover lumber and laminated surface lumber are examples of such wood materials. They are all made up of numerous portions of wood sheets glued together with no incessant grain lines for fault, crack initiation and published (Švajlenka & Kozlovská, 2017).

Figure 2.5: Prefabricate wood project

Figure 2.5 show the construction of prefabricated project which is made from wood material.

2.3.4. Steel

Steel is a typical construction element which is used in modular buildings as hold up frame (I-beams and columns), ground, and walls. It can be used in coincidence with other element or as the primary construction material, such as in shipping container conversions, steel has several advantages, including a short weight to power ratio, ease of transport, and recyclability, easy protection, poor acoustic production (Nguyen, 2012).

Moreover, the prefabricated house is made up of a light steel frame with sandwich panels for the building envelope materials, as well as a standard module for space series component combinations, bolt connections, and a novel idea of environmentally, economic activities in prefabricated houses. The developed countries are currently at the forefront of scientific and technological development, and they are investigating the possibility of life, they no longer have time to take care of housing and construction projects because the globe has advanced so much (Torbaghan & Kazemi, 2018).

Figure 2.6: Prefabricate steel project

Figure 2.6 show the construction of prefabricated project which is made from steel material.

2.3.5. Different between cost in place and prefabricate concrete

Concrete is constructed using cement, fine aggregate, coarse aggregate, and water, so there are actually more differences between cost-in-place construction and prefabricate concrete. Prefabricate concrete is a cost-effective and safe way to build any structural type, ensuring quick construction, high profits, and good quality. Traditional building methods are being phased out in favor of precast concrete construction (Rippon, 2011).

The aim of this study is to illustrate how a building expense is distributed across the various components in a way that is useful to the client as well as to the design team through prefabrication (Chavan & Desai, 2017). Cast in place concrete is mixed on-site and poured into molds, consider this to be the traditional method of concrete, used primarily for foundations and load-bearing structures such as beams and columns. The traditional approach to product development has been to sequence tasks according to manufacturing process uncertainties (Yee, et al. 2011).

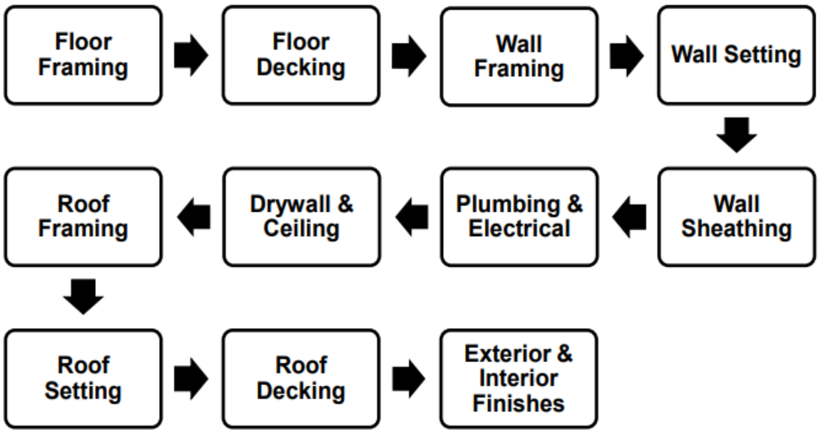

Figure 2.7: Process of prefabricate construction project

Figure 2.7 show the implementation process of prefabricate projects.

Table 2.1: Comparison of Cast in place and prefabricate concrete

Description	**Prefabricate concrete**	**Cast in place concrete**
Speed of construction	Erection speed is extremely fast. On-site construction is moving quickly.	Construction is relatively gradual. On-site casting necessitated time for reinforcement laying and fixing, formwork, and concrete setting.
Quality control	The precast concrete has excellent quality control.	Because to site circumstances, poor supervision, and unskilled personnel, quality may suffer.
Manufacturing conditions	Because of the factory's-controlled circumstances, high quality may be obtained.	Because reinforced concrete is cast on site and site conditions are not uniform, it may have an impact on strength.
Labor Requirement	There is less labor required, and that labor can be lower-skilled.	In the case of Reinforced concrete, more labor is necessary on site.
Frame	Here is what we require: Regular shapes in buildings are used to save money, and the	On-site, it can be cast in any shape.

	need for form repetition will influence building design.	
Size Restrictions	There are no size restrictions.	Precast concrete cannot be used for two-way structural systems due to panel size limitations.
Environmental conditions	Weather is no longer an issue; you may cast in any condition and obtain the same results, allowing you to fine-tune your mixes and procedures.	Environmental factors like as temperature and humidity can have an impact on concrete's performance.
Cost	When the building has irregular shapes, it is more cost-effective.	The economics of scale necessitate regular-shaped structures.
Flexibility in design	There is more flexibility in building design.	Building design freedom is limited.
Connections	Connections are less complicated.	It is difficult to make connections.
Durability	You may create exceptionally durable concrete by precisely controlling the process from materials to consolidation to curing.	RCC is a long-lasting material, but it requires careful quality control.
Size and form	It's simple to create a lot of copies of the same precast product; by maximizing repetition, you can get a lot of value out of a mold and a set-up. This can't be changed on the spot.	When the structure is in an uneven shape and there are no recurring shapes, in-situ concreting is a good option. It allows for more freedom in the implementation.
Discount for large orders	Because a Precast can purchase materials for several projects, volume savings can help to reduce expenses.	Because the owner can only purchase a modest number, the quantity discount is not significant.

2.4. The other Countries experience at prefabricated construction projects

For the past few decades, prefabricated has played a significant role in international development of building manufacturing. It ensures the economy, and protection of the environment during the construction of the structures and is therefore preferred over onsite buildings. Prefabricated, modularization organization building, and industrialized building are the terms used to describe the manufacturing of modular parts on the site or off of it (Moodley & Preece, 2008).

As urban populations grew during the second half of the twentieth century, the use of human power, as well as the use of devices, machines, and other equipment, mostly automatic, was common to provide low-cost housing for the growing urban population. As a result of the second world war, prefabricated concrete was very popular, to conclude, the introduced prefabricated construction projects in the world are listed below (Rippon, 2011).

2.4.1. Singapore prefabricate housing

Currently, Singapore's main public housing authority is creating a scheme to provide high-quality housing at a reasonable price, and to improve the quality of the current public housing stock. A housing development board has been in existence since its founding, responsible for the construction of more than 750,000 apartments that include 86 percent of Singapore's population. Prefabrication technology was used to address challenges involved in the development of high-rise apartment expansions in densely populated areas.

From 1991 to 1994, 21,000 housing units were restored as a result of the program. Prefabrication in public housing modifications is only justified if components are kept simple and streamlined, precast concrete components are homogenous, and as many repetitions of each component are kept at a minimum.

2.4.2. China prefabricate housing

Hong Kong's housing industrialization started in 1953, when a major fire swept through the city, destroying many homes. More than 53,000 people were living on the streets in 2002. Prefabricated components accounted for 17% of all building components in terms of cubic meters. In mainland China, housing industrialization began in 1998. In the decade between 1998 and 2008, the housing market saw a tremendous increase in demand. Due to the large population and lack of land, most people live in multi-story apartment buildings. It is a major challenge for Chinese real estate developers to build more houses in a short period of time with higher quality. With sales of RMB 41 billion, a market shares of 2.34 percent, and 5,570,000 square meters sold in 2008. Vande is China's largest residential developer. Vanke began exploring prefabricated housing in 1999, and completed two prefabricated housing projects in 2006 and 2007 (Yee, et al. 2011).

2.4.3. Japan prefabricate housing

As a result of the second world war, many Japanese manufactured homes were destroyed. Japanese enterprises used the prefabricated housing concept to build more houses without sacrificing quality. Japan has its own industry standard for prefabricated homes: a house is classified as prefabricated if two thirds or more of the construction is completed in a factory and if the principle sections of the home, such as walls and floors, are prefabricated according to industry standards. In 2002, prefabricated housing accounted for about 20% to 25% of new residential construction. For 2002, the ratio rises to about 85% and higher if we include prefabricated modules.

2.4.4. American prefabricate housing

At first, the housing market in North America was fragmented, with a regional focus that was different from that in many European countries. In 1960, precast concrete methods sparked a lot of attention due to their successful deployment in Europe, and several precast concrete technologies were launched in the United States and Canada with the help of large European precast companies looking to expand their markets. Precast concrete has been used in the United States since the early 1960s, depending on what new discoveries are made in the field. It is not always the case, as most prefab facilities are made up of numerous subcomponent lines that work together, a main line is usually the direction that connects them together so they can be assembled and fitted for a final measurement check, any external or interior fixtures may or may not be fitted after this final assembly, depending on the manufacturer and the level of customization involved (Sandberg & Andersson, 2016).

2.4.5. United Kingdom prefabricate housing

After the second world war, the UK lost much of its infrastructure, particularly dwellings, resulting in a housing crisis that needed to be resolved as soon as possible. Since then, a strong push has been made for homes that are supported by innovation (Lawson & Bergin, 2012). A methodical approach to building homes became critical as the need for social housing grew, becoming the perfect form of housing, lasting well beyond their original lives of 10-15 years, despite industry opposition when the notion of providing temporary housing after the war first emerged (Russell, 1996). The prefabricated and factory-manufactured housing represented a significant innovation, which lead to a small public consultation over the type of temporary housing needed, and traditional started to gain traction after the war, providing over 450,000 residences a decade later. Prefabrication became a household term due to its offsite production and quick mass production (GuNawardeNa & Kumar, 2017).

2.4.6. India Prefab housing experience

Hindustan Housing Factory was established in 1950 to meet the housing needs caused by the influx of West Pakistani refugees (now Bangladesh). As a replacement for old timber sleepers, the Hindustan Housing Factory was the first in India to construct pre-stressed concrete sleepers. Government-owned Hindustan Prefab Limited (HPL) manufactures precast concrete for various civil and architectural projects in India.

Prefabricated materials are renowned for their longevity and high quality in India. In an extremely competitive construction market, prefabrication is being used to plan, visualize, and manage the construction process using BIM (Building Information Modeling) methodologies. Due to the requirement to make the most of limited resources, these building systems are gaining traction in India. In addition, they have the ability to address the current challenge of India's housing crisis (Nguyen, 2012).

3. RESEARCH METHODOLOGY

The purpose of this chapter is to provide an overview of the research methods used to study prefabricate and cast in place concrete construction projects, as well as the current situation implementation and project management in various countries. A literature review will assist in determining the most appropriate method for conducting the analysis (Joyner & Glatthorn, 2018). The study also gives an overview of the questionnaire, the target population, the sample used and the survey's analysis and evaluation, as well as the framework created for organizing the construction industry in Kabul, city.

3.1. Flowchart

Flowchart is a diagram that modify step by step progression through a procedure or system in current research method.

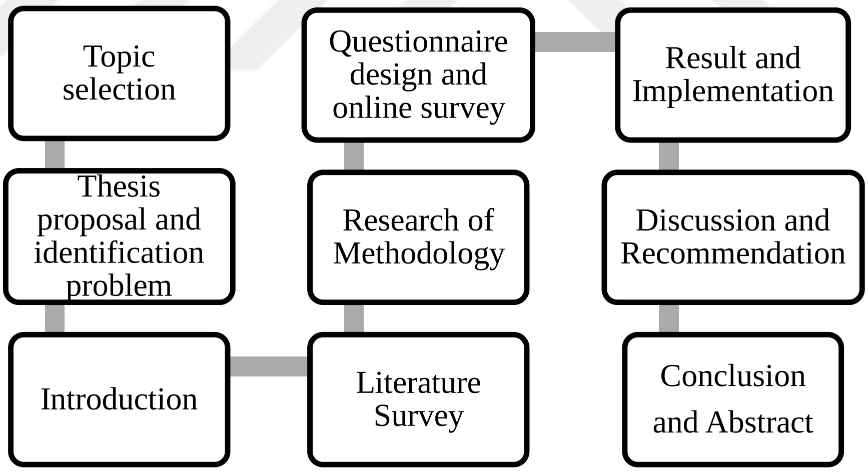

Figure 3.1: Flowchart of the Methodology

Figure 3.1 depicts flowchart methodology, and modify step by step progressive of research which is started from topic selection and ended to conclusion.

In this part, the research methodology used was to review the literature on, construction industry knowledge, advantages, obstacles and tactics to incorporate and accept this industry for the construction industry player. The collection of literature ranged from the latest publication 10 years, which has been 2010 to 2020.

The analysis referred to artefact produce in different acknowledge journals, as like as google scholar, data science, Journal of Engineering drawing and Technology. The research focus to Prefabricated building components as an alternative to cast in place concrete projects in Kabul Afghanistan.

3.2. Methodology of Approach

The research approach is a strategy and procedure that includes everything from broad assumptions to extensive data gathering, analysis, and comprehension approaches. According to the nature of the research problem being addressed. The research approach is separated into three categories:

- The Quantitative Method
- The Qualitative Method
- The Mixed Method

3.2.1. Quantitative Method

The quantitative method follows a scientific method in which the study of literature and theory on the subject leads to precise goals and objectives, as well as questions and theories that can be investigated by looking at the relationships between various variables. As well as contributing to positivity, quantitative methods help to collect accurate data, examine the connections between various facts and how they relate to one another, as well as the theoretical assumptions and recommendations of previous studies. In qualitative research, there are usually no prior hypotheses; therefore, the study aims to get a perspective that can lead to the development of theories (Leedy & Ormrod, 2015).

3.3. Aim of the Research

Prefabricated concrete construction projects for urban development in Kabul city, are an effective alternative to cast-in-place construction. This study examines the perception of quality for prefabricated concrete construction projects versus cast-in-place construction projects and analyzes scope, cost, and time for prefabricated and cast-in-place construction projects.

3.3.1. Definition of the Target population

Target population of this research is comprised of the expert and professionals such as civil engineer, structure engineer, architect, project manager, construction company employees, who have experience in construction projects, as like as cast in place and prefabricate projects in Kabul Afghanistan.

3.3.2. Definition of the Core Concept

Prefabricate concrete construction projects for urban development is an effective alternative to cast in place elements. Housing is one of the most pressing problems facing Kabul, Afghanistan. The combination of Afghanistan's increasing population, the government's weak delivery system, urban growth rates, and urban poverty rates, as well as the migration from rural to urban areas.

The perception of experts in considering the prefabricate elements as an alternative to cast in place concrete constitutes the core concept of the research. The perception of service quality can be identified as the understanding of prefabricate elements and cast in place concrete that are provided with expert and technical response. The experts’ perceptions are believed to be affected by the level of service quality according to cost, time, scope, element production and technology. The experts here are thought to be technical people such as civil engineers, architects, construction engineers, structure engineers and construction company employee experts as defined in target population.

