Organizational and Regional Perceptions on Risk Status of Change Orders, Shop Drawing Practices and Claims and, Key Control Measures in Construction Projects

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Civil Engineering

Eastern Mediterranean University
January 2021
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

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ABSTRACT

One of the most common concerns in construction projects is changes in the construction execution process. Projects in the Turkish construction industry have exposure to many changes depending on many factors. Many variables affect construction projects during execution. There are various contract clause components that can contribute to changes in construction projects. In particular, shop drawing practices have an important effect on the change of contract drawings. On the other side, changes may allow contractors to claim additional price and duration. Any organizations involved in the project may have to meet the monetary value of the claim. The projects may be completed with failures because of claims and every part is in seeking to express their self-righteousness in such cases; conflict may arise between parties involved in projects. The reasons for the changes and claims may differ depending on the project parties, the project region, and the project characteristic.

This research aims to examine the key events contributing to contract clauses named change orders, shop drawing practices, claims, and key control measures, based on a survey of construction professionals in the organizations and seeks to develop and propose the regional framework for Turkish construction industry which assists to construction organizations to control the problematic events encountered in construction projects. In this context, a variety of events leading to change were examined based on the perceptions of the organizations in Turkey, North Cyprus, Turkey, as well as in the U.S.A. On the other hand, a variety of events leading to shop drawing practices, and claims events and, in the final phase, a variety of potential measures that can be taken to prevent claims were examined based on the perceptions of the organizations in Turkey. The interaction status of key events of these contract clause components were examined in the perceptions of organizational characteristics. The events of change orders are also examined on the basis of developed and developing country characteristics. Descriptive method is used to analyse the survey data in numerical terms based on participants’ replies. After that, analytical research approaches were adopted to explore the impact of organizational and regional characteristics concerning key events of these contract clauses. The research findings showed that the critical events of contract clauses and control measures differed by the characteristic and regional features. A total of 12 different (variable) most critical events are identified on the basis of variety of organizational perceptions. 3 of these events were for "change order", 5 of them were for "shop drawings" and 4 variable "contractors' claims" were determined. On the other hand, 5 variable control measures are identified with respect to organizational perceptions. According to the perceptions of the organizations, a framework model has been presented to indicate the critical triggering events of these contract clauses and effective control measures in construction projects for the Turkish construction sector.

Keywords: change orders, variation, cost-time overrun, claim, disputes, mitigation measures, shop drawing

ÖZ

İnşaat projelerindeki en yaygın kaygılardan biri de uygulama sırasındaki değişikliklerdir. İnşaat projelerine birçok değişkenlik, uygulama sürecinde etki etmektedir. Türk inşaat endistrisinde İnşaat Projeler birçok faktöre bağlı olarak değişikliklere maruz kalmaktadır. İnşaat projelerinde değişikliklere katkıda bulunabilecek çeşitli sözleşme maddesi bileşenleri vardır. Özellikle şantiyede çizim uygulamalarının sözleşme çizimlerinin değiştirilmesi üzerinde önemli bir etkiye sahiptir. Diğer taraftan, değişiklikler, yüklenicilerin ek fiyat ve süre talep etmesine olanak sağlamaktadır. Projede yer alan herhangi bir organizasyon, talebin parasal değerini karşılamak zorunda kalabilmektedir. Projeler talepler nedeniyle başarısızlıkla sonuçlanmakta ve bunun sonucunda taraflar arasında ciddi anlaşmazlılar doğmakta ve oluşan bu durum karşısında taraflar kendilerinin mağdur olduğunu ifade etme eğilimde olmakta ve oluşacak olan olumsuzluğun bedelini karşı tarafa ödetme eğilimde bulunmaktadırlar. Değişikliklerin ve taleplerin nedenleri proje taraflarına, proje bölgesine ve proje karaktersitiğine bağlı olarak değişebilmektedir.

Bu tezin amacı, organizasyonel ve bölgesel karakteristiklerin, değiştirme talimatları, şantiye çizim uygulamaları, yüklenici talepleri, ve kilit kontrol önlemleri olarak adlandırılan sözleşme maddelerine katkıda bulunan en kritik olaylar üzerindeki etkisi irdelemek, ve Türk inşaat endüstrisindeki inşaat organizasyonları algısında, inşaat projelerinde karşılaşılan sorunlu olayların önlenebilmesi amacında, en kritik olaylara ve en etkili önlemlere dikkat çekmeye amaçlayan çerçeve modeli geliştirmeyi amaçlamaktadır. Bu bağlamda, İnşaat projelerinde değiştirme talimatlarına yol açabilen çeşitli olaylar Türkiye, Kuzey Kıbrıs ve de A.B.D. bulunan inşaat organizasyonlarının verilerine dayanarak incelenmiştir. Öte yandan, şantiye çizim uygulamalarına ve yüklenici taleplerine yol açabilen inşaat projelerinde karşılaşılabilen çeşitli olaylar, ve son süreçte de, taleplerin önlenebilmesi adına uygulanabilen çeşitli potansiyel önlem çeşitleri Türkiye'de yer alan inşaat organizasyonlarının algılarına dayanarak irdelenmiştir. Bu sözleşme maddesi bileşenlerinin anahtar olaylarının etkileşim durumu, organizasyonel özelliklerin algılarında incelenmiştir. Değiştirme talimatları olaylarını, gelişmiş ve gelişmekte olan ülke karakterisiği bazında irdeleme de yapılmıştır. Tanımlayıcı yöntem, Katıkımcıların yanıtlarına göre anket verilerini sayısal terimlerle analiz etmek için betimleme yöntemi kullanılmıştır. Daha sonra, analitik araştırma metodu yaklaşımları adapte edilerek bu sözleşme maddelerinin kilit olaylarıyla ilgili organizasyonel ve bölgesel özelliklerin etkisini irdelenmiştir. raştırma bulguları, sözleşme maddelerinin ve kontrol önlemlerinin kritik olaylarının organizasyonel ve bölgesel karakteristiğe göre farklılık gösterdiğini tespit edilmiştir. Çeşitli organizasyonel ve bölgesel algılar temelinde, toplam 12 farklı (değişken) kritik olay tespit edilmiştir. Bu kritik olayların 3'ü "değiştirme talimatları", 5'i "şantiye çizim uygulamaları" ve 4 değişken "yüklenici talepleri" adına belirlendi. Öte yandan organizasyonel algılara göre 5 değişken önleyici tedbir tanımlanmıştır. Organizasyonların algılarına göre, inşaat projelerinde bu sözleşme maddelerinin kritik tetikleyici olaylarını ve etkili kontrol önlemlerini belirtmek için Türk inşaat sektörü için çerçeve model sunulmuştur.

Anahtar Kelimeler: değiştirme talimatları, değişiklikler, zaman-fiyat aşımı, talep, anlaşmazlık, önleyici ve yumuşatıcı önlemler, şantiyede çizimler

DEDICATION

To My Father

ACKNOWLEDGEMENT

I would like to offer my gratitude to my Ph.D. thesis supervisor Prof. Dr. Tahir Çelik for his continuous supports and guidance in my research and in preparing this thesis.

I would like to thank my department, Eastern Mediterranean University Civil Engineering Department for all the opportunities and all my professors who contributed to me come to these days.

I would like to thank organizations for their participation in survey and contributions to the research.

I would also like to thank a lot to my family for their continuous supports.

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LIST OF SYMBOLS AND ABBREVIATIONS

AV. C.T.P.I	Average of Cost-Time Prevention Index
AV. P.S.S	Average of Project Success Rate
AV. R.I.W	Risk Index Average of Work Items in The Project Discipline
AV. R.S.I	Average of Risk Significance Index
AV. S.I	Average of Cost and Time Overrun Index
B.I	Benefit Index
BIM	Building Information Modeling
C.I	Cost Overrun Index
C.I.C	Cost Impact Index of Shop Drawing According to The Contract Types
C.I.P	Cost Impact Index of Shop Drawings according to the Procurement Model
C.P.I	Cost Overrun Prevention Index
C.T.I	Severity Cost-Time Overrun Index
D.I	Dispute Index
E.I	Claim Prevention Effectiveness Index
F.I	Frequency Index
F.I.C	Frequency Index of Shop Drawing According to The Contract Types
FIDIC	International Federation of Consulting Engineers
F.I.P	Frequency Index of Shop Drawings According to The Procurement Model

I.I	Importance Index
N	Total Number of Participant
P.D.F	Frequency of Shop Drawings for Project Discipline
P.D.R.I	Project Discipline Risk Index
P.S.S	Project Success Rate
R.I.A	Risk Index of Administrative Model
R.I.C	Risk Index of Contract Type
R.I.I	Relative Importance Index
R.I.P	Risk Index of Procurement Type
R.I.W	Risk Index of the (i) th Work Item in the Project Discipline
R.S.I	Risk Significance Index
U.A.E	United Arab Emirates
U.S	United States
U.S.A	United States of America
T.I	Time Overrun Index
T.P.I	Time Overrun Prevention Index
Wi	The weight assigned on Likert's Scale Given to Each Factor
Xi	Number of Choice of the (i) th Weight in the Likert's Scale

Chapter 1

INTRODUCTION

1.1 Overview

Construction projects are complicated enterprises and associated with various changes (Desai et al., 2015). It is considered a miracle that everything turns out exactly as planned (Eriksson, 2017). Due to the contribution of many different industries and the involvement of many parties, construction projects are under the influence of many dynamism (Zarei et al., 2018). In construction projects, there are almost always updates that take place in technical and administrative features of projects such as design, specification/drawings, scope definition, and construction methods after the contract awarded. Construction project contracts contain many and various contract clauses. Change orders (Cho, 2020), shop drawing practices (Abdul-Malak & Bachnak, 2020), claims (Khorooshi, et al. 2017), as well as control measures (Ezeldin & Abu Helw, 2018) are important components that characterize and qualify construction project contracts.

1.1.1 Overview on Change Orders

In a book written by Sun & Meng (2009), the authors noted that, in construction projects, a change refers to "an alteration to design, building work, project program or other project aspects caused by modifications to preexisting conditions, assumptions or requirements after the contract has been awarded" (p.560). Change in construction projects is often considered inevitable (Charles, Wanigarathna, & Sherratt, 2015), (Sun & Meng, 2009), (Nunnually, 2004). Senouci et al. (2017) and

Desai, Pitroda & Bhavasar (2015) stated that, changes in construction projects are very common and are likely to occur at any stage of a project from different sources for various reasons.

Senouci et al. (2017) and Hwang & Low (2012) emphasized that changes are one of the most common distress in construction projects. Many time delays (Senouci et al., 2017) (Alnuami et al., 2010), (Sun & Meng, 2009), cost overruns (Senouci et al., 2017), (Serag et al., 2010) (Sun & Meng, 2009), and quality defects (Sun & Meng, 2009) (Moselhi, Assem & El-Rayes, 2005), and demoralization and legal disputes, and moral disturbances among project stakeholders (Wu, Hsieh & Cheng 2005), in construction projects can be attributed to changes at various stages of a project (Sun & Meng, 2009) (Hao , Shen, Neelamkavil & Thomas, 2008) due to an uncertain, complex, multi-party, and dynamic environment of construction projects (Zarei et al., 2018) (Zaneldin, 2006).

For instance, Oweyobi et al. (2016) showed that average cost and time escalation is around 33.95 and 29.45 per cent of the original project cost and time in educational building projects in Nigeria. By other researchers, Aness, Mohamed & Abdul Razek (2013) reported that the average overrun of original contract value was between 11 and 15%, while the average contract schedule exceeds 10 to 20% in construction projects implemented in Egypt because of the changes.

In his book, Levy (2018) stated that, the formal changes made in construction projects are named "change orders". "Change Order" is a contract clause which states that no changes other than those for project enrichment or extra work ordered by the owner’s representative will be approved (p. 232). A change order is a formal document that alters some conditions of the contract document. In another book written by Fisk & Reynold, (2010), the authors noted that a change order is the only legal means available to change the contract provisions after the award of the contract and normally requires the owner's signature (p.130). Changes orders may also be executed to correct errors in the plans and specifications or may the direct result of contractor suggestions that are approved by the owner and the architect/engineer (Fisk & Reynold, 2010, p.309). The change order may alter the contract price, schedule, and completion date of the project (Fisk & Reynold, 2010, p.310). Only a change order should be used to authorize a deviation from the contract provisions (Fisk & Reynold, 2010, p.119).

1.1.2 Overview on Shop Drawing Practices

Depending on the terms of the contract, construction projects proceed with the shop drawings approved on the construction site (Abdul-Malak & Bachnak, 2020). The variability and complex nature of construction has increased the degree of uncertainty involved in the planning and execution phases. Construction has traditionally separated planning and design from construction processes that caused some scope and design-related changes during construction (Aslam, Baffoe-Twum, & Saleem, 2019).

In their book, Fisk & Reynold (2010) stated that Shop drawing is a set of drawings are produced by contractors during the execution phase under their contract with the owner. Shop drawing is a link between design and construction, and such drawings are submitted to the owner's architect/engineer by a contractor or subcontractor (p.118). Shop drawings act as a bridge to fill the gap between contractor and contract documents (Porwal & Hewage, 2013). While construction drawings are done in the design phase by the design team, shop drawings are done by the manufacturer (by contractors) in the construction phase but before construction of the relevant component of the building (Porwal & Hewage, 2013). Shop drawings often contain information that is not related to the design concept, or only about the manufacturing process or construction techniques on site, all of which are beyond the scope of the architect's or engineer's duties and responsibilities only shows that the items conform to the design concept of the project and compliance with the plans and specifications (Fisk & Reynold, 2010, p.130). Shop drawings practices needed since plans and drawings cannot reveal every detail of every aspect of the work. This is true of large construction projects (Fisk & Reynold, 2010, p. 118). Shop drawing is one of the most critical elements of project administration (Levy, 2018, p.119). Because of the increasing complexity of today's construction, in recent years, shop drawings have become a very important factor affecting project status and, have become one of the major sources of a professional liability claim against the designer (Fisk & Reynold, 2010, p.118). Advances in materials and systems make designs more complex, the shop drawings are more accurate than designs created by architects or engineers, as they contain more details (Levy, 2018, pp.301-302). Shop drawings practices improve the quality of construction practices and simplify the execution process; it leads to increases in cost and duration of the project (Fisk & Reynold, 2010, p118).

In one of the past research study, Manrique et al. (2015) emphasized that the shop drawings have important benefits in increasing the quality in wood-framing construction residential facilities, as the shop drawings show all the requirements in construction. On the other hand, authors emphasized that due to the shop drawings and design deficiencies in the tender documents; the projects were subjected to 5 to 8% changes in the drawing and specifications after the contract process.

One of the problematic areas in the shop drawing approval process is the cost and specification problems matters arise (Chin, 2009). When alternate sources and designs of materials and equipment are submitted, there is often disagreement on the quality and equivalence of the alternate products used in the lump-sum bids (Chin, 2009).

Since the shop drawings contain more details than the contract drawings, it may cause a revision of the works specified in the contract as they may be more costly than the contract price. In this context, the contract price may be exceeded and may cause financial problems that may lead to disputes between the parties. While construction is underway, by the shop drawings practices, changing one work can affect others.

On the other hand, one of the most important and misunderstood facts about shop drawings is that a shop drawing approval normally does not allow changes to the contract provisions. Changes in the work can only be authorized with separate written change orders. A shop drawing is not a change order, and any variation from the design drawings and specifications must result from a formal change order (Fisk & Reynold, 2010, p.118).

1.1.3 Overview on Contractors' Claims

The other important contract component is that, contracts give contractors the right to claim from the owner for any financial and duration damages due to any deviations in the contract provision. In Construction, the claim is an additional compensation or extension of completion time for the work claimed to be added to the construction contractor. Most of the claims concern conditions or events encountered during the construction phase (Mirza, 2005). In book written by Thomas & Wright (2016) defined the word claim as, “claim is the right to extra money and time due to the expenses raised by any circumstance which beyond the contractors’ control” (p.16). In his book, Nunnually (2004) stated that “a claim is a request by the contractor for a time extension or additional payment based on the occurrence of an event beyond the contractor’s control” (p.512). Twort & Rees (2004) defined the word claim as “‘claims for more money by a contractor which may or may not be payable’, for matters other than those for which payment is specified in the contract” (p.212).

Contractors can often make claims on construction projects based on many factors, however changes takes place in any contract conditions have become one of the most common causes leading to a claim (Hayati, Latief, & Rarasati, 2019) (Al-Sabah, Fereig & Hoare, 2003). In their research, Gunduz, Nielsen & Ozdemir (2015) stated that, in the construction industry, contractors tend to maximize their profit to increase market share. Tan et al. (2008) have referred that change orders can compensate the contractor’s financial damage to be done to claim extra financial resources throughout the construction process. For this reason, contractors might ask changes during the execution process for any reason to increase their earnings to be able to avoid financial damage. In this way, financial losses are tried to be reduced. Contractors see change orders and also any deviations in contract condition/document as a major opportunity to request an extra price from the client to reduce the distress caused by low bid price. Claim is a tool used by contractors to demand more time and/or money (Tan et al., 2008).

Contractors may tend to value the prices of the changes, taking into account prices higher than the base prices in the contract. The book written by Twort & Rees (2004) stated that, ICE terms contracts require the contractor to undertake such sequential variations and must be paid in invoice rates or at rates based on them. Sometimes, this may seem harsh to the contractor because he may do a slightly different job than he expected, and the rates applied in this way may seem too low to him. The problem of setting the rate for extra work or omitted items or a change in quantity on its own can sometimes be difficult to justify a new rate (p. 208).

Project owners are likely to feel antipathy to the contractors' claims (Thomas & Wright, 2016) (Gang & Guiling, 2011). A new price and time estimation will undergo to request the budget and time required to perform changes to the project during the execution process. Often times, key parties involved in construction projects demonstrate different approaches to the necessity and valuation of claims The differences in valuation of claim is becoming one of the critical cause of conflict between the owner and the contractor (Thomas & Wright, 2016) (Acharya, Lee & Im, 2006). The contractor is in a struggle to claim additional payment and time due to any changing case in the project; however, clients often do not volunteer to meet the contractors ’claims (Arain & Pheng, 2005). Patil (2005) stated that when one party denied the other party's claim in construction projects, a dispute arise between the parties.

Nowadays, claims arising from various reasons that can contribute to a project’s delay and/or increased costs are becoming widespread. For instance, Ahbab, Daneshvar & Çelik (2019) were reported that “design changes” and “poor project management and supervision” were the primary reasons that severely affects time and cost management in large transportation projects financed by the Asian Development Bank.

On the other hand, one of the most important and misunderstood facts about claims and change orders is that a change orders does not allow claims formally. Change orders are approved and agreed document however, claim is a one party intent that is contractors, and mostly leads to disputes. Formally, claims arises other than the change orders, as change orders itself may involve required alteration on cost and time condition of contract (Thomas & Wright, 2016, p.126) (Levy, 2018, pp.263-264).

Any organization in the project may experience victimization because of the negativities caused by the claims. Problems created by claims are very serious since budget and duration are considered as the most important parameters of a project. As a result, the projects cannot be completed at the targeted budget and time, and the parties suffer various losses.

1.1.4 Overview on Control Measures

It is well understood in current body of knowledge that, any changes, shop drawing practices and claims encountered in the project can leads to increases in the budget and duration of the project, resulting in cost and time overruns, quality defects and disputes between the major parties involved in construction projects. In their research studies, Mahamid & Bingönül (2016) and Zaneldin (2006) stated that the construction industry should develop methodologies and techniques to reduce or prevent claims because project participants are becoming more aware of the high costs and risks associated with claims. In his book, Hayes (2018) noted that controlling changes is a key factor in successfully managed projects. The author also underlined that; implementing a good change control procedure will have a significant impact on the project parameters (p.185). Project management teams need to have the ability to respond effectively to change to minimize the impact on the project (DuBois et al., 2015). In project management, changes in projects can lead to significant variations in contract duration, total direct and indirect costs, or both (Viswanathan & Jha, 2020). Therefore, project management teams need to have the ability to respond effectively to change to minimize the impact on the project.

After all the above clarifications and explanations, it became clear that these four different contract clause components have no formal connection. However, they can have active relationship. A consequence of one of them can leads to the needs of others. Figure 1.1 shows the facts and features of the contract clause components.

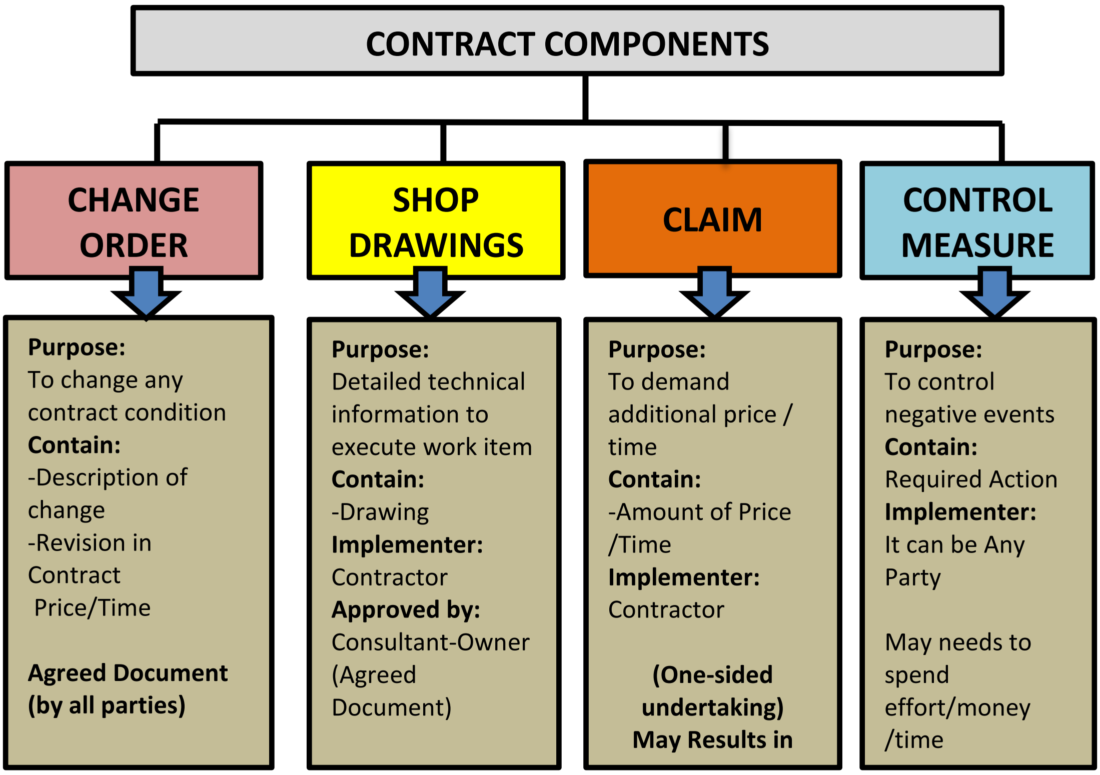

Figure1.1: Facts and features of the contract clause components

Additionally, the other fact is that the characteristics of regions, organizations, and projects are also parameters which are necessary to be considered during examination of the key problems and key control measures as organizations and regions have their own characteristics, construction law, culture, economics and construction technologies. In order to achieve success in the project, problematic events that lead to changes and claims in projects should be recognized and controlled. Projects in Turkey and Northern Cyprus are facing a lot of changes and claims. Serious costs are paid because of changes in construction projects. Within the context of Northern Cyprus, no research studied has been done focusing any of these four contract clauses components. Studies on this subject are limited in this region, although they have great importance for the regional construction sector.