3.3.3. List of External variable

Time: The beginning and end of construction projects are determined by this variable.

Construction material: In construction projects, wood, concrete, steel, cement, aggregates, bricks, clay, metal, foam, and a range of other materials are commonly utilized.

Scope for implementation: In this variable, both parties establish expectations for the project, including responsibilities, milestones, and technical details.

Quality control: The variable represents the level of performance achieved when the activity meets or exceeds a client's or owner's expectations.

Production elements: Designed in a factory and installed on the construction site, this variable refers to the production of construction elements.

Durability: Construction sites benefit from the ability to prefabricate concrete, which has a durable strength.

Prefabricate construction: Prefabricate construction affects the perception of short time in construction projects.

Traditional concrete projects: A traditional concrete project differs from a prefabricate project because it needs to be built for a long time.

Affordable: Modifying the low-cost housing construction project is the affordable variable.

Cost: The variable is related to the budget of the project, which is used during construction.

Not affordable: This variable is stand to not affordable, when it is compared with prefabricate buildings.

Excellent performance: This variable is stand to performance on construction activities.

Precast housing: Building elements are created in a factory and then assembled on site, this variable refers to precast elements.

Feeble Quality: In this way, cast-in-place concrete has a weaker quality, which explains why it is weaker than prefabricate concrete.

Urban development: This variable is stand for urban development, which modifies cast in place concrete projects.

Cast in place concrete projects: The variable of Cast in place concrete stand to prefer use of prefabricate instead of cast in place concrete.

3.3.4. List of Demographic Variable

Demographic variable in this research methodology, provides information about research participants and is essential to establish whether the persons in a study are a representative sample of the target population for purposes of generalization, and it will cover the following aspects, (appendix-A).

Gender: This variable includes male and female.

Age: This variable includes 20-29 years, 30-39 years, 40-49 years, 50 years and above.

Education: This variable includes high school degree, undergraduate degree, Master degree, Ph.D. and others.

Profession: This variable includes civil engineer, structure engineer, architect, project manager, construction companies employee.

Experience: This variable includes work history of respondents, 1-5 years, 6-10 years, 11-15 years, 16 years and above.

3.3.5. Core Concept Diagram

According to title research, aim of research, and target population, the fundamental concept of the research topic is usually the perception of evaluation between prefabricate concrete and cast in place concrete projects. One will often start her/his research questions with an assertion or thesis that she/he must explain how she/he responded to base on her/his topic readings. Core concept is given in Figure 3.2.

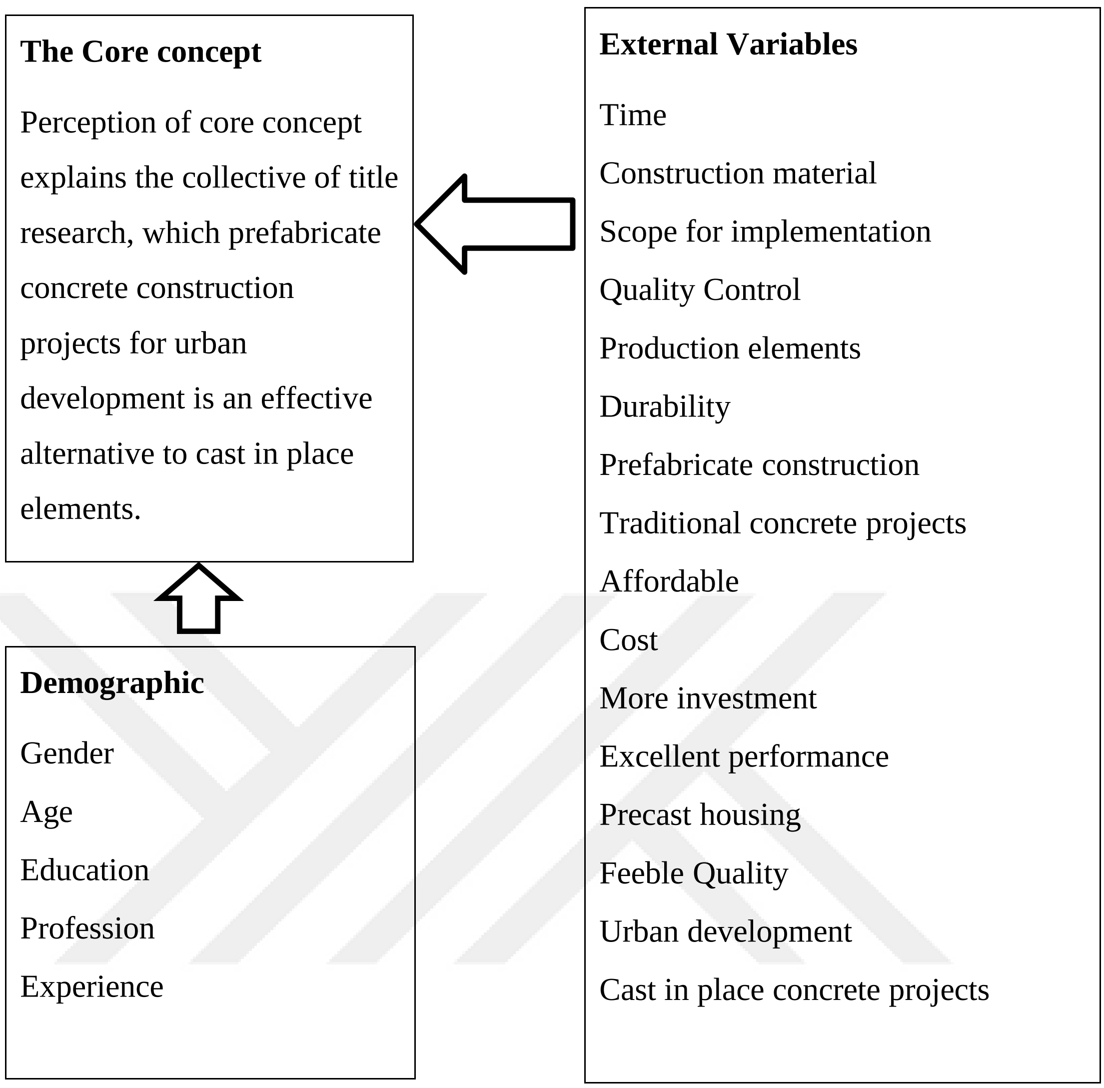

Figure 3.2: Core concept diagram

Figure 3.2 shows the core concept diagram which includes the external variable, demographic variable and core concept variable.

3.3.6. Questionnaire Design

Questionnaire design has a crucial role in obtaining reasonable survey findings. To collect expert opinions on the use of prefabricating construction as an alternative to cast-in-place construction, a questionnaire was used in which the experts considered implementation, cost, time, scope, element production, and technology for both types of construction. There are two parts to the questionnaire, with a total of 26 questions. The questionnaire is cleverly designed to get a high response rate from construction professionals. The structured portion of the survey is graded 1 to 5 points, which can be found in Table 3.1.

Table 3.1: Likert scale used the questionnaire

Strongly disagree	Disagree	Neither agree/ Nor disagree	Agree	Strongly agree
1	2	3	4	5

Table 3.1 shows the five-point Likert scale, which is used in questionnaire survey to modify the respondent's selection.

3.3.7. Duration of the research

When the dissertation topic was determined, the dissertation performance began in March 2021 and continued until, February 2022. During this research, the method described in Figure 3.1 Flowchart of the Methodology was applied. The research questionnaire survey and data collection were completed, by the end of December 2021, data analysis and data cleaning will be complete along with discussion at February 2022.

3.4. Data analysis

The most significant part of every study is data analysis in fact, the data analysis process summarizes the information research. It involves applying analytical and logical reasoning to data to find patterns, correlations, and trends. The survey is organized around the main concept diagram, which is divided into two parts and has a total of 26 questions. A five-point Likert type scale based on frequency labeling is utilized for the questions, while intensity labeling is employed for the rest. The collected data were analyzed in SPSS software. For analysis a consecutive methodology of Principal Component Analysis, Reliability Analysis, Multiple Regression and Correlation Analysis and finally, Measures for Association and Correlation are performed.

3.4.1. Principal Component Analysis

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of correlated variables into a set of uncorrelated variables in exploratory data analysis for predictive models, principal component analysis is the most extensively used tool. Principle component analysis belongs to the exploratory methods of factor analysis because it is the initial step of statistical methods employed in research analysis. Principal component analysis is, in fact, a technique for determining the number of groups, elements, or components that may be recovered from a study model (Kothari, 2004).

For data analysis in this research, SPSS considers groups with eigenvalues larger than 1 to be significant, and the number of components is calculated accordingly. The goal is to reduce the number of variables to a manageable number of components by grouping the variables. A factor variable is thought to measure a common aim, and the factor is given a new name based on the goal it is supposed to measure. At the conclusion of the analysis, the researcher, not the software, does the labeling procedure. The researcher creates a table with the results of principle component analysis which is extracted from the SPSS software output. This table shows the number of components extracted, the percentage of explained variance, component labels, and the makeup of variables within each component in four rows.

3.4.2. Reliability Analysis

The Reliability Analysis technique calculates a number of regularly used scale reliability indicators as well as scale item correlation information. The concept of reliability is examined in two stages. First, the topic of dependability is examined. If there are more than one items in an instrument, the internal consistency is initially assessed. If the internal consistency is judged to be satisfactory, the same measurement tool is used on the same target population at a later time (test, retest technique) or on various target populations at the same time (Kothari, 2004).

The internal consistency measurement is called Cronbach's alpha, which is used to determine the internal consistency of a system. The data sets for this measurement should at the very least be in interval scale. Internal consistency can be defined as a respondent's willingness to reply to items measuring a certain issue in a consistent manner. If Cronbach's alpha is 0.91-1.00 it will be excellent, 0.81-0.90 it will be good, 0.71-0.80 it will be good and acceptable, 0.61- 0.70 it will acceptable, 0.01- 0.60 it will not acceptable, various procedures are taken to improve the measurement. Cronbach's alpha is influenced by a number of factors the number of items in an instrument is the first. Cronbach's coefficient unnaturally increases as the number of items in an instrument grows. It is dangerous to have a large number of things in an instrument since it causes Cronbach to inflate. Similarly, measuring a single topic multiple times artificially inflates. Cronbach's alpha is a scale dependability indicator that determines how closely a group of objects are related to one another. To maintain the number of items constant, Cronbach's alpha climbs in lockstep with the average inter item correlation (Kothari, 2004).

$$\infty = \left(\frac{k}{k-1}\right)\left(\frac{S^2x-\sum S^2y}{S^2x}\right) \qquad (3.1)$$

Where:

k: is the number test item

S^2y: is the sum of the item variance

S^2x: is the variance of total score

Table 3.2: The alpha Cronbach's value

Interpretation	Excellent	Good	Good and acceptable	Acceptable	Not acceptable
Alpha Cronbach's value	0.91-1.00	0.81-0.90	0.71-0.80	0.61-0.70	0.01-0.60

Table 3.2 summarizes the Cronbach's alpha value, which is divided in to five categories excellent 0.91-1.00, good 0.81-0.90, good and acceptable 0.71-0.80, acceptable 0.61-0.70 and not acceptable 0.01-0.60, (knotting, et al. 2009).

For showing that an instrument is trustworthy, a test retest or parallel forms approach must be used to stabilize internal consistency. The external variables that make up the groups are turned into components after the reliability analysis, and the new components are introduced to the model as new external variables.

3.4.3. Multiple Regression and Correlation Analysis

The most frequent approaches for assessing the relationship between two numerical variables are regression and correlation. The strength of a linear link between two variables is measured by correlation, whereas the relationship is described as an equation by regression.

The above-mentioned relationship is expressed mathematically as regression. If the relationship pattern is linear this time, the mathematical expression of the relationship is a line equation. Curves are used to express the relationship in curvilinear relationship patterns. Regression equations and regression models are terms used to describe the equations that capture these linear and curvilinear patterns. The linearity of a model can be expressed using the simple correlation coefficient r. when r is higher than or equal to 0.70 the regression model is linear, when r is less than or equal to 0.70 the model is nonlinear (Kothari, 2004).

$$Y=\beta 0+\beta 1Q1+\beta 2Q2 \ldots\ldots\ldots\ldots.\beta iQi \qquad (3.2)$$

Y: Dependent variable

β 0: Intercept

βi: Slop for Xi

Q: Independent variable

The correlation relationship between the variables is referred to as correlation. The simple correlation coefficient is used to measure the association between two variables in a model that comprises one dependent and one independent variable. When there is one dependent and numerous independent variables, the same measurement is called multiple correlation coefficient. This measurement is done using the canonical correlation coefficient if the model has more than one dependent and independent variables.

3.4.4. Measures for Association and Correlation

Measures of association and correlation are used in a research model to determine the relationship between demographic factors and the core concept. Because the types of scales for the variables that the links between them are sought for different, these measures are classified into two categories: association and correlation. For nominal and ordinal scales for quantitative data, association measurements are valid, while correlation measures are utilized for interval and ratio scales quantitative data. The scale types of the variables whose association is being investigated must be the same in order for these measures to be used (Kothari, 2004).

Table 3.3: The method for measures of association and correlation

Demographic variables and their scale levels	**Possible modification of CC**	**Appropriate measure**	**Appropriate test**	**In SPSS**
Nominal	CC must be transformed into categorical variable CCC by categorizing data into groups	Cramer's V or phi coefficient	Chi – square test	Analyze, Descriptive, Cross tables
Ordinal	There is no need for transformation in SPSS, use original CC variable (due to automatic transformation)	Spearman – rho test	t – test	Analyze, Correlate
Interval	There is no need for transformation. Both of the variables are in interval scale	Pearson r	t – test (small samples) or F test (large samples)	Analyze, Correlate

4. IMPLEMENTATION AND RESULT

This chapter describes the specifics of the information acquired via a questionnaire survey. And distributed to 180 people, which received 164 responses. The researcher was asked by the respondents to use numbers form (1 to 5) point. Likert scale to provide their feedback to determine and assess the efficacy of prefabricated concrete projects and cast in place concrete projects at construction business which are constructed in Kabul, Afghanistan.

Table 4.1: Five-point Likert scale

Strongly disagree	**Disagree**	**Neither agree/ Nor disagree**	**Agree**	**Strongly agree**
1	2	3	4	5

Table 4.1 shows the Likert scale five point, which is used in questionnaire design to modify the respondent’s selection.