Thus, it became clear in requirements for conducting further and more focused and comprehensive research on change, shop drawing practices and claim events and control measures as regional. Within this context, applying the most appropriate key control measure to control the key problems is required to get the most benefits hence, this study seeks to develop and propose the regional framework for Turkish construction industry which assists to construction organizations to control the problematic events encountered in construction projects.

1.2 Problem and Research Justification

Problems concerning changes and claims are often seen in Northern Cyprus and Turkey. A lot of changes are experienced in construction projects carried out in Northern Cyprus and Turkey. Gunduz, Nielsen & Ozdemir (2015), emphasized that facts named “inadequate contractor experience” and “ineffective project planning and scheduling” are experienced often in construction projects in Turkey. Kazaz, Ulubeyli & Tunçbilekli (2012), emphasized that “design and material changes” is the main delay reason on construction projects carried out in Turkey. In a very recent another study conducted in Turkey, Sönmez, Dikmen & Akbıyıklı (2020), concluded that, exchange rates can have a serious adverse effect on the time–cost relationship in building projects in Turkey. In another very recent study conducted in Turkey study, Kocaman, Kuru & Çalış (2020) reported that, according to unit price contracts, the possibility of dispute is high due to changes in construction projects with lump sum contracts. Additionally, the authors revealed that most of the contract prices were below the threshold for works between 2007 and 2017 in Turkey.

The reason for so many changes and claims in construction projects in Northern Cyprus and Turkey often depends on the lack of quality consultancy services. The quantity-based selection method is often implemented in Northern Cyprus and Turkey and therefore, poor quality of consultancy services are provided since the technical consultants are selected based on bid price (Quantity based) rather than quality based (Kocaman, Kuru & Çalış, 2020). This fact pose very serious adverse effect on projects as the success and the quality of the project outcomes (from design to execution) is subject to the efforts of consultancy services.

Changes in the projects constitute one of the major problems in the Northern Cyprus construction sector. The negative effects because of changes in the construction sector continue even after the completion of the projects, as the dispute arises between the parties last longer. Most cases regarding the construction sector in courts are based on disputes between the owner and contractors because of the changes (İlter & Çelik, 2014, 2018). It is experienced that the cost incurred due to changes is covered by any of the parties involved in the construction project.

Over the last few decades, in past researches, a variety of results were reported worldwide based on the impact of changes, shop drawing practices and claims in construction projects. Research on the changes dates back to the past, but this issue is still on the agenda today. Today, researches on this subject are still widely carried out.

For instance, in a research study conducted by Oweyobi et al. (2016), examine the causes of variation orders, ascertain their effects and establish the cost and time performance implication as a result of changes on educational building project s in Nigeria. The authors concluded that, the average cost and time escalation is 33.95 and 29.45 per cent of the original project cost and time, respectively, due to the change orders in the educational building projects in Nigeria. Additionally the authors implied that the average cost implication of variation orders is 23.79 per cent in the educational building projects in Nigeria. Aness, Mohamed & Abdel Razek (2013), reported that the average cost and time overrun because of change orders is between 11 and 15% of the original contract value and between 10 and 20% of the original project duration in large projects in Egypt. Ijaola and Iyagba, (2012) reported that the cost and time overruns as a result of change orders in construction projects in Nigeria were approximately 79 and 68 percent. The US has spent 13 billion to 26 billion dollars a year on construction change orders in the construction industry. With the additional financial resources to be spent for claims and legal disputes, the total cost of the project change can reach 50 billion dollars annually in the US (Gündüz, 2002). Taylor et al. (2012) reported that, the average percentage change in the original contract value is "contract omissions" with 39.94%, and the highest financial impact rate is "owner-induced improvement" with "7.80" in the highway Project in the State of Kentucky (USA).

In past researches, researches were examined the change orders on the basis of variety of regional and project characteristics (Sha’ar et al., 2017) (Lee et al., 2015), (Choi et al., 2015) (Aness, Mohamed & Abdel Razek, 2013) (Ijaola & Iyagba, 2012), (Taylor et al., 2012) (Enshassi, Arain & Al-Raee, 2010b) (Lu & Issa, 2005).

For instance, in one of the study, Choi et al. (2015), were examined the impact of change orders in terms of schedule and cost overruns based on different contract types of highway projects in the US. Authors have investigated the differences of contract types of highway projects in the U.S. based on change order effects in terms of schedule and cost overruns. In another research, Sha’ar (2017) revealed that “‘lack of proper coordination between various disciplines of the design team” is one of the most critical factors causing design- construction interface problems in large construction projects in Palestina. Lee et al. (2015) applied the Loss Distribution Approach method to analyze the amount and number of loss incidents resulting from change orders occurring in apartment projects in South Korea. The authors created a risk matrix by creating 5 categories for change ranking factors and 8 categories for job types to calculate the severity and frequency distribution of the amount and number of loss events in construction projects. It was concluded that in terms of amount and number of loss events, the greatest impact was due to the "field condition" of apartment construction projects in Korea.

In majority of past researches, researches have investigated the effect of shop drawings practices on cost and time of projects as a kind of a single factor among variety of factors. In addition, in previous studies, the effect of "shop drawings" has been examined according to limited technical and administrative parameters (Kumar, 2016) (Marzouk & El-Rasas, 2014) (Bramble & Callahan, 2011) (Abd El-Razek, Bassioni & Mobarak, 2008) (Doloi et al., 2012) (Meghai & Rajiv, 2013) (Arain & Assaf, 2007).

For instance, Kumar (2016) examined the significant factors contributing delay in Indian construction industry. The research revealed that "delay in approving shop drawing documents" was one of the fundamental owner-consultant contributed factor leading delay in construction projects in India. In another research study, Marzouk & El-Rasas (2014) and Abd El-Razek, Bassioni & Mobarak (2008) were indicated that, in Egypt, delay in preparation and waiting for approval of shop drawings has become one of the top significant contractors and consultant originated delay factor, respectively. Delay in the approval of shop drawings is one of the most critical owners originated attributes affecting delay in residential construction projects in India (Doloi et al., 2012) (Meghai & Rajiv, 2013). Bramble & Callahan (2011) stated that the delay in reviewing the shop drawings has become one of the most important design-related delays in the US construction projects.

On the other hand, in past researches, researchers were examined claims on the basis of variety of regional and project characteristics (Al-Qershi & Kishore, 2017) (Gunduz, Nielsen, Ozdemir, 2015, 2013) (Mahamid, 2014) (Aness, Mohamed & Abdul Razek, 2013) (Bakr, 2014) (Kazaz, Ulubeyl & Tuncbilek, 2012) (Enshassi, Abdul-Aziz & Abushaban, 2012) (Enshassi, Kumaraswamy & Al-Najjar, 2010a) (Toor & Olungana, 2008).

For instance, in one of the research, Al-Qershi & Kishore (2017) examined the factors contributing to delay in Indian construction industry based on the contractors' perspective. The authors highlighted that most dominating delay causes are associated with the owner/ owner's representative attributes. In another study, in their both research, Gunduz, Nielsen, Ozdemir (2015), (2013), examined the probability of the factors contributing delay in construction projects in Turkey. The authors concluded that, contractor related issues are the primary critical factors contributing delay in construction projects in Turkey. In another study, Enshassi, Kumaraswamy & Al-Najjar (2010a) identified 110 factors causing time delay and 42 factors causing cost overruns by conducting a comprehensive literature review and interviews with professionals in Gaza and these causes are grouped into 12 categories. The authors concluded that "Strikes and border closure" and "lack of materials in the market" were the most significant factor causing a delay while "Increment of material prices because of continuous border closures" and "Supply of materials by Contractors" were stated to be the most significant factors causing cost overruns in construction projects implemented in Gaza. Hassanein & Nemr (2007) studied the causes of claims and the claim management status in the Egyptian construction industry. The authors highlighted that the most common causes of construction damage are "change orders" in projects and "modification of the Project by owner party". In the Egyptian construction sector, 54% of the reasons for claims were due to change orders. It was stated that in 57% of the project in Egypt, the change orders created because of poor documentation practices by the contractor's team.

On the other hand, plenty of research has been done worldwide to examine the key control measures in order to control changes and claims based on different regions and project characteristics. In majority of past researches, various key control methods have been pointed which assist to control changes and claims in construction projects according to different regions (Oyewobi et al., 2016) (Iqbal et al., 2015) (Aness et al., 2013) (Olawale & Sun, 2010) (Taylor et al., 2012) (Stare, 2011) (Mohamad, Ali & Al-Harthy, 2012) (Meng, 2012) (Bryde et al., 2013) (Succar, 2009).

For instance in one of the research, Oyewobi et al. (2016), stated that, “improvement on contractual procedure”, “common understanding amongst professionals when interpreting customer’s requirements” and “application of new technology in the design phase as Building Information Modelling (BIM)” are the most effective potential methods to reduce the frequency of change in educational building projects in the Nigeria.

In another study, Iqbal et al. (2015) concluded that the most effective preventive and remedial risk management techniques in construction projects implemented in Pakistan are "proper schedule by getting update data of the project" and "guidance from previous similar projects" and "close supervision and coordination". For instance in one of the research, Taylor et al. (2012), emphasized that “front end planning” can be beneficial to mitigate change orders in highway construction projects in Kentuck State (U.S.) because of owner-induced enhancement, and contract item overrun and, contract omissions.

In past researches, depending on the various regional characteristics, variety of methods and measures were highlighted and proposed to control the changes and claims in construction projects. It is well revealed that, the characteristics of the regions are the major determinant fact on key driving events and key control measures that must be recognized to deal with the problematic events in the construction projects, as regions have their own characteristics, construction law, culture, economics and construction technologies. For the success of the project, based on various dynamics, the most appropriate measure should be implemented to eliminate the factors causing the changes and claims.

Last but not least, as formal status, these four contract clause components have no formal relationship. The occurrence of one does not mean that the other should occur as well. However, it is experienced they can have a very active relationship as the consequence of one can be a contributor to the other component. In past research, change orders, shop drawings, claims events and control measures were not examined on a unique study in a holistic manner. In majority of the past researches, researchers have examined these 4 components by not focusing on them together. In the past, there has been no research focusing on the holistic combination of these four contract clause components. Additionally, in majority of past researches, researches have investigated the effect of shop drawings practices on cost and time of projects as a kind of a single factor among variety of factors rather than focusing only shop drawing contract clause. In addition, in past studies, the status and effect of "shop drawings" has been examined based on limited variety of technical and administrative parameters. Besides this, there has been no research focusing on shop drawing practices in Turkish construction industry. Additionally, the culture, construction laws, procurement methods, and economic conditions and technologies are the main regional variances that lead to a differentiation on the key driving events and key control measures. In past research, researchers have revealed the fact that, the key driving factors and key measures differ depending on regional, organizational, and project characteristics. On the other hand, the other major fact is that, the expectations of the parties from construction projects may differ in accordance with their interest. Problems in construction also cause serious ethical problems and disputes (Nora et al., 2016) (Hao, Shen, Neelamkavil & Thomas, 2008). According to the ethical survey conducted in the construction sector, 84 percent of the respondents stated that they faced unethical situations in their business relations, while 61 percent stated that the sector was “tainted” by unethical actions (Hao, Shen, Neelamkavil & Thomas, 2008). Also, the last but the most important fact is that no regional model was ever developed aiming to assists in recognizing and controlling the key problematic events leading to change and claims for the Turkish construction industry. As Turkey and Northern Cyprus are facing a lot of changes and claims, the proposed model will seek to point out the key problems and to key control measures associated with change and claims thus, project stakeholders will be able to be more sensitive to problems and measures by paying attention to these issues in projects and will be able to achieve greater success in projects.

1.3 Research Question

In this context, the three research questions determined for this study as follows:

- What are the key driving critical events of contract clauses named change orders, shop drawing practices, and claims, and what are the key control measures in preventing change and claims in building construction projects based on organizational perceptions in the Turkish construction industry?

- How are the key driving critical events and key control measures vary, depending on the organizational characteristics in the Turkish construction industry?

- What kind of a tool is to be developed to point out the key problematic events of contract clauses named change orders, shop drawing practices, claims, as well as, to point out to the key control measures in preventing of those problems in the Turkish construction industry.

1.4 Aim and Objectives of the Research

After considering all the basic information mentioned above for the research, the aim of the research is decided as:

- The aim of this research is to develop framework which assists to point out to the key problematic events of contract clauses named change orders, shop drawing practices, claims, and to point out to the key control measures in preventing of those problems in the Turkish construction industry.

In order to achieve the stated aim, the following research objectives were identified;

I. To explore the key risky events leading change order in building construction projects according to the perception of construction organizations involved in construction projects.

II. To determine the key diriving events and key drives technical and administrative features of building construction projects leading top risky shop drawing practices according to the perception of construction organizations involved in construction projects.

III. To explore the key risky events leading claims in building construction projects according to the perception of construction organizations involved in construction projects.

IV. To explore the key control measures in preventing claims in building construction projects according to the perception of construction organizations involved in construction projects.

V. To establish a link among the key events of change orders, shop drawing practices, claims, and key control measures on the basis of organizational characteristics.

VI. To evaluate the impact of organizational characteristics on the risk perceptions of organizations concerning the key events of contract clauses named change orders, shop drawing practices, claims and, control measures.

VII. To develop framework to assists pointing out to the key problematic events of contract clauses named change orders, shop drawing practices, claims, and to point out to the key control measures on the basis of organizations perceptions in preventing of those problems events in the Turkish construction industry.

Figure 1.2 shows the basic outcome content in the research phases conducted in this specific research.

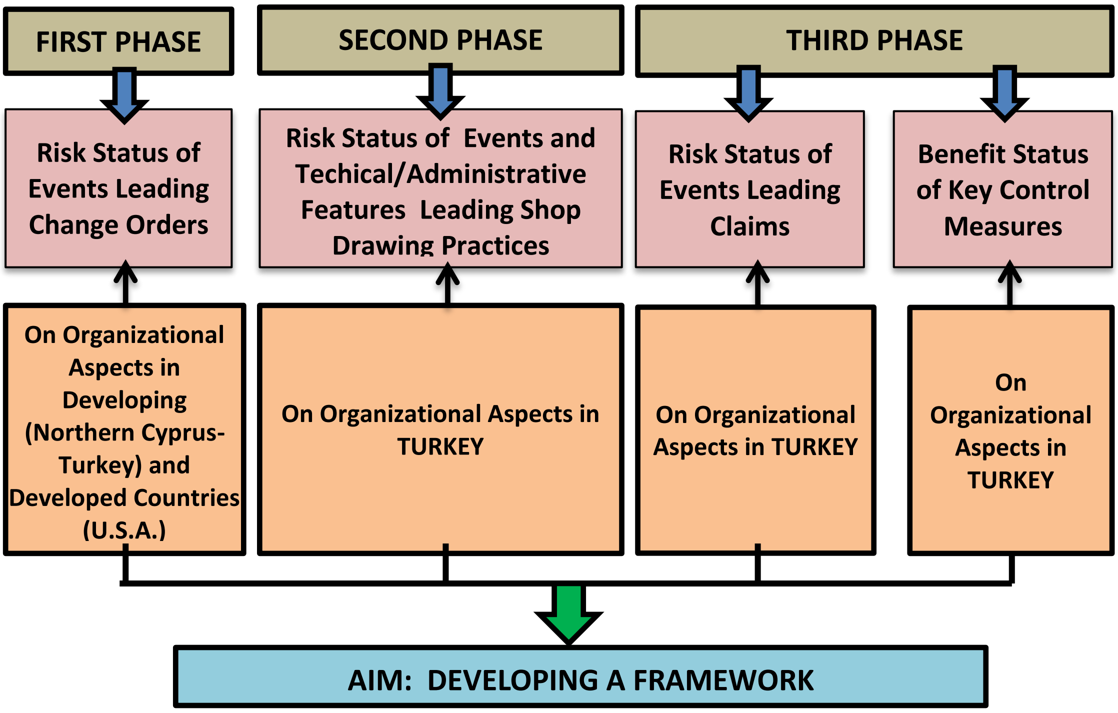

Figure 1.2: Principal outcome content in the research phases

1.5 Methodology

The research processes from design through to conclusion are sequentially organized as shown in Figure 1.3. The research steps and type of methods and techniques adopted to implement each research phases indicated in Figure 1.2 are illustrated in Figure 1.3. Figure 1.3 shows the steps and the methods and techniques used in the three principal research phases (Figure 1.2) in this study. Common research steps, types of methods, and techniques were performed in three principal research phases of this study.

This research adopted a multi method approach to examine the importance of contractual events. In this study, survey was used as a research tool to collect the data for analysis. On the other hand, after data collection process, in examination process, basically two principal research methodologies were applied. For step 4 (See Figure 1.3) "descriptive method" is used to analyse the survey data in numerical terms

(Kemp et al., 2018). On the other hand, after quantification process, in step 5, “analytical research” was applied to examine the relationship between the organizational characteristics and organizational perceptions on the contract clauses events (Chen, 2019).

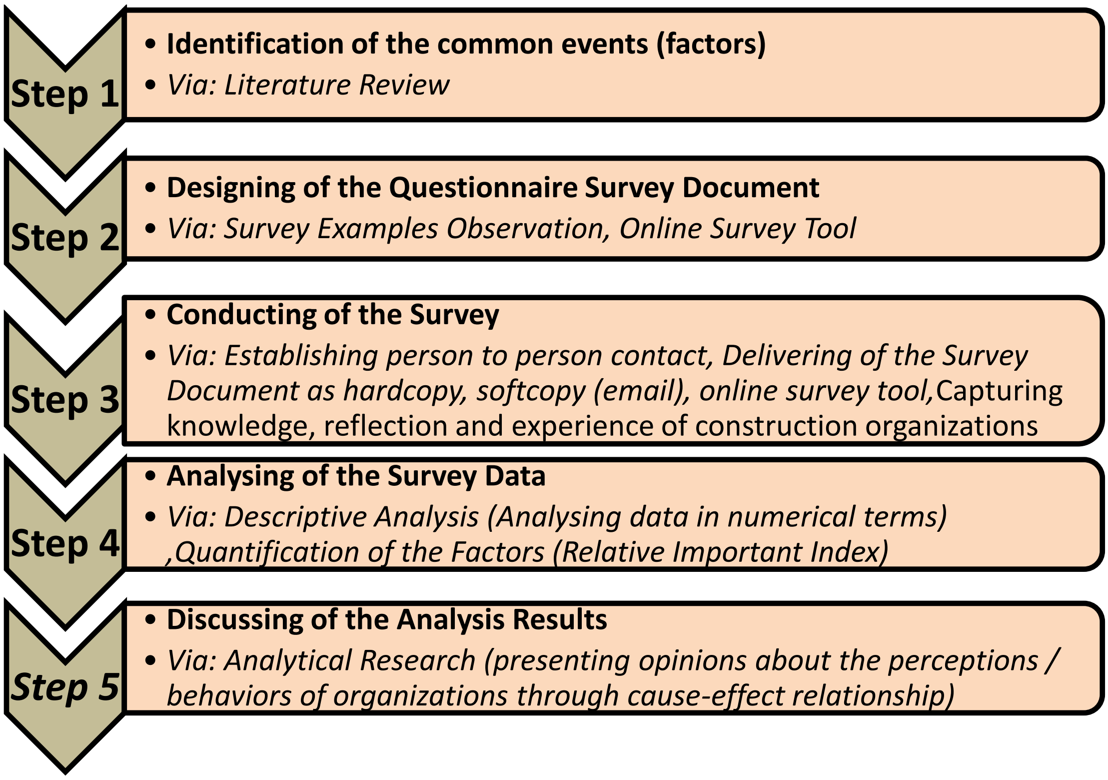

Figure 1.3: Common research process for all research phases (phase 1, phase 2, phase 3)

1.6 Limitations of the Research

In this research, the findings on change order events have only proven according to the ideas of the construction organizations in Northern Cyprus, Turkey and the U.S.A. for lump sum contracted design bid build procured model building projects because of the chosen region and project characteristics.

The findings about the shop drawing practices, and findings on claim events and the control measures have only proven by the ideas of the construction organizations in

Turkey, for a lump sum and design-bid-build contracted building projects because of the chosen region and project characteristics.