4.1. Demographic structure of respondents

Respondents are someone who responds to a question, letter, email message, survey, or another form of communication this necessitates a response. The word react appears in the responder, which indicates to answer or reply to a survey. The research questionnaire was distributed to Kabul Afghanistan construction industry which included civil engineer, structure engineer, Architect, Project manager and construction company’s employee. The questionnaire was share through Facebook, email, WhatsApp and messenger. Total of 180 questionnaires were distribute out of which 164 responded. 91.11 percent of those polled responded, of the 164 people who responded, among those responded 6 of them had high school education, 98 of them had undergraduate, 53 of them had MSc degree, 5 of them had a Ph.D. and there were 2 responses with blank, moreover, work experience of participants were 1-5 years, 6-10 years, 11-15 years, 16 years and above. The demographic structured of respondents is given with more detail at table 4.2.

Table 4.2: Demographic structure of respondents shows variables (Q1 to Q7)

		Q1-Gender	Q2-Age	Q3-Education	Q4-Profession	Q5-Experience	Question #6	Question #7
N	Valid	164	164	164	164	164	164	164
	Missing	0	0	0	0	0	0	0

Q1-Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	0.6	0.6	0.6
	Female	23	14.0	14.0	14.6
	Male	140	85.4	85.4	100.0
	Total	164	100.0	100.0	

Q2-Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	1.8	1.8	1.8
	20-29 Years	39	23.8	23.8	25.6
	30-39 Years	71	43.3	43.3	68.9
	40-49 Years	45	27.4	27.4	96.3
	50 Years and above	6	3.7	3.7	100.0
	Total	164	100.0	100.0	

Q3-Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	1.2	1.2	1.2
	BSc or Undergraduate	98	59.8	59.8	61.0
	High school	6	3.7	3.7	64.6
	MSc or Post graduate	53	32.3	32.3	97.0

		Frequency	Percent	Valid Percent	Cumulative Percent
	Ph D.	5	3.0	3.0	100.0
	Total	164	100.0	100.0	

Q4-Profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	1.8	1.8	1.8
	Architect	21	12.8	12.8	14.6
	Civil Engineer	59	36.0	36.0	50.6
	Construction Company	14	8.5	8.5	59.1
	Other	9	5.5	5.5	64.6
	Project Manager	29	17.7	17.7	82.3
	Structure Engineer	29	17.7	17.7	100.0
	Total	164	100.0	100.0	

Q5-Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	1.8	1.8	1.8
	1-5 Years	47	28.7	28.7	30.5
	11-15 Years	45	27.4	27.4	57.9
	16 Years and above	8	4.9	4.9	62.8
	6-10 Years	61	37.2	37.2	100.0
	Total	164	100.0	100.0	

Q6- Your knowledge with (Ms. project, Primavera, PRINCE2, Smart sheet) software's for construction project business

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	3.0	3.0	3.0
	Elementary	74	45.1	45.1	48.2
	High	16	9.8	9.8	57.9
	Middle	69	42.1	42.1	100.0

	Total	164	100.0	100.0	

Q7- Do you know what organization is responsible to production of prefabricated element in Kabul Afghanistan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	1.8	1.8	1.8
	Kabul Municipality	19	11.6	11.6	13.4
	Ministry of urban development and land	20	12.2	12.2	25.6
	National Development Corporation	114	69.5	69.5	95.1
	Other	8	4.9	4.9	100.0
	Total	164	100.0	100.0	

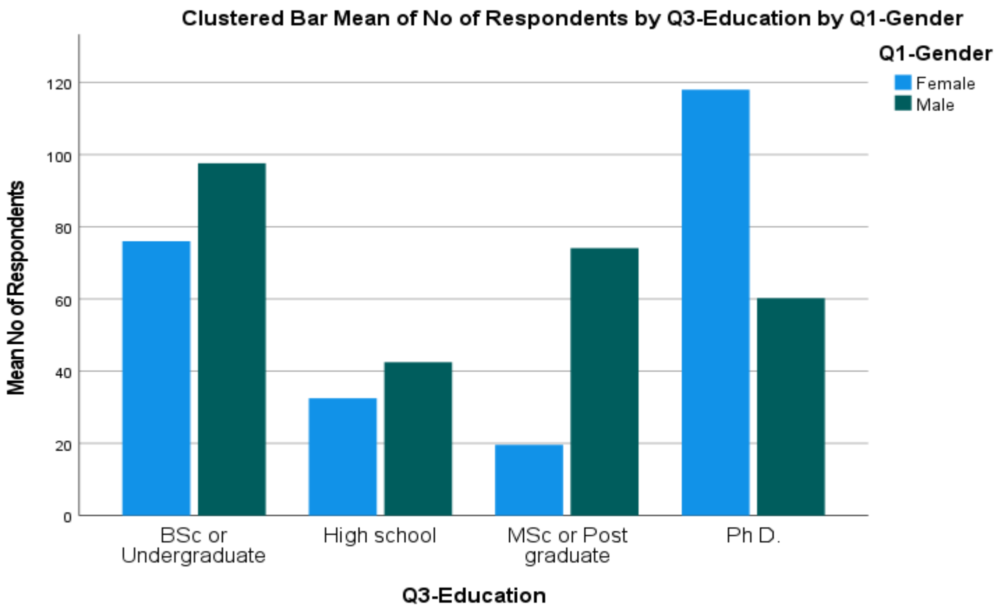

Figure 4.1: Level of education demographic

Figure 4.1 depicts the level of education about respondents, which include high school, bachelor degree, master degree and Ph.D. degree.

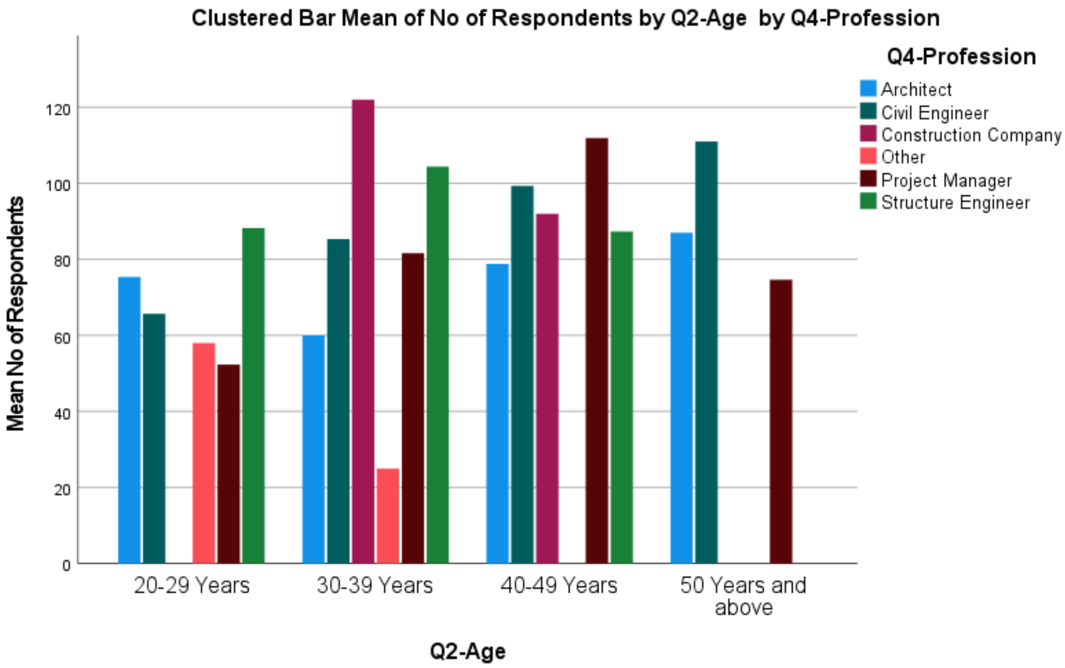

Figure 4.2: Level of age demographic

Figure 4.2 depicts the age and profession about respondents, which include Architect, civil engineer, structure engineer, project manager and others.

4.2. Descriptive analysis

Descriptive analysis is a sort of data analysis that helps to show and explain, or summarize data points in a constructive way so that patterns can developing that satisfy all of the data conditions which is responded by questionnaire survey. It is also one of the most important steps in the statistical data analysis process, as it provides a sense of how data are distributed, aids with the detection of outliers and mistakes, and allows the researcher to spot relationships between variables, such that the researcher becomes able to conduct future statistical analysis. In the current statement, calculation of standard deviation and mean considered to have a clear descriptive analysis among profession which are responded questionnaire survey. The descriptive analysis result is shown in table 4.3.

In the column labeled N, the number of cases is recorded, the Minimum and Maximum columns contain information about the range of variables, the sum of the Mean column values, the data in the Std. Deviation column which is determined at table 4.3, it can be used to analyze variability, the bigger the standard deviation, the more individual data points deviate from the mean. In contrast, if there is a lot of resemblance between data points, the standard deviation, variance statistics, skewness statistics, kurtosis statistics, which are various for each variable and selected by SPSS. Table 4.6 and 4.7 show the compression of performance with different profession, which include Civil engineer, Structure engineer, Architect, Project manager and construction company employee.

Table 4.3: Descriptive Statistics analysis of respondents

	N	Range	Min	Max	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Question #8	161	3	2	5	4.58	0.057	0.729	0.532	-1.813	0.191	2.784	0.380
Question #9	163	4	1	5	4.51	0.056	0.715	0.511	-1.728	0.190	3.989	0.378
Question #10	164	4	1	5	4.42	0.062	0.799	0.638	-1.493	0.190	2.318	0.377
Question #11	164	4	1	5	4.33	0.059	0.752	0.566	-1.415	0.190	3.064	0.377
Question #12	164	4	1	5	4.24	0.058	0.744	0.554	-1.152	0.190	2.379	0.377
Question #13	164	4	1	5	4.20	0.056	0.719	0.518	-1.322	0.190	4.121	0.377
Question #14	164	4	1	5	3.99	0.064	0.814	0.662	-.0945	0.190	1.584	0.377
Question #15	163	4	1	5	4.04	0.066	0.849	0.720	-1.248	0.190	2.334	0.378
Question #16	164	4	1	5	4.34	0.065	0.838	0.703	-1.523	0.190	2.452	0.377
Question #17	164	4	1	5	4.25	0.048	0.620	0.385	-1.004	0.190	4.308	0.377
Question #18	163	4	1	5	2.53	0.083	1.062	1.127	0.538	0.190	-0.430	0.378
Question #19	163	4	1	5	2.44	0.097	1.243	1.544	0.770	0.190	-0.454	0.378

Question #20	160	4	1	5	4.09	0.061	0.775	0.601	-1.394	0.192	3.848	0.381
Question #21	162	4	1	5	4.36	0.058	0.744	0.554	-1.696	0.191	4.878	0.379
Question #22	163	3	2	5	4.23	0.051	0.651	0.423	-0.944	0.190	2.415	0.378
Question #23	163	4	1	5	3.60	0.073	0.927	0.860	-0.659	0.190	0.866	0.378
Question #24	164	4	1	5	4.21	0.057	0.730	0.533	-1.395	0.190	4.188	0.377
Question #25	164	4	1	5	4.40	0.068	0.870	0.756	-2.114	0.190	5.490	0.377
Question #26	163	4	1	5	4.52	0.056	0.715	0.511	-1.853	0.190	4.653	0.378
Valid N (list wise)	152											

Table 4.4: External variable which collected through questionnaire survey (Q#8 to Q#17)

		Question #8	Question #9	Question #10	Question #11	Question #12	Question #13	Question #14	Question #15	Question #16	Question #17
N	Valid	161	163	164	164	164	164	164	163	164	164
	Missing	3	1	0	0	0	0	0	1	0	0
Mean		4.58	4.51	4.42	4.33	4.24	4.20	3.99	4.04	4.34	4.25
Median		5.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.50	4.00

Mode	5	5	5	4	4	4	4	4	5	4
Std. Deviation	0.729	0.715	0.799	0.752	0.744	0.719	0.814	0.849	0.838	0.620
Variance	0.532	0.511	0.638	0.566	0.554	0.518	0.662	0.720	0.703	0.385
Skewness	-1.813	-1.728	-1.493	-1.415	-1.152	-1.322	-0.945	-1.248	-1.523	-1.004
Std. Error of Skewness	0.191	0.190	0.190	0.190	0.190	0.190	0.190	0.190	0.190	0.190
Kurtosis	2.784	3.989	2.318	3.064	2.379	4.121	1.584	2.334	2.452	4.308
Std. Error of Kurtosis	0.380	0.378	0.377	0.377	0.377	0.377	0.377	0.378	0.377	0.377
Range	3	4	4	4	4	4	4	4	4	4
Minimum	2	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5	5

Table 4.5: External variable which collected through questionnaire survey (Q#18 to Q#26)

		Question #18	Question #19	Question #20	Question #21	Question #22	Question #23	Question #24	Question #25	Question #26
N	Valid	163	163	160	162	163	163	164	164	163
	Missing	1	1	4	2	1	1	0	0	1
Mean		2.53	2.44	4.09	4.36	4.23	3.60	4.21	4.40	4.52

Median	2.00	2.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00
Mode	2	2	4	4	4	4	4	5	5
Std. Deviation	1.062	1.243	0.775	0.744	0.651	0.927	0.730	0.870	0.715
Variance	1.127	1.544	0.601	0.554	0.423	0.860	0.533	0.756	0.511
Skewness	0.538	0.770	-1.394	-1.696	-0.944	-0.659	-1.395	-2.114	-1.853
Std. Error of Skewness	0.190	0.190	0.192	0.191	0.190	0.190	0.190	0.190	0.190
Kurtosis	-0.430	-0.454	3.848	4.878	2.415	0.866	4.188	5.490	4.653
Std. Error of Kurtosis	0.378	0.378	0.381	0.379	0.378	0.378	0.377	0.377	0.378
Range	4	4	4	4	3	4	4	4	4
Minimum	1	1	1	1	2	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

Table 4.6: Compression of performance with different profession (Q8 to Q17)

Q4-Profession	Question #8	Question #9	Question #10	Question #11	Question #12	Question #13	Question #14	Question #15	Question #16	Question #17
Mean	2.50	4.00	4.00	4.33	3.67	3.67	4.00	3.33	3.67	4.67

	N	2	2	3	3	3	3	3	3	3	3
	Std. Deviation	0.707	0.000	1.732	0.577	1.155	1.528	1.000	1.155	1.528	0.577
	Variance	0.500	0.000	3.000	0.333	1.333	2.333	1.000	1.333	2.333	0.333
	Range	1	0	3	1	2	3	2	2	3	1
	Sum	5	8	12	13	11	11	12	10	11	14
Architect	Mean	4.62	4.57	4.48	4.67	4.43	4.48	4.00	3.90	4.38	4.24
	N	21	21	21	21	21	21	21	21	21	21
	Std. Deviation	0.590	0.676	0.602	0.577	0.811	0.814	0.775	.995	0.921	0.539
	Variance	0.348	0.457	0.362	0.333	0.657	0.662	0.600	.990	0.848	0.290
	Range	2	2	2	2	3	3	3	4	3	2
	Sum	97	96	94	98	93	94	84	82	92	89
Civil Engineer	Mean	4.47	4.36	4.27	4.10	4.15	4.12	3.88	3.97	4.27	4.22
	N	58	59	59	59	59	59	59	58	59	59
	Std. Deviation	0.799	0.846	0.848	0.865	0.761	0.646	0.984	0.917	0.906	0.767
	Variance	0.639	0.716	0.718	0.748	0.580	0.417	0.968	0.841	0.822	0.589
	Range	3	4	3	4	3	4	4	4	4	4
	Sum	259	257	252	242	245	243	229	230	252	249