1.7 Findings

The various types of events of change orders, shop drawing practices, contractors' claims are evaluated based on the adverse impact on the construction project, and various types of control measures are evaluated in terms of ability to prevent the claims. A total of 17 different (variable) critical events and measures are identified on the basis of variety of organizational perceptions. 3 of these events were for "change order", 5 of them were for "shop drawings" and 4 variables for the "contractors' claims" were determined. On the other hand, 5 variable control measures are highlighted with respect to organizational perceptions. Additionally, it is determined that the perceptions of organizations regarding critical events are related to their characteristics. It was seen that critical events are highly coherent with the characteristics of the regions. It has been found that the critical change order events differ on the basis of developing and developed regional characteristics. The framework model has been developed by taking into account critical events and control measures as an indicator and warning system regarding the type of risk and measures in construction projects in the Turkish construction sector.

1.8 Research Significance and Contribution to the Knowledge

This research provides three main contributions to current body of knowledge. These are mainly;

I. The most fundamental contribution of this study to current knowledge is the development of this four-component framework. Especially the framework can be helpful to raise the awareness in the Turkish construction industry by pointing out the most serious problems and the most effective measures in order to prevent the cost and time increases caused by the changes and claims which frequently encountered in the Turkish construction sector. Additionally, the findings can be considered as an indicator for the other regions and countries with similar characteristics.

II. The other essential contribution of this study to current knowledge is that, no research has been done for Turkey, which concerning the status of shop drawing practices in construction projects. In addition, previously, the "effect of shop drawings on construction projects" has been examined based on a very limited number of technical and administrative parameters. Besides in majority of past studies, the effects of shop drawing practices were considered as one of a single factor among a variety of the factors. In this study, more focused research were done to monitor the status (impact) of shop drawing practices with respect to variety type of technical and administrative features of building construction projects. Thus, this study provides information based on various aspects about the "effect of shop drawings" in construction projects. In this respect, also this study can be useful to draw attention to the key essential technical and administrative project variables affecting the shop drawings which help to reduce the risks of shop drawings practices primarily in Turkish construction industry.

III. Additionally in this study, change order events have been evaluated on the basis of developing (Northern Cyprus - Turkey) and the U.S.A. as one the principal indicator of the developed country. Thus, this study also can point out to the main differences between the status of construction sector in developing and developed countries on the basis of key events leading changes in construction projects.

IV. This research provides sound model to point out the key driver events of contract clauses named change, shop drawing practices and claim, and key control measures for building construction projects in developing countries. Additionally, this research also reveals the perceptions of organizations in developing countries regarding the basic problems and methods in building construction projects. These achievements can be considered as the basic originality of this specific research.

1.9 Guide to Thesis

The content and the structure of the thesis are:

- Chapter 2 includes the definition of the change order, historical background of variation/ change orders, factors affecting change order, and effects of a change order on projects. Besides, the definition of contractors' claims, severity, and factors affecting contractors' claims was included. Existing research studies concerning changes and claims on construction projects were also mentioned in this chapter.
- Chapter 3 address the definition of shop drawing practices, the relationship between shop drawing and change orders, severity, and factors affecting shop drawing practices. Existing research studies are also mentioned in this chapter.
- Chapter 4 includes the historical background of change management and change and claim mitigation measures in construction projects. Existing research studies regarding control measures and, critical thinking of the thesis were also mentioned in this chapter.
- Chapter 5 presents the methodology of this research and data types and analysis methods.

- Chapter 6 presents the conducted questionnaire surveys and presents the respondents profiles, and comments on the number of survey respondents.
- Chapter 7 presents the quantitative research findings on change order events and, presents the discussions concerning most critical change order events in construction projects.
- Chapter 8 presents the quantitative research findings on shop drawing events and, presents the discussions about most critical events affecting shop drawing practices in construction projects.
- Chapter 9 presents the quantitative research findings on events leading contractors' claims and on claim control measures. Discussions about the critical findings on events of contractors' claims and control measures are also presented.
- Chapter 10 presents the interactions status between the critical findings concerning events of contract clauses named change order, shop drawing practices, claims and control measures and presents the framework for Turkish construction industry in the form of an indicator of the key driver events and key control measures of these contract clauses for the building construction projects on the basis of organizational aspects. Discussions and recommendations on the most critical findings are also presented based on the organizational and regional characteristics.
- Chapter 11 deals with conclusions and address the main implications about the research findings and states the recommendations for the Turkish construction industry and for potential future studies.

Chapter 2

VARIATION (CHANGE) ORDER

2.1 Introduction

In this chapter, the definition of a change order, historical background of variation/ change orders, factors affecting change order and change order impact on construction projects and, contractors' claims, factors affecting contractors' claims are explained based on the validity of the literature. In recent years, many researchers have researched changes in construction projects. Many researchers have explored the changes in construction projects in recent years. Many literature sources contain comprehensive and diverse information about changes in construction projects and contractor claims. Many researchers investigated and analyzed the causes and effects of change and claim factors in construction projects based on various evaluation parameters according to different projects, participants and regional characteristics. In this way, a comprehensive literature review has conducted and presented in this section to understand the state and the most important findings regarding changes in construction projects and contractors' claims.

2.2 What is Variation (Change) Order

In a book, named Project Management in Construction (Levy, 2018), it is noted that, the AIA (American Institute of Architects) A201 General Conditions, defined change order as, a written instrument prepared formally by the owners' representative (architect/engineer) and signed by the owner and contractor agreeing to the following change(s) in the contract (p.54):

- A change in the work—either added or deleted
- An adjustment to the contract sum, if any, either increasing, decreasing, or having no impact on cost
- An adjustment to the contract time, if any, either increasing or decreasing the completion time.

"Change Order" is a contract clause which states that no changes other than those for project enrichment or extra work ordered by the owner's representative will be approved (Levy, 2018, p. 231).

A change order is a formal document that alters some conditions of the contract document (Fisk & Reynold, 2010, p.310). The change order may alter the contract price, schedule, and completion date of the project (Fisk & Reynold, 2010, p.310).

In construction projects, a variation order is "alteration to the scope of works in a construction contract in the form of an addition, substitution or omission from the original scope of works" (Srivastava, 2016, chapter 7: Variations). Construction scope changes may be required after agreeing on a contract to respond to changes or to deal with issues related to design, site condition, or construction methods. Any modification or change to works agreed in the contract is treated as a variation Choi & Kim, 2016). In Construction, change orders are also called variations or variation orders. A change order is a work that is added to or deleted from the original scope of work of a contract (Filicetti, 2008).

It should be noted that the phrase ‘Variation Order’ is not used in most conditions of the contract. In the United States, the term ‘change order’ is used instead of variation order (Twort & Rees, 2004, p. 211).

The usual construction contract contains a clause authorizing the owner or owner’s representative to order changes to the project within the general scope of the contract. The document directing such a change is referred to as a change order (Nunnually, 2004, p.511).

In this context, it is understood that a change occurring at any point specified in contract documents becomes a potential reason for implementing "change order". For this reason, primarily the contract documents used in construction projects are explained and presented below.

2.2.1 Definition of Contract

According to the explanations in the Civil Engineering Project Management book, “A construction contract is the written documents that define the roles, responsibilities, and work under the construction contract, and are legally binding on the two parties, the Employer and the Contractor” (Twort & Rees, 2004, p.51).

The authors noted that a contract is an agreement between two parties which they intend to be legally binding concerning the obligations of each party to the other and their liabilities. The contract binds the contractor to construct the works as defined, and the employer to pay for them in the manner and timing set out (Twort & Rees, 2004, pp. 52-53).

2.2.2 Contract Documents

Civil Engineering Project Management book stated that a typical set of contract documents prepared for tendering are the following (Twort & Rees, 2004, pp.53-54):

- Introduction to Tenderers: The purpose of this document is to tell to contractors how to submit their tender and the required substances they must fill in to provide information on guarantees, bond, proposed methods for construction, etc (Twort & Rees, 2004, p.53).
- General and Particular Conditions of the contract: The general conditions of contract may comprise by general duties/powers of parties, a legal relationship, contractor-employer general obligations/responsibilities, and other legal responsibilities.
- Specification: This describes in words the works required, the quality of materials, and workmanship to be used (Twort & Rees, 2004, p.53). Besides, the Construction Project Administration book defines the specifications as, "the part of the contract documents that define the qualitative requirements of the project is to build". It is a "detailed description of requirements, dimensions, materials, etc., as of a proposed building" (Fisk & Reynolds, 2010, p.96).
- Bill of quantities or Schedule of prices: Twort & Rees (2004) stated that, a bill of quantity shows the number or quantity of each item and its unit of measure, the rate per unit of quantity quoted by the tenderer, and the consequent total price for that item (p. 53).
- The Contract Drawings: These should provide as complete a picture as possible of all works to be built. The more complete the contract drawings are, the more accurately the contractor can price the work and less likelihood there is that variations and extra payments will be necessary. The contract drawings provided

to tenderers demonstrate what requires (Twort & Rees, 2004, p.54). Construction project administration book stated that the role of the drawings is to define the geometry of a project, including dimensions, form, and details (Fisk & Reynolds, 2010, p.96).

- Tender and Appendices: This document contain other substances defining the terms of the contract and which the tenderer confirms he/she accepts the offer, such as works completion time , damages for failure not being completed on time, completion of the bond, and minimum required amount of insurances (Twort & Rees, 2004, p.54).

The next section explains the definition and roles of key parties involved in construction projects.

2.2.3 Roles of the Key Parties in the Construction Projects

Levy, (2018) and Twort & Rees (2004) stated in their book that there are two key participants in the construction contract, “the Employer” and “the Contractor” since the construction contract is made between these participants (p. 51). However, the third party is the consultant (designer, engineer), who is designated as the project manager or employer representative.

Fisk & Reynold (2010), defined in their book that the principal participants involved in construction projects are namely, contractors as builders, consultants (p. 1).

The roles and responsibilities of key project participants' are defined in the construction contracts (Twort & Rees, 2004). The following section explains the roles and responsibilities of the main project parties in construction projects.

2.2.3.1 The Employer (Client)

The employer (client), is the party that finances the project and the owner of the building. The owner enters into a project with an architect/engineer to plan and design according to their wishes (Fisk & Reynolds, 2010, p.1).

The employer sets out his required standards and performance objectives for both design and construction in a document entitled 'the Employer's Requirements' (Twort & Rees, 2004, p.42).

The owners take part during the design period to set criteria for design, cost, and time limits (Fisk & Reynolds, 2010, p.1) and sets down what requires in the tender document (Twort & Rees, 2004, p.51). The owners have created the need for the facilities and raise the financial resources for their creation.

2.2.3.2 The Contractor

In their book, Twort & Rees (2004) noted that the contractors are the party, who implements and builds the project, according to the client's wishes and requirements under the supervision of supervisors (p.51). The contractor takes on the obligation to construct the works according to the client's requirements and tender documents and contract (Twort & Rees, 2004, p.51). Delivering the finished facility for acceptance by the owner becomes the primary assignment of the contractors in construction projects (Hussin & Omran, 2009).

Additionally, authors stated that the contractor develops the requirements and designs and constructs the Works under employer requirements. The Contractor is responsible for all design matters except any specifically identified in the Contract to be done by other parties (p.42).

2.2.3.3 The Consultant

Meng & Boyd, (2017) stated that the project management team is responsible to the owner for the direction and coordination of all facets of the project. The team is often made up of representatives from the owner, the design firm, and the supervision of the constructor. Authors also stated that consultants are also called construction professionals.

On the other hand, the architect/ engineer (A/E) goal is delivering design documents for the facility. It can be an outside contracting group such as ME firm or the owner's captive central engineering department.

Hussin & Omran (2009) stated in their conference paper that, in construction projects, professionals represent the team in the design and supervision of construction projects. The consultant is the party that designs the project, manage the tender process, and supervise the contractor during construction. The consultant team is employed by the client and becomes the representative of the owner.

Hussin & Omran (2009) noted that the design usually comprises drawings and specifications, usually prepared by a design team including architects, interior designers, surveyors, civil engineers, quantity surveyors, mechanical engineers, electrical engineers, and structural engineers. The design team is commonly employed by the property owner. These construction management professionals deal with time, money, equipment, technology, people, and materials in managing a construction project. Also, they have to manage the construction process to meet the needs of clients with legal, cost, and environmental constraints. Professionals owe his client's duty to supervise or inspect the works to ensure that they are carried out according to the contract.

Construction manager (CM) is responsible for the administration of the contract after it has been signed. Often the CM is named in the contract as the prime contractor for interaction between the contractor and the owner (Meng & Boyd, 2017).

Purchase, Rosa & Schepis (2016), stated in their book that, the advisers who offer professional services to the client on the investment, the design, cost, contractual arrangements, and all the other facets of dealing in building and property.

In their book, Twort & Rees (2004) noted that consultants are designated as project managers (supervisors) and called as representatives of the owner in construction projects. Their role starts from the designing phase and continues as contractors' supervisor and project manager in the execution process. Since contracts give authority only to consultants (the Supervisor) to order for change orders (p. 42).

According to the definitions stated above, it is understood that consultants have a significant role in the evaluation and criticism of the requirements of changes and the valuation of changes for extra cost and time needed to implement the changes. They act as independent, but they are the representative of the owner since payments to consultants are performed by the owner in the project. These parties usually have novel ideas because of the different expectations from the project performance in terms of cost, time, quality, and facility that causes some conflicts and changes during construction operations.

2.2.4 Change Order Process on Construction Projects

2.2.4.1 Who Does Order Change in Construction Projects?

The contract clause (UNDER ICE 51(1) and FIDIC) allow the Engineer to order any variations in his opinion desirable for the satisfactory completion and functioning of the works (Thomas & Wright, 2016). The names of these contracts mentioned above are stated given below.

ICE contracts are published by Thomas Telford on behalf of the Institution of Civil Engineers (ICE), the Association of Consulting Engineers (ACE), and the Civil Engineering Contractors Association (CECA) (Wurmnest, 2017).

FIDIC (International Federation of Consulting Engineers) was founded in 1913. It is an international model of contract published to promote the consulting engineering industry’s strategic goals and to disseminate information and resources (Rosenberg & Tweeddale, 2016, pp.1-2).

In FIDIC contracts (the Red book 3rd and 4th edition), “clause 51” is about the right to vary of the works in contracts. In FIDIC contracts, Sub-Clauses 13.1-13.2 deals with value engineering and permits the Contractor to propose a change that will benefit the Employer. The proposal is prepared at the cost of the Contractor. The Contractor may submit proposals for variations which may accelerate completion, reduce the cost either of completing the Works or of their ultimate maintenance or operation, improve the efficiency or the value of the Works or otherwise benefit the Employer (Rosenberg & Tweeddale, 2016, pp.1-2).

In a book named Civil Engineering Project Management, Twort & Rees (2004) noted that, the contractor normally has no right to vary the works. However, the contractors can make suggestions about how the work might be varied, for his benefit or the benefit of the employer or both. Under the contract, the Engineer is the only party immediately concerned with variation orders and the handling of contractor's claims (p. 211).

The next section explains the steps for change order application in construction projects.

2.2.4.2 Steps to Order Changes

There are three basic elements involved in change orders documents (Levy, 2018, pp. 234-235):

- A change in the scope of the contract work.
- The cost of the work.
- How this change affects the completion time of the project.
- How this change affects the productivity of the workers (climate condition)
- The information about the working area for the change

The formal change order document should the following information (Fisk & Reynold, 2010, pp.316-317):

- Identification of change order
- Description of change
- Reason for Change
- Change in Contract Price
- Change in Unit Prices

- Change to Contract Time
- A statement that secondary impacts are included
- Approvals by owner's and contractor's representative

The steps to claim a variation under a construction contract are as follows (Levy, 2018, p.234):

1. To identify whether the change in scope is in fact a 'variation' within the meaning of the contract.
2. To look to the relevant clauses of the contract to see what is required (check the contract).
3. To send any notice to the owner (Notify the clients).
4. To prepare detailed costing and other substantiating information regarding the change (Variation) case.
5. To wait for a direction to proceed before starting work (waiting for approval).
6. To perform the work

The Figure 2.1, 2.2 and, 2.3 in the following show two examples of the change order document used in construction projects. The layout of change order documents differs depending on the project management organization and the contract types.

VARIATION ORDER

No...............

Job ....

Contract No. . ... Description ....

Contractor ....

In accordance with and subject to the Conditions of Contract you are hereby instructed to execute the following work:

The prices to be allowed for the above work shall be:

This work is additional to / substituted for work hitherto included in the Contract.

You are instructed to omit items of work as follows:

Drafted .... Signed ....
Resident Engineer Engineer

Date .... Date ....

ESTIMATED NET EFFECT ON THE COST OF WORKS

This Variation Order	....	increase/decrease
Add total effect of previous Variation Orders issued	....	increase/decrease
Total estimated effect	________	increase/decrease

Figure 2.1: Layout of a "variation (change) order" (Twort & Rees, 2004, p.154)

VARIATION ORDER

No: 010- Market

Name of Contract:	Rehabilitation of Market Retailer's Section
Contract Number:	CW-15-2010-53754/58605
Contractor:	Kayas Construction Ltd. & Kemal Aktunç İnşaat Ltd. JV

Schedule No. : 9-Civil Works for Water Systems

Variation in Works Item : 9.2 Wastewater System
9.3 Rainwater System

After having checked the existing infrastructure as has been shown on drawings Me-02 Mech. Installation (Plumbing) and Me-03 Mech.Installation (Rainwater), it is observed that the piping system is either non-operational or partially blocked and cannot serve to discharge and convey the wastewater and rainwater of the market to its final recipient media.

The new to be constructed infrastructural system is shown in the attached drawing no. ME-SK 001.

The total value of the works for this variation order amounts to **EUR 7.351,23** including Tenderer's percentage (15%).

This Variation Order has no time requirement.

Figure 2.2: "Variation (change) order" document used in a construction project (Nicosia, North Cyprus, 2010)

LAWRANCE, FISK & McFARLAND, INC.

CHANGE ORDER

(Instructions on reverse side) No. 13

PROJECT: Hydroelectric Project

DATE OF ISSUANCE: 14 May 1990 EFFECTIVE DATE: 15 May 1990

OWNER: Oakville Power Company

OWNER's Contract No.: 89/90-00

CONTRACTOR: XYZ Constructors, Inc. ENGINEER: Lawrance, Fisk & McFarland, Inc.

You are directed to make the following changes in the Contract Documents.

Description:
Item 1 - Exploratory excavation
Item 2 - Pipe relocation
Item 3 - Delete lateral 4A

Reason for Change Order:
Corrective work

Attachments: (List documents supporting change)
Attachment B (Sketch SK-30)

Data used are fictitious for illustration only

CHANGE IN CONTRACT PRICE:	CHANGE IN CONTRACT TIMES:
Original Contract Price $ 65,123,405.00	Original Contract Times Substantial Completion: 1400 Ready for final payment: days or dates
Net changes from previous Change Orders No. 1 to No. 12 $ 62,037.00	Net change from previous Change Orders No. 1 to No. 12 days
Contract Price prior to this Change Order $ 65,185,442.00	Contract Times prior to this Change Order Substantial Completion: 1410 Ready for final payment: 1440 days or dates
Net Increase (decrease) of this Change Order $ 1726.00	Net Increase (decrease) of this Change Order 4 days days
Contract Price with all approved Change Orders $ 65,187,168.00	Contract Times with all approved Change Orders Substantial Completion: 1414 Ready for final payment: 1444 days or dates

RECOMMENDED:	APPROVED:	ACCEPTED:
By: Engineer (Authorized Signature)	By: Owner (Authorized Signature)	By: Contractor (Authorized Signature)
Date:	Date:	Date:

EJCDC No. 1910-8-B (1990 Edition)
Prepared by the Engineers Joint Contract Documents Committee and endorsed by The Associated General Contractors of America.

Figure 2.3: "Variation (change) order" document (Fisk & Reynold, 2010, p.315)

2.3 Difficulties of Variation (Change) Order on Construction Projects

Project Management in Construction Book stated that "The change order process can be one of the most difficult aspects of the entire construction undertaking". The two major problems that owner and their design consultants facing with contractors' change orders are (Levy, 2018, p.232):

- The Contractors don't clearly define the nature of the change order
- The contractor does not provide sufficient cost information with detailed breakdowns, thus allowing the reviewing party to survey and understand all costs associated with change.
- The contractor (project manager) has not scrutinized all accompanying subcontractor/vendor proposals to ensure that they have correctly identified the changes.

In another book, it is noted that, to minimize disputes, all change orders issued should contain an adjustment in contract time and price which is mutually acceptable to the contractor and owner (Nunnually, 2004, p.511).

2.4 Factors Influencing Change Order

In his book, Nunnually (2004) noted that "it is rare indeed if a construction project is completed without changes being made" (p.511). All construction projects are unique. Due to the variability of location and time of the projects to be implemented, construction projects are never the same. Construction projects are uncertain by nature, as the construction projects consist of different technical and administrative variations and being under the influence of many factors. Construction Projects are multidisciplinary projects that involve many disciplines. Besides that, construction projects are performed with the contributions of many industries and parties. It is also under the influence of the decisions of many segments. In this manner, the success of construction projects depends on the effects of many elements. The progress of construction projects depends on the situation of many industries. Finishing a project on schedule is being a hard task to accomplish in the uncertain, complex, multi-party, and dynamic environment of construction projects. For this reason, construction projects have to face many uncertainties.

Lester (2006) has demonstrated that there are very few projects which do not change in some way during their life cycle. Equally, there are very few changes that do not affect either (or all) the time, cost, or quality aspects of the projects (p.84).

Changes may also be executed to correct errors in the plans and specifications or may the direct result of contractor suggestions that are approved by the owner and the architect/engineer (Fisk & Reynold, 2010, p.309).

Aggressive scheduling for construction projects is becoming increasingly common in project management because of tight budgets and the client's desire to start operations quickly. This has led to an increase in the changes and magnitude of the project change (Levy, 2018).

In majority of Contruction Project Management based books, the most common factors affecting variation are highlighted as follows (Levy, 2018) (Fisk & Reynold, 2010) (Lester, 2006) (Twort &Rees, 2004) (Nunnually, 2004) (Gündüz, 2002).