Construction Company	Mean	4.93	4.64	4.64	4.50	4.36	4.29	3.93	4.29	4.50	4.21
	N	14	14	14	14	14	14	14	14	14	14
	Std. Deviation	0.267	0.497	0.497	0.650	0.633	0.611	0.616	0.611	0.519	0.426
	Variance	0.071	0.247	0.247	0.423	0.401	0.374	0.379	0.374	0.269	0.181
	Range	1	1	1	2	2	2	2	2	1	1
	Sum	69	65	65	63	61	60	55	60	63	59
Other	Mean	3.56	3.78	3.11	3.44	3.78	3.44	3.56	3.33	3.22	3.78
	N	9	9	9	9	9	9	9	9	9	9
	Std. Deviation	0.882	0.833	1.167	0.882	1.481	1.130	0.726	1.000	1.093	0.667
	Variance	0.778	0.694	1.361	0.778	2.194	1.278	0.528	1.000	1.194	0.444
	Range	3	3	4	2	4	4	2	3	3	2
	Sum	32	34	28	31	34	31	32	30	29	34
Project Manager	Mean	4.82	4.76	4.59	4.52	4.28	4.24	4.17	4.31	4.48	4.31
	N	28	29	29	29	29	29	29	29	29	29
	Std. Deviation	0.390	0.511	0.501	0.509	0.455	0.577	0.658	0.471	0.509	0.471
	Variance	0.152	0.261	0.251	0.259	0.207	0.333	0.433	0.222	0.259	0.222
	Range	1	2	1	1	1	2	2	1	1	1

	Sum	135	138	133	131	124	123	121	125	130	125
Structure Engineer	Mean	4.86	4.72	4.86	4.55	4.41	4.38	4.17	4.21	4.62	4.38
	N	29	29	29	29	29	29	29	29	29	29
	Std. Deviation	0.441	0.455	0.351	0.506	0.501	0.561	0.658	0.774	0.561	0.494
	Variance	0.195	0.207	0.123	0.256	0.251	0.315	0.433	0.599	0.315	0.244
	Range	2	1	1	1	1	2	3	4	2	1
	Sum	141	137	141	132	128	127	121	122	134	127
Total	Mean	4.58	4.51	4.42	4.33	4.24	4.20	3.99	4.04	4.34	4.25
	N	161	163	164	164	164	164	164	163	164	164
	Std. Deviation	0.729	0.715	0.799	0.752	0.744	0.719	0.814	0.849	0.838	0.620
	Variance	0.532	0.511	0.638	0.566	0.554	0.518	0.662	0.720	0.703	0.385
	Range	3	4	4	4	4	4	4	4	4	4
	Sum	738	735	725	710	696	689	654	659	711	697

Table 4.7: Compression of performance with different profession (Q18 to Q26)

Q4-Profession	Question #18	Question #19	Question #20	Question #21	Question #22	Question #23	Question #24	Question #25	Question #26

	Mean	4.00	5.00	5.00	4.33	4.33	4.33	4.00	4.67	4.33
	N	2	3	3	3	3	3	3	3	3
	Std. Deviation	0.000	0.000	0.000	1.155	1.155	0.577	1.000	0.577	1.155
	Variance	0.000	0.000	0.000	1.333	1.333	0.333	1.000	0.333	1.333
	Range	0	0	0	2	2	1	2	1	2
	Sum	8	15	15	13	13	13	12	14	13
Architect	Mean	2.62	2.05	3.90	4.62	4.25	3.52	4.29	4.67	4.52
	N	21	21	20	21	20	21	21	21	21
	Std. Deviation	1.024	0.921	0.968	0.590	0.444	1.078	0.561	0.483	0.928
	Variance	1.048	0.848	0.937	0.348	0.197	1.162	0.314	0.233	0.862
	Range	4	3	4	2	1	4	2	1	4
	Sum	55	43	78	97	85	74	90	98	95
Civil Engineer	Mean	2.80	2.98	3.98	4.28	4.15	3.31	4.10	4.14	4.47
	N	59	59	59	58	59	58	59	59	59
	Std. Deviation	1.215	1.383	0.900	0.833	0.761	1.030	0.941	0.991	0.679
	Variance	1.475	1.914	0.810	0.694	0.580	1.060	0.886	0.981	0.461
	Range	4	4	4	4	3	4	4	4	3

	Sum	165	176	235	248	245	192	242	244	264
Construction Company	Mean	1.93	1.93	4.29	4.31	4.36	3.86	4.29	4.71	4.64
	N	14	14	14	13	14	14	14	14	14
	Std. Deviation	0.616	0.730	0.611	0.480	0.497	0.663	0.469	0.469	0.497
	Variance	0.379	0.533	0.374	0.231	0.247	0.440	0.220	0.220	0.247
	Range	2	3	2	1	1	2	1	1	1
	Sum	27	27	60	56	61	54	60	66	65
Other	Mean	2.78	2.88	4.00	3.67	3.78	3.78	3.78	3.22	3.88
	N	9	8	8	9	9	9	9	9	8
	Std. Deviation	0.667	1.246	0.756	1.118	1.093	0.972	0.833	1.563	1.126
	Variance	0.444	1.554	0.571	1.250	1.194	0.944	0.694	2.444	1.268
	Range	2	4	2	4	3	3	3	4	3
	Sum	25	23	32	33	34	34	34	29	31
Project Manager	Mean	2.24	2.07	4.19	4.48	4.34	3.83	4.28	4.59	4.66
	N	29	29	27	29	29	29	29	29	29
	Std. Deviation	0.786	0.842	0.622	0.688	0.484	0.805	0.528	0.568	0.484
	Variance	0.618	0.709	0.387	0.473	0.234	0.648	0.278	0.323	0.234

	Range	3	4	2	3	1	3	2	2	1
	Sum	65	60	113	130	126	111	124	133	135
Structure Engineer	Mean	2.31	1.86	4.21	4.45	4.31	3.72	4.41	4.72	4.59
	N	29	29	29	29	29	29	29	29	29
	Std. Deviation	1.072	0.953	0.491	0.506	0.471	0.702	0.501	0.455	0.682
	Variance	1.150	0.909	0.241	0.256	0.222	0.493	0.251	0.207	0.466
	Range	4	4	2	1	1	2	1	1	3
	Sum	67	54	122	129	125	108	128	137	133
Total	Mean	2.53	2.44	4.09	4.36	4.23	3.60	4.21	4.40	4.52
	N	163	163	160	162	163	163	164	164	163
	Std. Deviation	1.062	1.243	0.775	0.744	0.651	0.927	0.730	0.870	0.715
	Variance	1.127	1.544	0.601	0.554	0.423	0.860	0.533	0.756	0.511
	Range	4	4	4	4	3	4	4	4	4
	Sum	412	398	655	706	689	586	690	721	736

Table 4.7 shows the compression of performance with different profession, which include Civil engineer, Structure engineer Architect, Project manager and construction company.

4.3. Principle Component Analysis

The most popular use of multivariate data analysis is principle component analysis (PCA), which is used to portray a multivariate data table as a smaller number of variables so that trends, jumps, clusters, and outliers may be seen. This overview may reveal the connections between observations and variables, as well as among the variables.

The implementation of PCA in this research is conducted through SPSS. In fact, SPSS considers groups with eigenvalues larger than 1 to be significant, and the number of components are calculated accordingly. The goal is to reduce the number of variables to a manageable number of components by grouping the variables. A factor's variables are thought to measure a common aim, and the factor is given a new name based on the goal it is supposed to measure. At the conclusion of the analysis, the researcher, not the software, does the labeling procedure. The researcher creates a table with the results of PCA extracted from the SPSS software output.

Table 4.8 shows that the necessary dataset homogeneity was attained when the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) coefficient is 0.781, which is greater than 0.50 as required. Moreover, the Bartlett's Test of Sphericity significance value is 0.001, which is less than the commonly used significance level α=0.05. These results show that no extreme point analysis is required, and PCA can be proceeded as long as the two initial assumptions are met.

Table 4.8: KMO and Bartlett's tests results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.781
Bartlett's Test of Sphericity	Approx. Chi-Square	728.197
	df	171
	Sig.	<0.001

As shown in Table 4.9, SPSS extracts six components with eigenvalues larger than 1 and they are named as C1 to C6. These components explain totally 61.5% of the variation in data. The percentages of variance explained are higher for the components with higher eigenvalues. In fact, the first component, C1, explains nearly 11.53 percent of the total variance in the entire dataset, whereas this amount is 11.45% for the second component C2, 10.48% for the third component C3, 10.19% for the fourth component, 9.81% for the fifth component C5, and 8.03% for the last component C6, approximately.

Table 4.9: Total components variance explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.681	24.636	24.636	4.681	24.636	24.636	2.192	11.539	11.539
2	1.830	9.630	34.266	1.830	9.630	34.266	2.176	11.454	22.993
3	1.490	7.840	42.106	1.490	7.840	42.106	1.992	10.484	33.478
4	1.367	7.197	49.303	1.367	7.197	49.303	1.938	10.199	43.677
5	1.310	6.893	56.196	1.310	6.893	56.196	1.865	9.817	53.494
6	1.022	5.381	61.577	1.022	5.381	61.577	1.536	8.083	61.577
7	0.908	4.778	66.355						
8	0.788	4.148	70.502						
9	0.745	3.922	74.424						
10	0.666	3.506	77.930						
11	0.634	3.337	81.266						
12	0.594	3.124	84.391						
13	0.551	2.898	87.288						
14	0.516	2.718	90.006						
15	0.457	2.403	92.409						
16	0.442	2.324	94.733						
17	0.405	2.131	96.864						

18	0.335	1.763	98.628						
19	0.261	1.372	100.000						

Extraction Method: Principal Component Analysis.

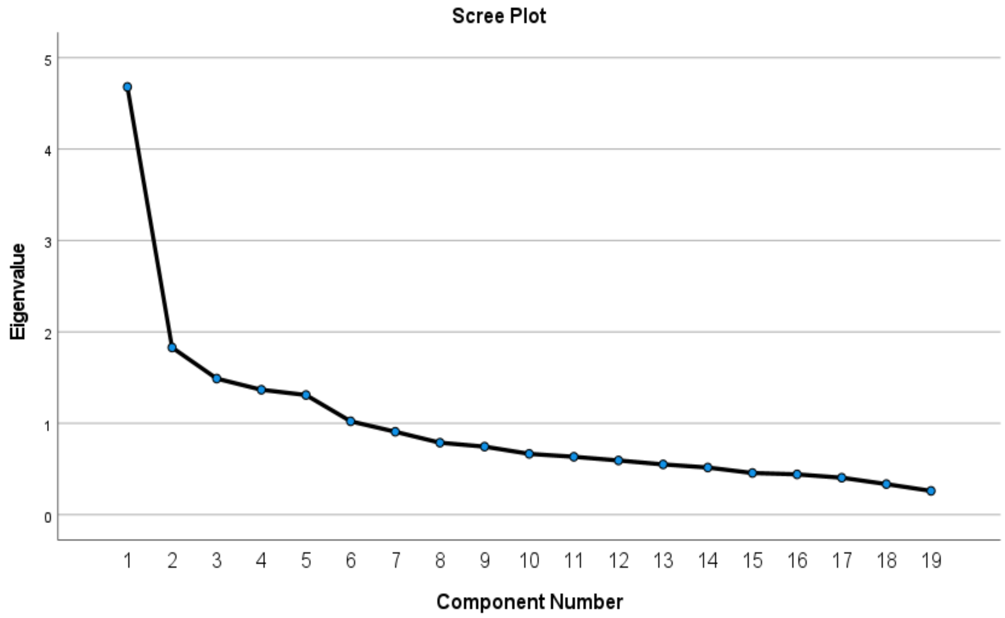

Figure 4.3: Component extracted by SPSS

Figure 4.3 shows the scree plot depicts the proportion variation explained as a function of the primary components decreasing in size, each component explains a little less than the previous component. This is used to suitable number of components for further investigation.

Table 4.10: Rotated Component Matrix for component (C1-C6)

	1	2	3	4	5	6
Question #21	0.702	0.020	-0.014	0.024	-0.040	0.018
Question #16	0.683	-0.086	0.088	0.231	-0.176	0.119
Question #11	0.593	0.312	0.113	0.291	0.011	0.058
Question #14	-0.293	0.726	0.076	0.077	-0.125	0.180
Question #13	0.201	0.609	0.218	0.239	0.173	-0.021

Question #15	0.132	0.561	0.118	0.488	-0.072	-0.248
Question #10	0.441	0.509	0.313	-0.077	-0.214	0.062
Question #8	0.415	0.459	0.299	0.081	-0.230	0.130
Question #22	0.157	0.427	-0.294	0.247	0.020	0.364
Question #25	0.194	0.185	0.780	-0.035	0.008	0.120
Question #9	0.058	0.200	0.744	0.151	-0.274	0.016
Question #20	-0.029	-0.043	0.619	0.505	0.099	0.075
Question #12	0.226	0.140	-0.008	0.712	-0.021	0.153
Question #26	0.462	0.009	0.211	0.558	0.121	0.089
Question #23	0.028	0.192	0.067	0.526	-0.195	0.049
Question #19	-0.038	-0.067	-0.085	-0.053	0.882	-0.111
Question #18	-0.152	-0.010	-0.047	-0.061	0.853	0.138
Question #17	0.066	-0.126	0.153	0.211	0.152	0.774
Question #24	0.100	0.232	0.059	-0.029	-0.130	0.765

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

Table 4.10 shows the rotated components matrix, which displays the factor loadings of each external variable for each of the components, this table is the key to interpreting to six factor, and the factors the correlation coefficient between the variable and factor and we select the high value for each comment which is necessary for Table 4.11, rotated component matrix for component C1 (0.702, 0.683, 0.593), rotated component matrix for component C2 (0.726, 0.609, 0.561, 0.509, 0.459, 0.427), rotated component matrix for component C3 (0.780, 0.744, 0.619), rotated component matrix for component C4 (0.712, 0.558, 0.526), rotated component matrix for component C5 (0.882, 0.853), rotated component matrix for component C6 (0.774, 0.765).