- Inadequate Design, Inadequate Data Collection: Projects run on a short timeline and there is less or no time for comprehensive design. Design is rarely complete before construction. Most of the design-related changes or design errors are because of the design coordination problem between all parties (designers- client- contractor). These cause more design changes and slows the project down.

- Project Management Efforts and Experience: The management team directs multiple projects which may cause deficiencies in the control mechanism. Part-time management reduces control over the project, causing planning and source allocation problems. The experienced manager knows how to deal with the situation. The more the manager experience the less will be changing.
- Duration: If projects have short durations, this forces the contractor to work fast and other problems occur. The actual duration is usually greater than estimated which shows no sufficient time being consumed in the planning stages of the project.
- Contractor/ Client/ Project Manager Communication: Bad communication between parties because of a lack of coordination.

Besides, Zaneldin (2006) highlighted in his research article that the most common factors affecting variation orders are as follows:

- Variation in Quantities.
- Estimating error.
- Scheduling error
- Design error or omissions.
- Execution errors.
- Poor communication between parties.
- Specification and drawings inconsistencies.
- Termination of works.

- Poorly written contracts.
- Accident.
- Planning error (organization).

In research study conducted by Oweyobi et al. (2016), the characteristics of project, organizations, client, environmental factors, market conditions, countries are stated as a kind of most contributor factors affecting variation orders.

Based on the literature review, it was understood that the complex and dynamic nature of construction projects is the principal source of variations. The most common reasons for variation orders in the construction industry are inadequate/faulty design and poor coordination/communication between parties considered being the primary factors influencing variation orders. The source of all these reasons is being that construction projects are exposed to many uncertainties. The sources of all these factors are as considered uncertain by the construction industry.

2.5 What Do Owners Consider Important?

In 2004, the Construction Management Association of America (CMAA) surveyed the owners, concerning the most urgent challenges in construction projects. The following comments expressed by owners (Levy, 2018, p.11):

- The high cost of change orders, indicating that contractors need to scrutinize these costs more closely before submitting them to the owner.
- One of the principal concerns of owners is a perceived decline in design documents leading to cost overruns. It was underlined that the project managers should examine the design documents in advance and observes the deficiencies

and errors, alert architects and engineers as early as possible, and enable them to make the required corrections.

- Lack of innovation in the industry and new ideas
- Poor quality of the design documents—plans and specifications.
- Problems with communication and lack of collaboration were also listed as one of the principal reasons for cost overruns. It is also noted that project managers need to enhance their efforts to form an effective project team, open lines of communication between all team members, encourage the open sharing of information, and create an environment that avoids an adversarial relationship.
- Another principal factor is ethics and ethical behaviour play a vital role in creating and maintaining the integrity of the project team (pp.110-111).

Sun et al. (2006), emphasized that "clients' dissatisfaction is due to the over 50% of construction projects suffer from delays and overspending and over 30% of the completed projects have quality defects" (p.261). In fact, in many cases, delays are caused by client requirement changes that result in different specifications of work (Sun et al. 2006, pp.261-262).

2.6 Impacts of Variation Order on Project Performance

Changes are common in construction projects and can happen because of many reasons that can contribute to delaying projects and/or increasing their costs.

The US construction sector spends 13 to 26 billion dollars per year for construction variation orders. The author also stated that with the additional financial resources spent on claims and legal disputes, the total cost of the project change could reach $50 billion annually. The audit report of highway projects built in the Washington

State has reviewed a total of 865 projects and showed that 87% (752) of the projects were completed with a combined total of 6413 variation orders of various sizes at an estimated value of 94 million dollars. According to the audit report, one-third of the total number of variation orders or 35.4 million dollars could be avoided. Inadequate field investigation, unclear specifications, planning errors, and design change or mistakes by the consulting engineer were cited as the reasons for these changes (Gündüz, 2012).

Gündüz (2012) also emphasized that it is very rare to have projects without variation order. The losses accompanying variation orders are not fully understood by the industry. In the past, little data has been collected and analyzed to quantify such losses.

In majority of construction management based books, the most common negative effects of variation orders are highlighted and described as follows (Levy, 2018) (Thomas & Wright, 2016) (Meng & Boyd, 2017) (Nunnually, 2004) (Hwang & Low, 2012):

- Increase in Project Cost: This is accepted as the most common effect of project changes that may occur. Any major additions to the original work scope will lead to a significant increase in project cost.
- Recruiting New Professionals: Engagement of specialized professionals may be essential to facilitate the changes. If the professionals are not readily available to deal with the new changes, there will be accumulated problems.
- Increase in Overhead Expenses: proper documentation is vital. The proposed changes are properly communicated and documented to all the parties involved. More expenses will be necessary for the legal documentation and paper

procedures about the agreed changes.

- Quality Degradation: This is also one of the primary concerns for owners. Contractors may compensate for the losses by cutting corners due to the frequent changes of the owners. Thus, this will affect the quality of the work negatively.
- A decrease in Labour Productivity: Working overtime could demoralize the morale of workers and deteriorate the productivity of workers. Productivity degradation will affect the delaying of the project too.
- Delay in Procurement Process: Procurement delays can be frequent in a construction project because of project changes. New specialized materials or equipment may be needed to be the resources of the project.
- Rework and Demolition: Rework and demolition are considered the most potent effect of project changes that can occur. Minor or major rework may need depending on the timing when the changes occurred.
- Safety Conditions: Health and safety of the workers should be carefully taken care of. Safety conditions in construction projects may be affected by changes. Employers should always ensure a safe workplace condition for workers. When there is new equipment or other construction methods used, proper and additional safety measures must be prepared for the workers.
- Delay in Completion Schedule: Completion schedule delay is the most frequent effect that can occur. A survey finding showed that 50 per-cent of the projects were delayed because of the frequent changes.

Figure 2.4 shows that while the cost of the change is minimal at the start of the project, the cost of the changes increases as the project progresses. While uncertainties that cause changes in the early stages of the project are at their maximum level, uncertainties and risks decrease with the progress of the project.

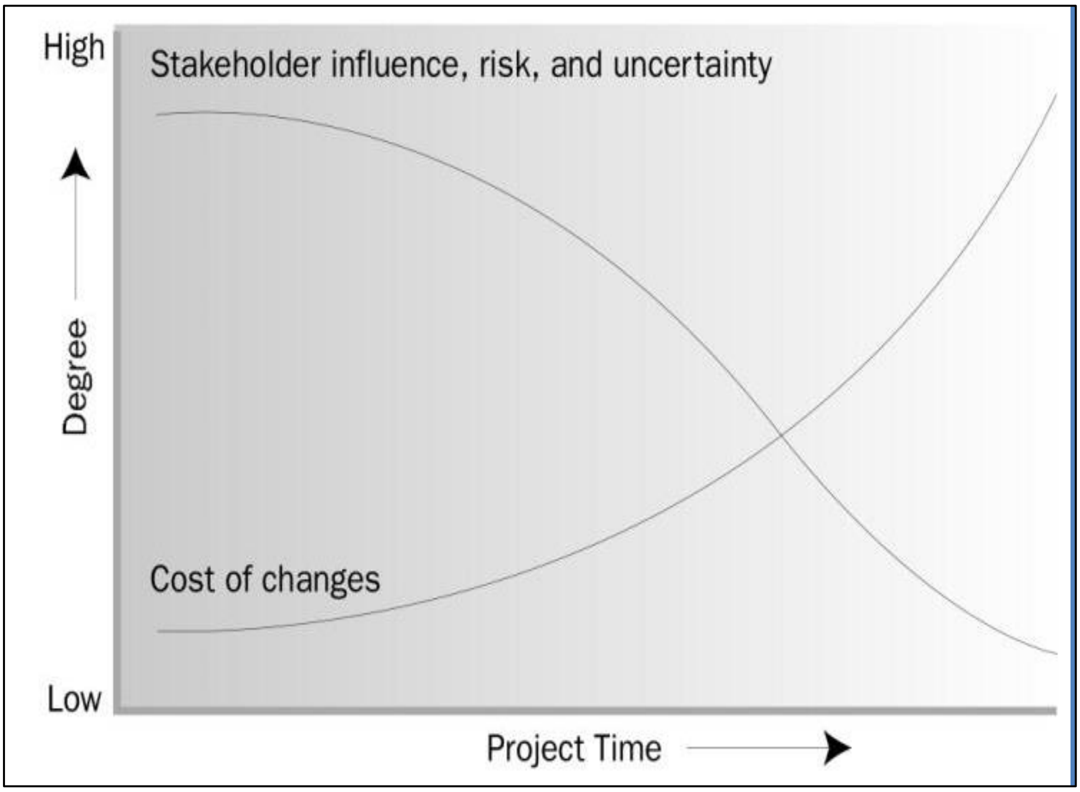

Figure 2.4: Cost and risk of variations of changes relative to time (PMBOK, PMI, 2008)

Contractors' claims for additional budget and time are considered as the most common consequence of changes in construction projects. In this context, the next section describes the description and status of the Contractor's claims on construction projects.

2.7 Contractors' Claims

In book written by Thomas & Wright (2016) defined the word claim as, claim is the right to extra money and time due to the expenses raised by any circumstance which beyond the contractors' control.

In their book, Twort & Rees (2004) defined the word claim as "'claims for more money by a contractor which may or may not be payable', for matters other than those for which payment is specified in the contract" (p.212).

In othe construction management based book, Nunnually (2004), stated that "a claim is a request by the contractor for a time extension or additional payment based on the occurrence of an event beyond the contractor's control" (p.512).

Zaneldin (2006) stated that claims are common in construction projects and can be caused by a variety of reasons that can contribute to a project's delay and / or increase in costs. The author stated that when a claim is submitted, the owner and contractor can agree on the claim, creating a change order or amendment, or falling into dispute, creating a construction contract dispute.

Mirza (2005), described that claim is a demand for something due or believed to be due, often the result of an action or direction. In Construction, the claim is an additional compensation or extension of completion time for the work claimed to be added to the construction contractor or both. Most of the claims concern conditions or events encountered during the construction phase (Mirza, 2005).

According to the Institution of Civil Engineers (ICE), conditions of contract) ICE the requirements of contractors to claim cost and time after ordered variations are described as follows:

Twort & Rees (2004) stated that ICE terms contracts require the contractor to undertake such sequential variations and must be paid in invoice rates or at rates based on them. Sometimes, this may seem harsh to the contractor because he may do a slightly different job than he expected, and the rates applied in this way may seem too low to him. The problem of setting the rate for extra work or omitted items or a change in quantity on its own can sometimes be difficult to justify a new rate (p. 208).

The Clause 53 of the ICE conditions of the contract sets out the procedure being followed by the contractor if he wants to claim (a) a higher rate or price than the engineer has set under a variation order or about some altered quantity under a billing item; or (b) additional payment he considers he entitles to under any other provision of the contract (Twort & Rees, 2004, p.212).

Contracts give contractors the right to claim from the owner for any financial and duration damages because of changes in the project. Contractors may tend to value the prices of the changes, taking into account prices higher than the base prices in the contract.