Table 4.11: Extracted of principle component analysis

Total variance explained

Number of factors/ components extracted	C1	C2	C3	C4	C5	C6	Total of variance explained
Percentage of explained variation	11.539	11.454	10.484	10.199	9.817	8.083	61.577
Label of components	Project execution	Implementation and quality	Economic of Projects	Performance of procurement	Placement of prefabricate concrete and cast in place concrete on projects	Construction material weight	
Composition of variables with each components	Q21, Q16, Q11	Q14, Q13, Q15, Q10, Q8, Q22	Q25, Q9, Q20	Q12, Q26, Q23	Q19, Q18	Q17, Q24	

Table 4.11 explain the adjusted components. C1 is composed of three variables (Q21, Q16, Q11) and the label is determined as project execution. The second component C2 is composed of six variables (Q14, Q13, Q15, Q10, Q8, Q22) and the label is determined as Implementation and quality. The third component C3 is composed of three variables (Q25, Q9, Q20) and the label is determined as Economic of Projects. The fourth component C4 is composed of three variable (Q12, Q26, Q23) and the label is determined as performance of procurement. The fifth component C5 is composed of two variables (Q19, Q18) and the label is determined as placement of

prefabricate concrete and cast in place concrete on projects, the sixth component C6 is composed of two variables (Q17, Q24) and the label is determined as construction material weight.

4.4. Reliability analysis

One of the most important tests that should be conducted for any outstanding research is data reliability analysis. The reliability analysis technique generates data on the correlations between individual scale items as well as a variety of commonly used scale reliability metrics, furthermore, reliability analysis can be used to investigate the properties of measuring scales and the items that make up the scales. The Reliability Analysis technique calculates a variety of commonly used scale reliability indicators as well as information on scale item correlations. Cronbach's Alpha information is provided in the table below.

Table 4.12: Cronbach's value alpha (knotting et al, 2009)

Interpretation	Excellent	Good	Good and acceptable	Acceptable	Not acceptable
Alpha Cronbach's value	0.91-1.00	0.81-0.90	0.71-0.80	0.61-0.70	0.01-0.60

Table 4.12 shows the Cronbach's alpha value, which modifies 0.91-1.00 excellent, 0.8-0.90 good, 0.71-0.80 good and acceptable, 0.61-0.70 acceptable and 0.01-0.60 not acceptable.

Table 4.13: Reliability Statistics for C1

Cronbach's Alpha	N of Items
0.640	3

Table 4.13 depicts the reliability for component C1, and Cronbach's alpha coefficient which is found as 0.640 which is less than 0.7, in this case it is acceptable, but it is not reliable, and it is need to select next design.

Table 4.14: Item-Total Statistics for C1

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Question #21	8.69	1.745	0.418	0.584
Question #16	8.70	1.415	0.508	0.456
Question #11	8.70	1.753	0.428	0.571

Table 4.14 depicts total item statistics for component C1, with three variables, if deleted one component here, the Cronbach's Alpha coefficient dose not approach to 0.7. Therefore, assume C1 to be not reliable.

Table 4.15: Reliability statistics for C2

Cronbach's Alpha	N of Items
0.739	6

Table 4.15 depicts the reliability statistics for component C2, and Cronbach's alpha coefficient is found as 0.739 which is greater than 0.7. In this case, it is acceptable therefore, component C2 is assumed to be reliable.

Table 4.16: Reliability statistics for C3

Cronbach's Alpha	N of Items
0.669	3

Table 4.16 depicts the reliability for component C3, and Cronbach's alpha coefficient which is found as 0.669, which is less than 0.7. In this case, it is acceptable, but it is not reliable and it is need to select next design.

Table 4.17: Item-Total Statistics for C3

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Question #25	8.61	1.493	0.498	0.555
Question #9	8.50	1.771	0.521	0.533
Question #20	8.93	1.723	0.436	0.633

Table 4.17 depicts total item statistics for component C3, with three variables. If each of the variables are deleted one by one, it is seen that the Cronbach's alpha does not converge to 0.7. Therefore, C3 is not reliable.

Table 4.18: Reliability statistics for C4

Cronbach's Alpha	N of Items
0.576	3

Table 4.18 depicts the reliability for component C4, and Cronbach's alpha coefficient which is found as 0.576, which is less than 0.7. In this case, it is acceptable but it is not reliable.

Table 4.19: Item-Total Statistics for C4

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Question #12	8.10	1.672	0.475	0.354
Question #26	7.85	1.771	0.423	0.431

Question #23	8.77	1.547	0.293	0.658

Table 4.19 depicts total item statistics for component C4, with three variables. If each of the variables are deleted one by one, it is seen that the Cronbach does not converge to 0.7. Therefore, C4 is not reliable.

Table 4.20: Reliability statistics for C5

Cronbach's Alpha	N of Items
0.777	2

Table 4.20 depicts the reliability statistics for component C5, and Cronbach's alpha coefficient is found as 0.777, which is greater than 0.7. In this case, it is acceptable therefore, component C5 is assumed as a reliable.

Table 4.21: Reliability statistics for C6

Cronbach's Alpha	N of Items
0.508	2

Table 4.21 depicts the reliability for component C6, and Cronbach's alpha coefficient which is found as 0.508, which is less than 0.7. In this case, it is acceptable but it is not reliable.

Table 4.22: Item-Total Statistics for C6

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Question #17	4.21	0.533	0.345	.
Question #24	4.25	0.385	0.345	.

Table 4.22 depicts total item statistics for component C6, with two variables, the third variable is not selected by SPSS.

Table 4.23: Detail of components

Component	Label of Component	Reliable/Not Reliable	Cronbach's alpha	Variables
C1	Project execution	Not Reliable	0.64	Q21, Q16, Q11
C2	Implementation and quality	Reliable	0.739	Q14, Q13, Q15, Q10, Q8, Q22
C3	Cost management of projects	Not Reliable	0.669	Q25, Q9, Q20
C4	Performance of procurement	Not Reliable	0.576	Q12, Q26, Q23
C5	placement of prefabricated concrete and cast in place concrete	Reliable	0.777	Q19, Q18
C6	Construction material weigh	Not Reliable	0.508	Q17, Q24

Table 4.23 depicts components detail from C1 to C6, which modify C2 and C5 are reliable, the Cronbach's alpha value is greater than 0.7 for components C2 and C5.

4.5. Multiple Regression and Correlation Analysis

The most common methodologies for investigating the relationship between two quantitative variables are regression and correlation. Correlation measures the strength of a linear link between two variables, whereas regression describes the relationship as an equation.

Table 4.24: The correlations analysis

Correlations

		Question #10	Question #21	Question #16	Question #11	C2	Question #25	Question #9	Question #20	Question #12	Question #26	Question #23	C5	Question #17	Question #24
Pearson Correlation	Question #10	1	0.22	0.257	0.376	0.66	0.398	0.343	0.096	0.23	0.224	0.22	-0.263	0.057	0.223
	Question #21	0.22	1	0.337	0.301	0.186	0.101	0.135	0.072	0.169	0.278	0.157	-0.089	0.008	0.156
	Question #16	0.257	0.337	1	0.407	0.25	0.161	0.172	0.172	0.261	0.324	0.15	-0.213	0.179	0.164
	Question #11	0.376	0.301	0.407	1	0.47	0.265	0.219	0.213	0.32	0.397	0.247	-0.121	0.148	0.136
	C2	0.66	0.186	0.25	0.47	1	0.346	0.399	0.242	0.376	0.337	0.298	-0.229	0.107	0.279
	Question #25	0.398	0.101	0.161	0.265	0.346	1	0.51	0.366	0.112	0.281	0.137	-0.092	0.138	0.172
	Question #9	0.343	0.135	0.172	0.219	0.399	0.51	1	0.407	0.175	0.168	0.249	-0.289	0.087	0.12
	Question #20	0.096	0.072	0.172	0.213	0.242	0.366	0.407	1	0.245	0.322	0.182	0	0.189	0.109
	Question #12	0.23	0.169	0.261	0.32	0.376	0.112	0.175	0.245	1	0.436	0.288	-0.084	0.219	0.154
	Question #26	0.224	0.278	0.324	0.397	0.337	0.281	0.168	0.322	0.436	1	0.194	-0.029	0.253	0.116
	Question #23	0.22	0.157	0.15	0.247	0.298	0.137	0.249	0.182	0.288	0.194	1	-0.125	0.039	0.151
	C5	-0.263	-0.089	-0.213	-0.121	-0.229	-0.092	-0.289	0	-0.084	-0.029	-0.125	1	0.088	-0.116
	Question #17	0.057	0.008	0.179	0.148	0.107	0.138	0.087	0.189	0.219	0.253	0.039	0.088	1	0.347
	Question #24	0.223	0.156	0.164	0.136	0.279	0.172	0.12	0.109	0.154	0.116	0.151	-0.116	0.347	1

Table 4.24 gives detail of the correlation between each pair of variables, and do want strong correlation between the criterion and the predictor variables, the value here are not acceptable, they are all less than 0.7. Hence further analysis is necessary. In addition, in this correlation variable 10 (Question #10) is the core concept for the current analysis.

Table 4.25: Model Summary for the first regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.714[a]	0.509	0.463	0.559	2.180

a. Predictors: (Constant), Question #24, Question #20, C5, Question #21, Question #23, Question #12, Question #25, Question #17, Question #16, Question #11, Question #26, C2, Question #9

b. Dependent Variable: Question #10

Table 4.25 summarizes the results for the first regression analysis applied using the variables declared in Table 4.24. Here, the adjusted R square value tells us that our model accounts for 46.3% of variance in the spelling scores, in this case it is not a good model.

Table 4.26: ANOVA for the first regression analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.767	13	3.444	11.019	<0.001[b]
	Residual	43.127	138	0.313		
	Total	87.895	151			

a. Dependent Variable: Question #10

b. Predictors: (Constant), Question #24, Question #20, C5, Question #21, Question #23, Question #12, Question #25, Question #17, Question #16, Question #11, Question #26, C2, Question #9

Table 4.26 reports the ANOVA results for the first regression analysis applied using the variables declared in Table 4.24. Here the overall significance of our model is assessed with sig value. the Sig is found to be less than < 0.05, that, this model is significant.

Table 4.27: Coefficients for the first regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-0.428	0.618		-0.692	0.490
	Question #21	0.081	0.076	0.071	1.074	0.285
	Question #16	0.052	0.066	0.056	0.793	0.429
	Question #11	0.044	0.077	0.043	0.577	0.565
	C2	0.152	0.021	0.551	7.087	<0.001
	Question #25	0.235	0.078	0.223	3.022	0.003
	Question #9	0.017	0.086	0.015	0.193	0.847
	Question #20	-0.138	0.071	-0.137	-1.957	0.052
	Question #12	-0.005	0.080	-0.005	-0.066	0.947

Question #26	-0.043	0.082	-0.039	-0.527	0.599
Question #23	0.010	0.054	0.012	0.190	0.850
C5	-0.031	0.024	0-.085	-1.300	0.196
Question #17	-0.016	0.084	-0.013	-0.189	0.850
Question #24	0.018	0.074	0.016	0.240	0.811

Table 4.27 shows the standardized beta coefficients provide a measure of each variable's contribution to the model. The t and sig values give a general estimate of the impact of each predictor variable, and a big value suggests that a unit change in this predictor variable has a large effect on the criterion variable. A large absolute t value indicates that a predictor variable has a significant influence on the criterion variable. For the regression coefficients to be valid, it is required that sig values corresponding to them must be less that the commonly used significance level $\alpha=0.05$. However, here, all sig values are greater than 0.05; that is, these regression coefficients cannot be used to form a valid model. Hence, in the second regression analysis applied, the component having Pearson correlation coefficient close to 0.7, which is C2, is only kept in the model and all the remaining variables and components are deleted.

Table 4.28: The correlations analysis

		Question #10	C2
Pearson Correlation	Question #10	1.000	0.685
	C2	0.685	1.000
Sig. (1-tailed)	Question #10	.	<0.001
	C2	0.000	.
N	Question #10	159	159
	C2	159	159

Table 4.28 gives detail of the correlation between core concept and component C2, and do want strong correlation between the criterion and the predictor variables, the value here are not acceptable, they are all less than 0.7. Hence further analysis is necessary.

Table 4.29: Model Summary for the second regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.685[a]	0.469	0.466	0.579	2.188

Table 4.29 summarizes the results for the second regression analysis applied using the only component 2. Here, the adjusted R square value tells us that our model accounts for 46.6% of variance in the spelling scores, in this case it is not a good model .

Table 4.30: ANOVA for the second regression analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	46.478	1	46.478	138.784	<0.001[b]
	Residual	52.579	157	0.335		
	Total	99.057	158			

a. Dependent Variable: Question #10

b. Predictors: (Constant), C2

Table 4.30 reports the ANOVA results for the second regression analysis applied using the variables declared in Table 4.24. Here the overall significance of our model is assessed with sig value. the Sig is found to be less than < 0.05, that, this model is significant.

Table 4.31: Coefficients for the second regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-0.246	0.400		-0.615	0.540
	C2	0.183	0.016	0.685	11.781	<0.001

a. Dependent Variable: Question #10

Table 4.31 shows the contribution of each variable to the model is measured using standardized beta coefficients. The t and sig values give a general indication of the impact of each predictor variable, and the big value implies that a unit change in this predictor variable has a large effect on the criterion variable. A large absolute t value indicates that a predictor variable has a significant effect on the criterion variable. For the regression coefficients to be valid, it is required that sig values corresponding to them must be less that the commonly used significance level α=0.05. However, here, all sig values are greater than 0.05; that is, these regression coefficients cannot be used to form a valid model. Hence, in the third regression analysis applied, the component having Pearson correlation coefficient close to 0.7, which is C2, is only kept in the model and all the remaining variables and components are deleted.

Table 4.32: Correlations analysis

		Question #10	C2
Std. Cross-product	Question #10	1.000	0.992
	C2	0.992	1.000
Sig. (1-tailed)	Question #10	.	<0.001
	C2	0.000	.
N	Question #10	159	159
	C2	159	159

a. Coefficients have been calculated through the origin.

Table 4.32 give detail of the correlation between core concept and component C2, we do not want strong correlation between the criterion and the predictor variables, the value here are acceptable, the value is greater than 0.7.

Table 4.33: Model Summary for the third regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.992[a]	0.984	0.984	0.578	2.194

Table 4.33 summarizes the results for the third regression analysis applied using the variables declared in Table 4.24. Here, the adjusted R square value tells us that our model accounts for 98.4% of the variance in the spelling scores, in this case it is not a good model.

Table 4.34: ANOVA for the third regression analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3172.295	1	3172.295	9509.947	<0.001
	Residual	52.705	158	0.334		
	Total	3225.000	159			

Table 4.34 reports the ANOVA results for the third regression analysis applied using the variables declared in Table 4.24. Here the overall significance of our model is assessed with sig value. the Sig is found to be less than < 0.05, that, this model is significant.

Table 4.35: Coefficients for the third regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	C2	0.174	0.002	0.992	97.519	<0.001

Table 4.35 displays standardized beta coefficients, giving a measure of the contribution of each variable to the model. For the regression coefficient to be valid it is required that sig values corresponding to them must be less than the commonly used

significance level α=0.05. Since here all sig values are less than 0.05, these regression coefficients can be used to form a valid model.

The data analyses described in the methodology section, the data from 26 samples gathered during the research study which are entered into SPSS Statistics 28.0 software. Data analysis for each variable were undertaken in order to overcome this problem. The model's variables with kurtosis values are removed. Some variables with negative kurtosis values near to 0 in this analysis, the variables Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9 Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, and Q26 were retained in the model. Another principal component analysis was run with these variables, the output of KMO = 0.781, Table 4.8, which meets the analysis, but a sig value of 0.490, Table 4.27, for Bartlett's test, which cannot be accepted. For the time being, the skewness values of the model's independent variables C1, C2, C3, C4, C5, and C6 which is extracted by SPSS in the model.

The components created using the principal component analysis are shown in Table 4.9. With the components generated here, the cumulative percentage of explained variation were found as C1=11.539%, C2=22.993%, C3=33.478%, C4=43.677%, C5=53.494%, C6=61.577%. From the analysis six components which is identified by SPSS.

The internal consistency analysis for component C1, C3, C4, C6, Cronbach’s alpha found as less than 0.70. Therefore, they are not reliable. And the internal consistency analysis for component C2, Cronbach’s alpha found as 0.739 which greater than 0.70. Therefore, C2 is reliable, and consistency analysis for component C5, Cronbach’s alpha found as 0.777 which greater than 0.70. Therefore, C5 is reliable.

C2 = Q8+Q10+Q13+Q14+Q15+Q22, and C5 = Q19+Q18. Table 4.23.

The regression analysis was used to discover the components representative items, Q10 determine dependent variable and Q8, Q9, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20 , which are modify in. (Appendix B).

4.6. Measures for Association and Correlation

Measures of association and correlation are used to provide a way of summarizing the size of the link between two variables, which is useful for determining the relationship between demographic parameters and the core concept. The majority of association measurements are scaled measures.

Table 4.36: Scales of the demographic variable

Demographic variable	Measure which modified in SPSS	Demographic variable details
Gender	Nominal	Male=1, Female=2
Age	Ordinal	20-29 Years=1, 30-39 Years=2, 40-49 Years=3, 50 Years and above=4
Education	Ordinal	High school=1, BSc Degree=2, MSc Degree=3, ph. D.=4, Others=5
Profession	Nominal	Civil Engineer=1, Structure Engineer=2, Architect=3, Project Manager=4, Construction Company=5, Others=6
Experience	Ordinal	1-5 Years=1, 5-10 Yeas=2, 11-15 Years=3, 16 Years and above=4
Engineering software	Nominal	Elementary=1, Middle=2, High=3
Prefabricate organization	Nominal	Kabul Municipality=1, National Development Corporation=2, Ministry of urban development and land=3

Table 4.36 displays the scales of the demographic variable for measures of association and correlation analysis which is explained in section 3 at the list of the demographic variables.

Table 4.37: Cross tabulation for the demographic variable "gender"

			Q1-Gender		
			Male	Female	Total
CCC	1.00	1	61	8	70
	2.00	0	78	16	94
Total		1	139	24	164

Table 4.37 displays the total of responded which include 139 males and 24 females.

Table 4.38: Symmetric measures for the demographic variable “gender”

		Value	Approximate Significance
Nominal by Nominal	Phi	0.118	0.319
	Cramer's V	0.118	0.319
N of Valid Cases		164	

Table 4.38 shows symmetric measures for the demographic variables “gender” for the approximate significance, which is 0.319, and value for Phi is 0.118.

Table 4.39: Correlations for the demographic variable “age”

			Question #10	Q2-Age
Spearman's rho	Question #10	Correlation Coefficient	1.000	0.172*
		Sig. (2-tailed)	.	0.029
		N	164	161
	Q2-Age	Correlation Coefficient	0.172*	1.000
		Sig. (2-tailed)	0.029	.
		N	161	161

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.39 shows the Spearman’s Rho correlation coefficient for demographic variable age, in which sig value is 0.029 which is less than the commonly used significance level α=0.05. This means that, there is a significant relationship between the demographic variable “age” and the core concept.

Table 4.40: Correlations for the demographic variable “education”

			Question #10	Q3-Education
Spearman's rho	Question #10	Correlation Coefficient	1.000	-0.045
		Sig. (2-tailed)	.	0.566
		N	164	164
	Q3-Education	Correlation Coefficient	-0.045	1.000
		Sig. (2-tailed)	0.566	.
		N	164	164

Table 4.40 shows Spearman’s Rho correlation coefficient for demographic variable education, in which sig value is 0.566 which is greater than the commonly used significance level α=0.05. This means that, there is not a significant relationship between the demographic variable “education” and the core concept.

Table 4.41: Correlations for the demographic variable “profession”

			Question #10	Q4-Profession
Spearman's rho	Question #10	Correlation Coefficient	1.000	-0.006
		Sig. (2-tailed)	.	0.934
		N	164	164
	Q4-Profession	Correlation Coefficient	-0.006	1.000
		Sig. (2-tailed)	0.934	.
		N	164	164

Table 4.41 shows the Spearman’s Rho correlation coefficient for demographic variable profession, in which sig value is 0.934 which is greater than the commonly used significance level α=0.05. This means that, there is not a significant relationship between the demographic variable “profession” and the core concept.

Table 4.42: Correlations for the demographic variable “experience”

			Question #10	Q5-Experience
Spearman's rho	Question #10	Correlation Coefficient	1.000	0.197*
		Sig. (2-tailed)	.	0.011
		N	164	164
	Q5-Experience	Correlation Coefficient	0.197*	1.000
		Sig. (2-tailed)	0.011	.
		N	164	164

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.42 shows the Spearman’s Rho correlation coefficient for demographic variable experience, in which sig value is 0.011 which is less than the commonly used significance level α=0.05. This means that, there is a significant relationship between the demographic variable “experience” and the core concept.

Table 4.43: Correlations for the demographic variable “Q6- Your knowledge”

			Question #10	Q6- Question #6
Spearman's rho	Question #10	Correlation Coefficient	1.000	-0.128
		Sig. (2-tailed)	.	0.104
		N	164	164
	Q6- Your knowledge with (Ms. project, Primavera, PRINCE2, Smart sheet) software’s for construction project business	Correlation Coefficient	-0.128	1.000
		Sig. (2-tailed)	0.104	.
		N	164	164

Table 4.43 shows the Spearman’s Rho correlation coefficient for demographic variable “Q6- Your knowledge with (Ms. project, Primavera, PRINCE2, Smart sheet) software’s for construction project business” in which sig value is 0.104 which is greater than the commonly used significance level α=0.05. This means that, there is

not a significant relationship between the demographic variable “Q6- Your knowledge with (Ms. project, Primavera, PRINCE2, Smart sheet) software’s for construction project business” and the core concept.

Table 4.44: Correlations for the demographic variable “Q7- Do you know what organization”

			Question #10	Q7- Question #7
Spearman's rho	Question #10	Correlation Coefficient	1.000	0.005
		Sig. (2-tailed)	.	.951
		N	164	164
	Q7- Do you know what organization is responsible to production of prefabricated element in Kabul Afghanistan	Correlation Coefficient	0.005	1.000
		Sig. (2-tailed)	0.951	.
		N	164	164

Table 4.44 shows the Spearman’s Rho correlation coefficient for demographic variable “Q7- Do you know what organization is responsible to production of prefabricated element in Kabul Afghanistan” in which sig value is 0.951 which is greater than the commonly used significance level α=0.05. This means that, there is not a significant relationship between the demographic variable “Q7- Do you know what organization is responsible to production of prefabricated element in Kabul Afghanistan” and the core concept.

4.7. Modify Core concept diagram

The Core concept diagram shows that prefabricating concrete construction projects for urban development is an effective alternative to cast in place elements, project in Kabul, Afghanistan, Figure 4.4.

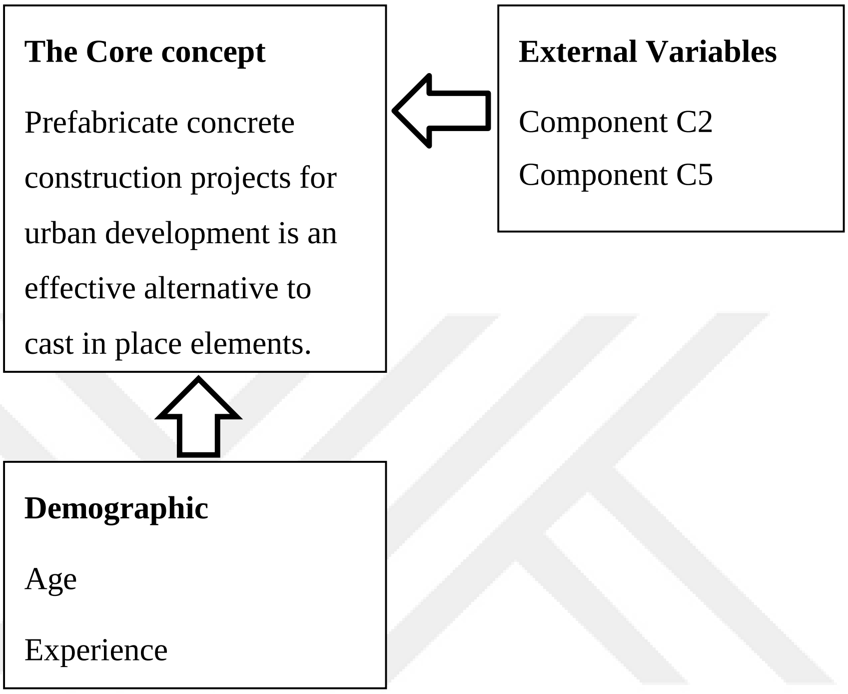

Figure 4.4: Modified Core concept diagram

Figure 4.4 shows relationship between external variable with core concept and demographic variable with core concept. The internal consistency analysis for component C2, Cronbach's alpha found as 0.739 which is greater than 0.70. Therefore, C2 is reliable, and internal consistency analysis for component C5, Cronbach's alpha found as 0.777 which is greater than 0.70. Therefore, C5 is reliable. Moreover, the Spearman's Rho correlation coefficient for demographic variable age, is 0.029 which is less than the, α=0.05. There is a significant relationship between the demographic variable "age" and the core concept. And the Spearman's Rho correlation coefficient for demographic variable experience, is 0.011 which is less than the, α=0.05. There is a significant relationship between the demographic variable "experience" and the core concept.

5. DISCUSSION AND RECOMMENDATION

5.1. Discussion

The purpose of this study is to uncover survey findings that illustrate numerical findings according to implementation and result sections, as well as to evaluate prefabricated concrete elements as an alternative to conventional concrete projects in Kabul, Afghanistan. In a questionnaire survey of quantitative research analysis, the researcher received 164 responses out of 180. Most of the 164 participants supported prefabricated concrete projects based on their comments in Kabul city.

We calculated the ANOVA results of the first and second regression analyses using the variables. The model was evaluated by estimating the sig value. In this case, the Sig is less than < 0.05, thus making these models significant. According to the internal consistency analysis for components C1, C3, C4, C6, Cronbach's alpha is less than 0.70. As a result, Component 2 is reliable, and Cronbach's alpha for Componenet5 was 0.777, a value greater than 0.70. Therefore, Component 5 is reliable. To conclude, the ultimate finding of this study in the second regression analysis, Component 2 is the only component that has a Pearson correlation coefficient close to 0.7 and all the other variables are deleted.

The demographic variable, there is a significant relationship between the demographic variable “age” and the core concept, the correlation coefficient sig value is 0.029 which is less than the, significance level α=0.05. And there is a significant relationship between the demographic variable “experience” and the core concept, the correlation coefficient sig value is 0.011 which is less than the, significance level α=0.05, which are useful relationship between demographic parameters and the core concept.

5.2. Limitation of this research

I conducted research as instructed by my advisor in Kabul, city, for two semesters about prefabricated building components as an alternative to cast-in-place concrete projects. As I evaluated which one is better for Kabul city's public population, I encountered different obstacles that led me to the following conclusions.

- It is hard to find written documentation and essential data, especially about prefabrication components, in Afghanistan.
- Due to officials' reluctance to provide information, extremely limited information was available for the investigation.
- There is a lack of written research papers on prefabricated construction projects in Kabul, Afghanistan.
- Since the project is primarily concerned with the design of structural frames. As a result, a complete comparison of the finished building is impossible.
- The collection of material for the construction of housing projects on-site is not organized, which limits the ability to compare material waste with prefab construction methods.
- In the online survey, it is possible that some respondents did not explain the real answer.

5.3. Recommendation

This study's recommendations have a number of implications for the successful implementation of prefabricating projects in Kabul Afghanistan, as listed below.

- As a result of their numerical analysis, the majority of the 164 participants prefer prefabricated concrete projects.
- Using ANOVA to modify the significant models, which the first, second, and third regression analyses applied using the variables, the models are assessed with sig value, and the sig value is less than < 0.05.
- In order to improve quality for urban development, there are significant resources for developing prefabricated construction projects.
- The results reveal that external variables and demographic variables have an important influence on the research concept.
- The results of this study demonstrate that prefabricate construction is more economical and faster than traditional construction, and further studies ought to be conducted to find more practical ways to incorporate this system into the construction industry in Kabul city.

6. CONCLUSION

This research analyzed prefabricated concrete elements with cast-in-place concrete projects in Kabul, Afghanistan, to find out the scope, cost and time required for prefabricated and cast-in-place construction projects. It is certainly true that prefabrication can be used to reduce material wastage, but when it comes to the adoption of prefabricated, mainly for the development of housing in Kabul city, it is clear this form of production is unpopular with private businesses and people. Prefabricated concrete systems offer many advantages over site-casting concrete.

In this study, a quantitative methodology and an online survey were used, which was designed as a Likert scale to get a high response rate from construction professionals. The structured section of the survey is graded between 1 and 5 points and has 26 questions, and is distributed to 180 professionals in Kabul, Afghanistan. A total of 164 valid questionnaires were collected through Google Form, resulting in 91.11 percent of the respondents responding, and analyzed using SPSS 28. The hypotheses were assessed using descriptive analyses, principle component analyses, reliability analyses, regression and correlation analyses, as well as measures of association and correlation analysis. Further, Cronbach's Alpha, KMO, and Bartlett's tests were used to test the validity of the adopted scales.

The findings of this study suggest that prefabricating projects can be adopted successfully. Firstly, prefabricated concrete is easier, faster and cheaper than cast in place concrete. Secondly, the cost of a prefabricated building system is initially less than that of cast in place. Lastly, construction management is acceptable depending on the extent of work on-site, quality and durability of the project. For urban development in Kabul, city, prefabricating concrete construction projects can be an effective alternative to cast-in-place elements.

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APPENDIX A

Table A.1: Demographic structure of respondents

Question description which is started from #1 to #7	No of respondents	Percentage of respondents
Q #1- Gender?		
Male	140	85.4%
Female	23	14.0%
Blank	1	0.6%
Total of respondent	**164**	**100.0%**
Q #2- Age?		
20-29 Years	39	23.8%
30-39 Years	71	43.3%
40-49 Years	45	27.4%
50 Years and above	6	3.7%
Blank	3	1.8%
Total of respondent	**164**	**100.0%**
Q #3- Education?		
High school	6	3.7%
BSc or Undergraduate	98	59.8%
MSc or Postgraduate	53	32.3%
Ph. D.	5	3.0%
Blank	2	1.2%
Total of respondent	**164**	**100.0%**
Q #4- Profession?		
Civil Engineer	59	36.0%
Structure Engineer	29	17.7%
Architect	21	12.8%
Project Manager	29	17.7%
Construction Company	14	8.5%
Others	9	5.5%
Blank	3	1.8%
Total of respondent	**164**	**100.0%**
Q #5- Experience?		
1-5 Years	47	28.7%
6-10 Years	61	37.2%

11-15 Years	45	27.4%
16 Years and above	8	4.9%
Blank	3	1.8%
Total of respondent	**164**	**100.0%**
Q #6- Your knowledge with (Ms. project, Primavera, PRINCE2, Smart sheet) software's for construction project business?		
Elementary	74	45.1%
Middle	69	42.1%
High	16	9.8%
Blank	5	3.0%
Total of respondent	**164**	**100.0%**
Q #7- Do you know what organization is responsible to production of prefabricated element in Kabul Afghanistan?		
Kabul municipality	19	11.6%
Nation Development Corporation	114	69.5%
Ministry of urban development and land	20	12.2%
Other	8	4.9%
Blank	3	1.8%
Total of respondent	**164**	**100.0%**

APPENDIX B

Table B.1: Show questionnaire survey which the researcher asked from the participants

No	Question	Strongly agree	Agree	Neither agree/Nor Disagree	Disagree	Strongly disagree
8	Prefabricate concrete buildings are constructed in very short time.	5	4	3	2	1
9	The costs in prefabricate concrete projects are less when compared to cast in place projects.	5	4	3	2	1

10	Prefabricate concrete construction projects for urban development is an effective alternative to cast in place elements.	5	4	3	2	1
11	Prefabricate concrete projects have simple scope for implementation on site.	5	4	3	2	1
12	Prefabricate concrete projects have excellent quality performance.	5	4	3	2	1
13	Prefabricate concrete projects have acceptable element production for construction projects.	5	4	3	2	1
14	The better-quality control may not be achieved if the technology is adopted for prefabricate projects in construction activities.	5	4	3	2	1
15	Prefabricate buildings are more durable than traditional construction.	5	4	3	2	1
16	Insulation can reduce the energy demands for heating and cooling system in prefabricate projects.	5	4	3	2	1
17	Prefabrication elements have less weight than traditional materials in construction projects.	5	4	3	2	1
18	It is not appropriate to use prefabricate building components instead of cast in place concrete.	5	4	3	2	1
19	Cast in place concrete projects have a special place in urban development.	5	4	3	2	1
20	Cast in place concrete projects requires more investment when compared to prefabricate buildings.	5	4	3	2	1
21	Cast in place concrete projects cannot be completed in short time if we compared to prefabricate projects.	5	4	3	2	1
22	Cast in place concrete projects are different in terms of implementation when compared to prefabricate construction.	5	4	3	2	1

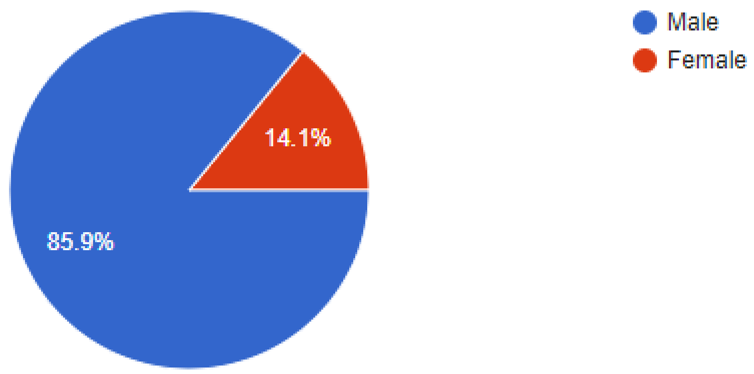
23	Cast in place concrete projects have weak quality than prefabricate buildings.	5	4	3	2	1
24	Production of components in cast in place concrete projects are harder than prefabricate projects.	5	4	3	2	1
25	The prefabricate concrete projects are more affordable than cast in place concrete projects.	5	4	3	2	1
26	Prefabricate projects are the shortest way to obtain housing for public people when compared to traditional construction methods.	5	4	3	2	1

APPENDIX C

Questionnaire survey which shows with google form question

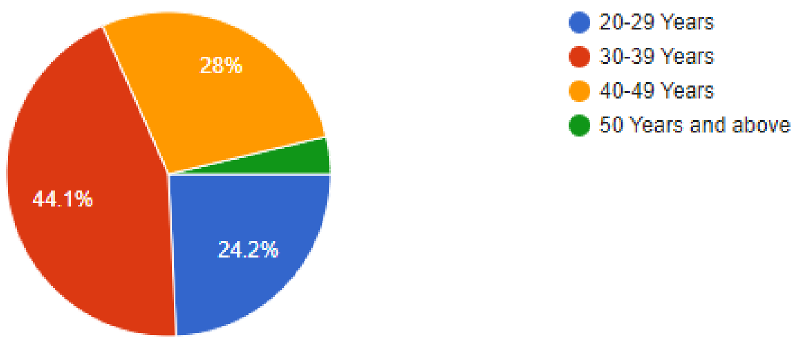
1- Gender?

163 responses



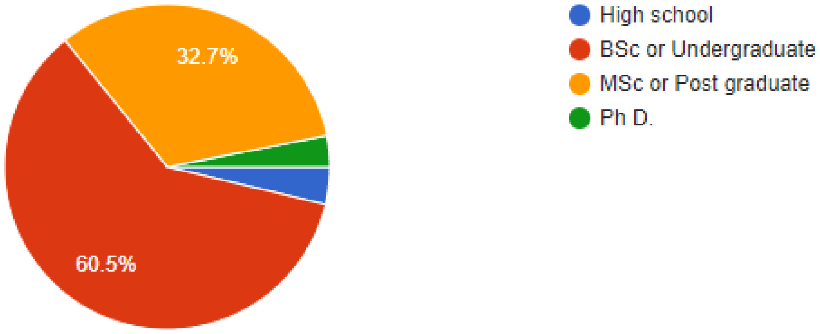
2- Age?

161 responses



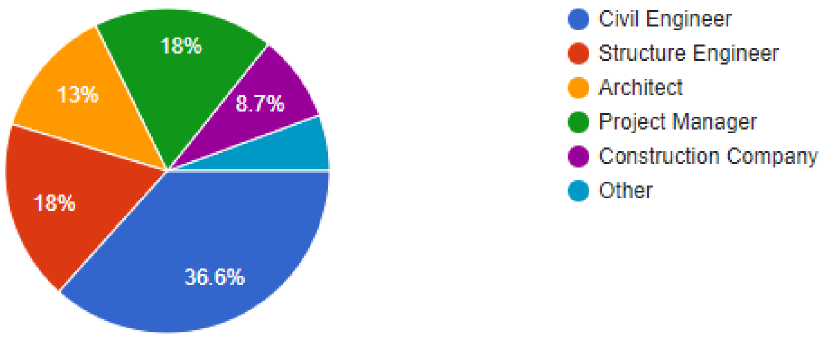
3- Education?

162 responses



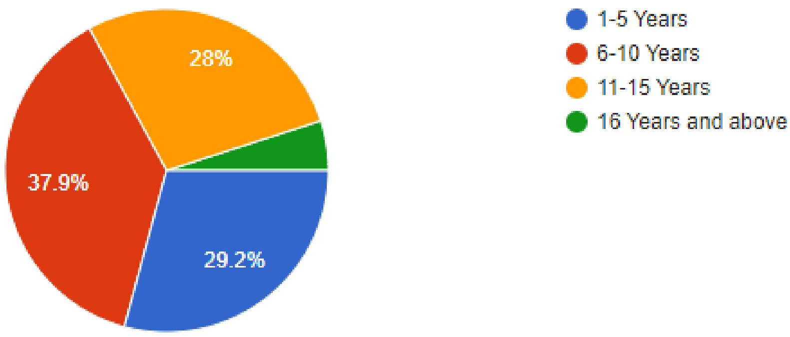
4- Profession?

161 responses



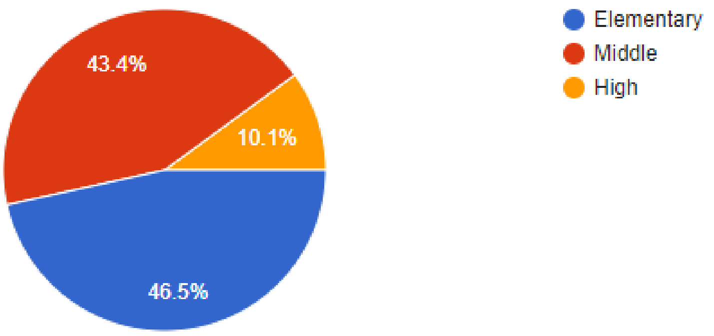
5- Experience?

161 responses



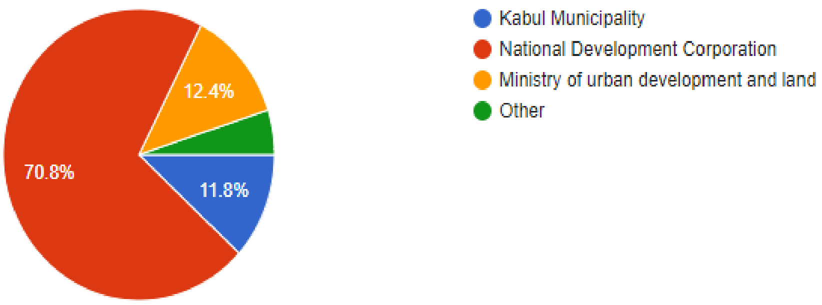
6- Your knowledge with (Ms. project, Primavera, PRINCE2, Smart sheet) software's for construction project business?

159 responses



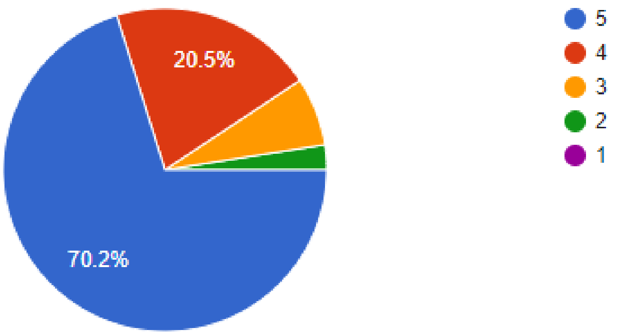
7- Do you know what organization is responsible to production of prefabricated element in Kabul Afghanistan?

161 responses



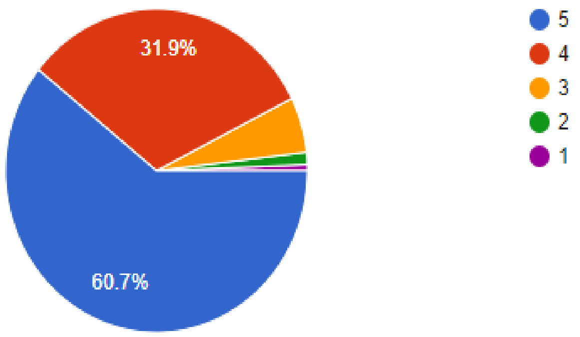
8- Prefabricate concrete buildings are constructed in very short time.

161 responses



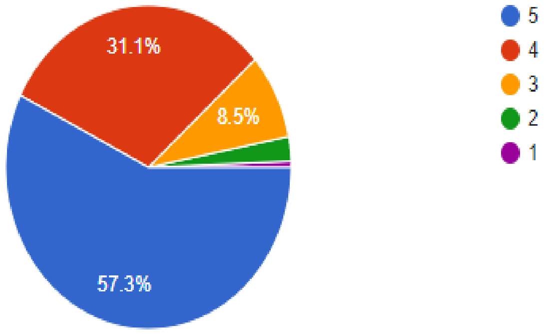
9- The costs in prefabricate concrete projects are less when compared to cast in place projects.

163 responses



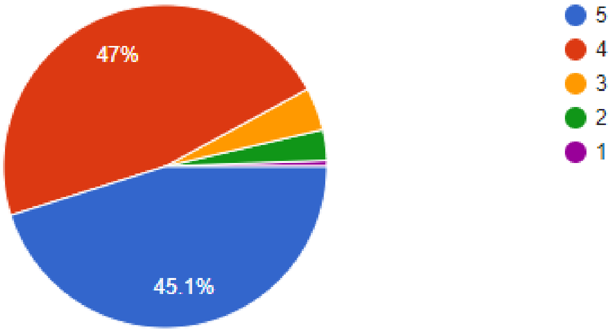
10- Prefabricate concrete construction projects for urban development is an effective alternative to cast in place elements.

164 responses



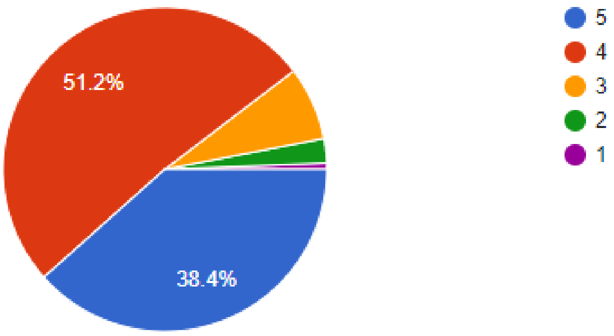
11- Prefabricate concrete projects have simple scope for implementation on site.

164 responses



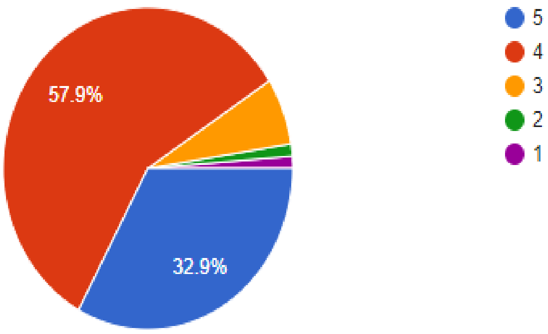
12- Prefabricate concrete projects have excellent quality performance.

164 responses



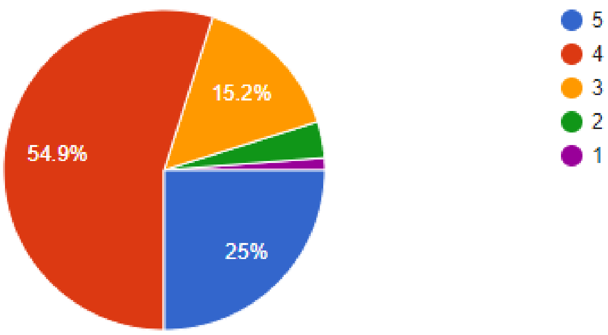
13- Prefabricate concrete projects have acceptable element production for construction projects.

164 responses



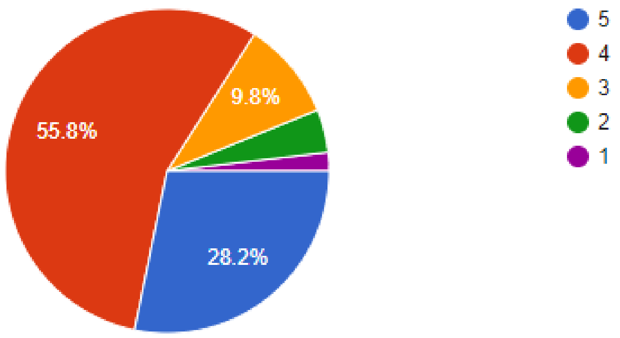
14- The better-quality control may not be achieved if the technology is adopted for prefabricate projects in construction activities.

164 responses



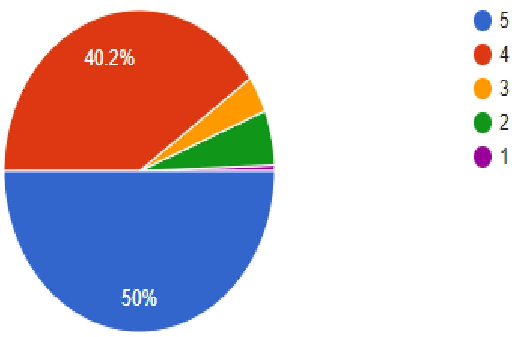
15- Prefabricate buildings are more durable than traditional construction.

163 responses



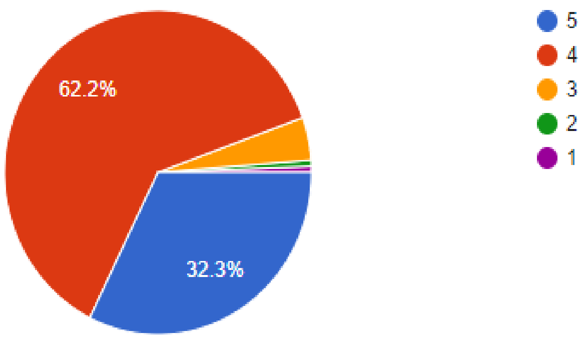
16- Insulation can reduce the energy demands for heating and cooling system in prefabricate projects.

164 responses



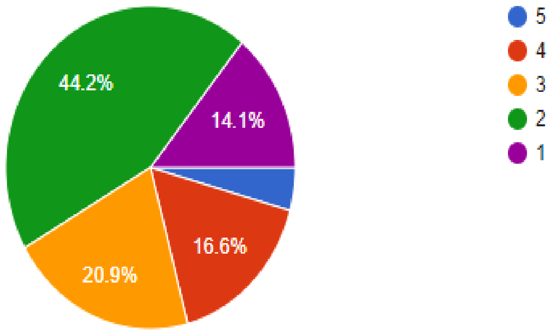
17- Prefabrication elements have less weight than traditional materials in construction projects.

164 responses



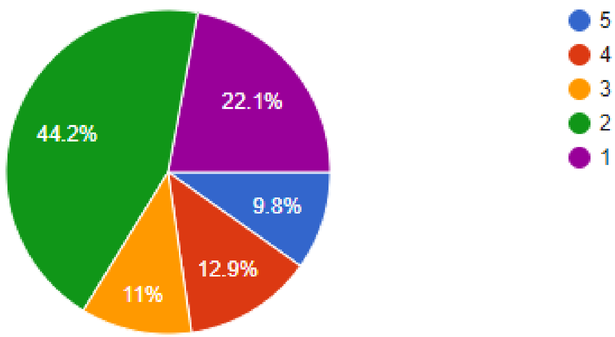
18- It is not appropriate to use prefabricate building components instead of cast in place concrete.

163 responses



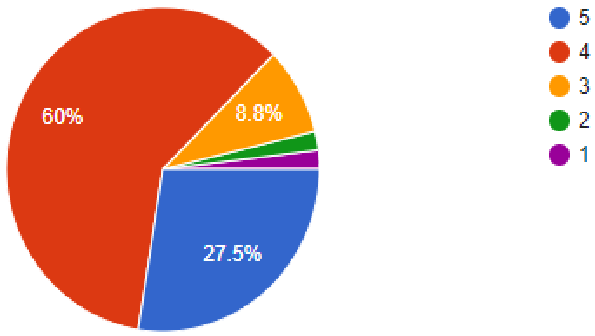
19- Cast in place concrete projects have a special place in urban development.

163 responses



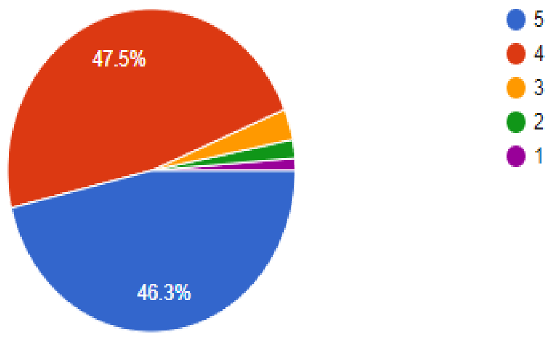
20- Cast in place concrete projects requires more investment when compared to prefabricate buildings.

160 responses



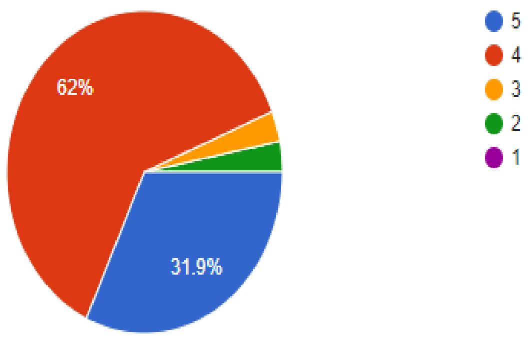
21- Cast in place concrete projects cannot be completed in short time when compared to prefabricate projects.

162 responses



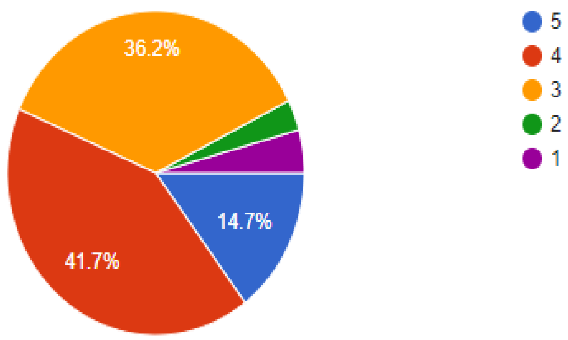
22- Cast in place concrete projects are different in terms of implementation when compared to prefabricate construction.

163 responses



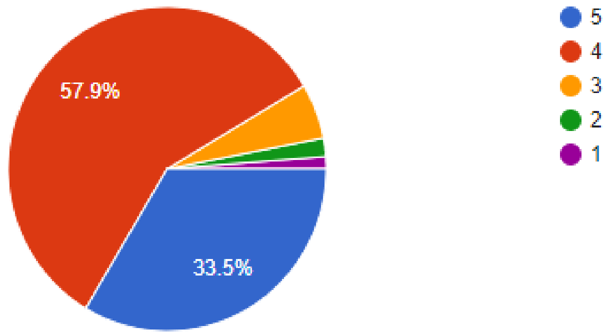
23- Cast in place concrete projects have weaker quality than prefabricate buildings.

163 responses



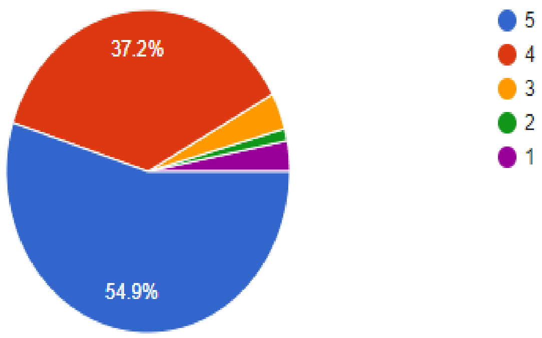
24- Production of components in cast in place concrete projects are harder than prefabricate projects.

164 responses



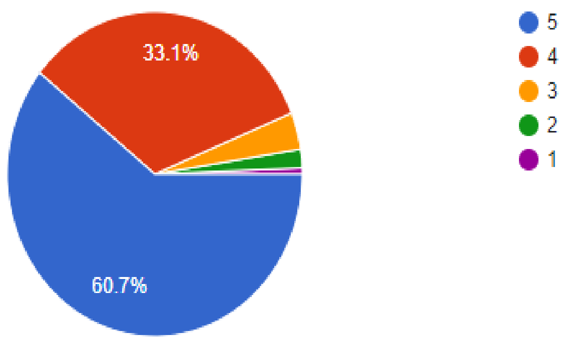
25- The prefabricate concrete projects are more affordable than cast in place concrete projects.

164 responses



26- Prefabricate projects are the shortest way to obtain housing for public people when compared to traditional construction methods.

163 responses



APPENDIX D

Table D.1: Multiple Regression and Correlation Analysis

		Question #10	Question #21	Question #16	Question #11	C2	Question #25	Question #9	Question #20	Question #12	Question #26	Question #23	C5	Question #17	Question #24
							Correlations								
Pearson Correlation	Question #10	1	0.22	0.257	0.376	0.66	0.398	0.343	0.096	0.23	0.224	0.22	-0.263	0.057	0.223
	Question #21	0.22	1	0.337	0.301	0.186	0.101	0.135	0.072	0.169	0.278	0.157	-0.089	0.008	0.156
	Question #16	0.257	0.337	1	0.407	0.25	0.161	0.172	0.172	0.261	0.324	0.15	-0.213	0.179	0.164
	Question #11	0.376	0.301	0.407	1	0.47	0.265	0.219	0.213	0.32	0.397	0.247	-0.121	0.148	0.136
	C2	0.66	0.186	0.25	0.47	1	0.346	0.399	0.242	0.376	0.337	0.298	-0.229	0.107	0.279
	Question #25	0.398	0.101	0.161	0.265	0.346	1	0.51	0.366	0.112	0.281	0.137	-0.092	0.138	0.172
	Question #9	0.343	0.135	0.172	0.219	0.399	0.51	1	0.407	0.175	0.168	0.249	-0.289	0.087	0.12
	Question #20	0.096	0.072	0.172	0.213	0.242	0.366	0.407	1	0.245	0.322	0.182	0	0.189	0.109
	Question #12	0.23	0.169	0.261	0.32	0.376	0.112	0.175	0.245	1	0.436	0.288	-0.084	0.219	0.154
	Question #26	0.224	0.278	0.324	0.397	0.337	0.281	0.168	0.322	0.436	1	0.194	-0.029	0.253	0.116
	Question #23	0.22	0.157	0.15	0.247	0.298	0.137	0.249	0.182	0.288	0.194	1	-0.125	0.039	0.151
	C5	-0.263	-0.089	-0.213	-0.121	-0.229	-0.092	-0.289	0	-0.084	-0.029	-0.125	1	0.088	-0.116
	Question #17	0.057	0.008	0.179	0.148	0.107	0.138	0.087	0.189	0.219	0.253	0.039	0.088	1	0.347
	Question #24	0.223	0.156	0.164	0.136	0.279	0.172	0.12	0.109	0.154	0.116	0.151	-0.116	0.347	1
Sig. (1-tailed)	Question #10	.	0.003	<.001	<.001	<.001	<.001	<.001	0.12	0.002	0.003	0.003	<.001	0.243	0.003
	Question #21	0.003	.	0	0	0.011	0.108	0.049	0.188	0.019	0	0.027	0.137	0.463	0.028
	Question #16	0.001	0	.	0	0.001	0.024	0.017	0.017	0.001	0	0.032	0.004	0.014	0.022
	Question #11	0	0	0	.	0	0	0.003	0.004	0	0	0.001	0.069	0.034	0.048
	C2	0	0.011	0.001	0	.	0	0	0.001	0	0	0	0.002	0.094	0
	Question #25	0	0.108	0.024	0	0	.	0	0	0.085	0	0.046	0.131	0.046	0.017
	Question #9	0	0.049	0.017	0.003	0	0	.	0	0.016	0.019	0.001	0	0.143	0.071
	Question #20	0.12	0.188	0.017	0.004	0.001	0	0	.	0.001	0	0.013	0.5	0.01	0.091
	Question #12	0.002	0.019	0.001	0	0	0.085	0.016	0.001	.	0	0	0.152	0.003	0.029
	Question #26	0.003	0	0	0	0	0	0.019	0	0	.	0.008	0.361	0.001	0.078
	Question #23	0.003	0.027	0.032	0.001	0	0.046	0.001	0.013	0	0.008	.	0.063	0.315	0.031
	C5	0.001	0.137	0.004	0.069	0.002	0.131	0	0.5	0.152	0.361	0.063	.	0.142	0.077
	Question #17	0.243	0.463	0.014	0.034	0.094	0.046	0.143	0.01	0.003	0.001	0.315	0.142	.	0
N	Question #10	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #21	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #16	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #11	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	C2	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #25	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #9	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #20	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #12	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #26	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #23	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	C5	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #17	152	152	152	152	152	152	152	152	152	152	152	152	152	152
	Question #24	152	152	152	152	152	152	152	152	152	152	152	152	152	152