2.8 Disputes in Construction

Odediran et al. (2012) described that the dispute was a problem or disagreement between the parties that could not be resolved by the construction Site or on-site project managers.

Thomas & Wright (2016) stated in their book that, disputes are disagreements between the contractor and owner over some aspect of contract performance (p.195).

Levly (2018), stated in his book that, at one time or another; the changes are that a project manager will have to deal with a dispute that results in a claim. The problem may arise at any point during the construction process, before the process even begins or after it has been completed (p.261). On the other hand, the author stated that stated that the most common cause of disputes in construction projects is the cost and time claims of contractors during the construction process.

The usual construction contracts empower the owner's representative (architect, engineer, or government construction officer) to decide on the validity of such claims. However, if the contractor is not satisfied with the decision, the issue becomes a dispute (Nunnually, 2004, p.513).

2.8.1 What Triggers Claims and Disputes?

According to the Project management in Construction book, the common factors leading to claims and disputes are highlighted as follows (Levy, 2018, pp.330-331):

- Plans and specifications contain errors, omissions.
- Incomplete or inaccurate responses or nonresponses to questions presented by one party in the contract to another party.
- The inadequate administration of responsibilities by the owner, architect/engineer, contractors.
- An unwillingness or inability to comply with the intent of the contract
- Site conditions differ materially from those described in the contract document.
- Unforeseen subsurface conditions
- Shift work and an owner's failure to recognize the added costs when requesting such work,
- Loss of productivity—both cause and effect
- Extra Work or Change Order works.
- Disruptions, delays, or acceleration to the work that creates any deviation from the initial baseline schedule.

- Inadequate financial strength by the owner, contractor, or subcontractor.

Often, most contractor claims and disputes arising out of poorly drafted or ambiguous contract documents. The factors affecting disputes between the contractor and the owner, and increasingly involving the architect/engineer, regarding the interpretation of plans and specifications, are extra work to the contract, payment for contract work and change orders, extension of time, damages for delay caused by either the owner or the contractor, changed or unforeseen conditions, the performance of subcontractors, compliance with contractual requirements. When such claims and disputes arise, the owner and architect/engineer must pay careful attention to the procedures outlined in the contract documents for the handling of claims and disputes (Fisk & Reynold, 2010, p.328).

The next section discusses previous research studies on changes in construction projects.

2.9 Previous Research Studies on Changes and Contractors' Claims in Construction Projects

In recent years, many researchers have explored change factors in construction projects based on various parameters. Change orders have long been an inherent part of the construction industry. Change orders are not new to the construction industry (Desai et al., 2015). Research on the changes dates back to the past, but this issue is still on the agenda today. Today, researches on this subject are still widely carried out. Changes in construction projects have been explored from various aspects over a wide period of time from past to present. In this context, a comprehensive literature review has been made to understand the techniques applied, and the results obtained in current research studies. The methods and findings have been extensively reviewed in current research studies and presented as follows.

Based on the validity of the literature review, Cheng (2014) identified factors affecting project cost through interviews with engineers at construction companies. The data of the factors in terms of cost impact were obtained by interviewing cost control experts in construction companies and consulting firms to compare and determine the perspectives of these expert groups according to cost impact factors.

Jadhav & Bhirud, (2015) were concluded that firstly, the owner changes, additional work and modification to prior work, and secondly, the lack of contractor involvement in design stage were the main causes of change orders in construction projects in Pune.

Choi et al. (2015) were examined the impact of change orders in terms of schedule and cost overruns based on different contract types of highway projects in the US. Authors have investigated the differences of contract types of highway projects in the U.S. based on change order effects in terms of schedule and cost overruns. At the end of the study, the authors highlighted the most common causes and severity of the change orders in highway projects in the United States, based on various contract type models.

Du, et al. (2016) emphasized that improvement of the management process of change orders is beneficial to the project on many aspects, such as cost and risk reduction and encouragement of a more trustworthy relationship between the construction parties. Case study was conducted at a Midwestern land-grant university to observe the application of discrete event simulation (DES) on optimization of the change order management process to tackle a variety of construction problems.

Ahbab, Daneshvar & Çelik (2019) were reported that “design changes” and “poor project management and supervision” were the primary reasons that severely affects time management in large transportation projects financed by the Asian Development Bank.

Kazaz, Ulubeyl & Tuncbilek (2012) has identified 34 factors causing delays in construction projects implemented in Turkey. Relative importance index of delay factors was calculated to rank and specify their importance on delay issues based on contractor’s perception in Turkey. In addition, delay factors were placed in 7 distinct groups according to their types and the relative importance index of the delay groups were compared. The authors concluded that, in the view of the contractors, the most important causes of delays in the Turkish construction industry were "design and material changes" followed by "delay in payments".

In a research study conducted by Oweyobi et al. (2016), examine the causes of variation orders, ascertain their effects and establish the cost and time performance implication as a result of changes on educational building project s in Nigeria. The authors concluded that, the average cost and time escalation is 33.95 and 29.45 per cent of the original project cost and time, respectively, due to the change orders in the educational building projects in Nigeria. Additionally the authors implied that the average cost implication of variation orders is 23.79 per cent in the educational building projects in Nigeria.

Lee et al. (2015) applied the Loss Distribution Approach method to analyze the amount and number of loss incidents resulting from change orders occurring in apartment projects in South Korea. The authors created a risk matrix by creating 5 categories for change ranking factors and 8 categories for job types to calculate the severity and frequency distribution of the amount and number of loss events in construction projects. It was concluded that in terms of amount and number of loss events, the greatest impact was due to the "field condition" of apartment construction projects in Korea.

Gunduz, Nielsen, Ozdemir (2015) examined the probability of the factors contributing delay in construction projects in Turkey. In their research, authors quantified the relative importance of delay factors and groups, and demonstrated the ranking of the factors and groups according to their level of importance in relation to delay by using the relative importance index method. At the end of the analysis, “inadequate contractor experience” and “ineffective project planning and scheduling by contractors” were resulted as the top two factors causing delay in construction projects in Turkey.

Mohamad, Ali & Al-Harthy (2012), were investigated the impact of design changes in reinforced concrete structures. Schedule delay and cost overruns were reported to be the common effects of design changes in reinforced concrete structures.

Sha’ar et al. (2017) examined 60 factors causing problems/conflicts between design and construction in large construction in Palestine. According to the opinions of the consultants and contractors, it was concluded that the most important factor causing the design-construction interface problem is “unstable client requirements”.

According to the consultants, this was followed by the “lack of proper coordination among the various disciplines of the design team”, while the second most important factor, according to the contractors, was determined as the “Awarding the contract to the lowest price”. Besides, it has revealed that “contractor-related” reasons are the most important categories according to the consultants, while “consultant-related” causes are the most important categories according to the contractor's perceptions that cause conflict between design and construction.

Doloi et al. (2012) identified 45 delay causes in construction projects in India, and these factors were grouped under 6 categories. The relative importance index was used as a descriptive analysis to rank delay causes (attributes). The authors concluded that the most critical factors affecting Project duration (causes of delay) were because of the "lack of commitment" and "rework because of errors in execution" caused by slow decision-making by the owner and inefficient site management.

Mahamid (2014) conducted a comprehensive literature review to identify the most common factors causing cost overruns on construction projects in Palestine. The author concluded that the most important factors affecting project cost in Palestine are "Currency Fluctuation", "Project financing" and "contract management", "competitors’ level" and "material cost".

Ijaola & Iyagba (2012), and Oladapo (2007), identified the causes, effects, and sources as well as benefits and remedial actions (Alnuami et.al., 2010) of change orders on construction projects in Nigeria and Oman (Mohamad, Ali & Al-Harthy, 2012). It was concluded that the most common change order factors in both Nigeria and Oman were "additional work" and "change in design", while the cost and time overruns as a result of change orders in construction projects in Nigeria were approximately 79 and 68 percent (Ijaola and Iyagba, 2012).

Bakr (2014) examined the types of variation by examining historical data on variation cases in construction projects in Jordan. The author analyzed the historical data of changes in construction projects in Jordan to identify the most common factor of change in the Jordanian construction industry.

Serag et al. (2010) were examined the predictor variables of a change order on roadwork constructions and analyze the impact of the change factors on Project cost. They developed a regression model to measure the percentage increase from ranges of change because of influencing different predictive variables. Because of the change orders in roadwork construction, it was shown that the most important determinant variable that causes the increase in project cost is the "timing of the change sequence".

Aness, Mohamed & Abdul Razek (2013), examined the average cost and schedule overrun in large projects in Egypt because of change orders. The authors were reported that the average overrun of original contract value was between 11 and 15%, while the average contract schedule exceeds 10 to 20% in construction projects implemented in Egypt.

Taylor et al. (2012) applied a matrix analysis method to explore the frequency and financial impact of change orders on different bid items in the highway Project in the State of Kentucky (USA). It has been concluded that the highest frequency, which represents the average percentage change in the original contract value, is "contract omissions" with 39.94%, and the highest financial impact rate is "owner-induced improvement" with "7.80".

Enshassi, Abdul-Aziz & Abushaban (2012) were analyzed factors affecting the performance of construction projects to identify the most important factor affecting the contractors' performance in Gaza based on contractors' perception. It has been determined that the most important factors affecting the performance of contractors in Gaza are "Delay arising from closure and material shortages" and "people-related factors".

Stare (2011), clarified that 90% of project changes in construction projects in Slovenia are the reason for project delay and cost overrun.

Wambeke, Hsiang, and Liu (2011) studied 50 different causes of variation in construction projects to assess their impact on task starting time and duration. In addition, the authors examined the number and type of people affected by variations, such as workers, foremen, and project managers in the US Army Corps of Engineers at regional offices. The authors also examined the similarities and differences in perceptions between workers, foremen, and Project managers in terms of starting time and task duration variations.

Alnuami et al. (2010), were investigated the effects of the change orders on construction projects by examining 4 different construction projects in Oman to examine their prevalence based on the perceptions of the client, consultant, and contractors. Authors reported that "Schedule delay", "cost overruns" and, "disputes" were the most significant effect of variation in construction projects in Oman. Besides, types of impact and benefits of change orders and types of remedies to minimize the negative effect of a change order are also examined according to perceptions of different parties.

Bröchner and Badenfelt (2011) examined 16 contractual relationships in Sweden to determine the reasons for change and determined their frequency according to contract type and contract incentives, respectively.

Sun & Meng (2009) conducted a comprehensive literature review by examining 101 scientific articles published in journals on the causes and effects of changes in construction projects. Three hierarchical levels were established to understand the fundamental root causes and primary effects of the changes on project variables and project activities.

Enshassi, Arain & Al-Raee (2010b) identified 64 reasons of the change order based on a literature review to show the most common and important change orders according to the perceptions of different parties operating in the Gaza strip. In addition, the ranking of variation factors were placed in 5 categories by species to identify the most common and important reasons for the order of change according to perceptions of different parties in the Gaza strip. It was emphasized that, according to all parties in the Gaza Strip, the most important reasons for the change were "lack of construction materials and equipment" and "changes in design". The authors highlighted that there is an agreement between the owner, the consultant and the contractor based on common reasons for a change order in construction projects in the Gaza strip.

Arain & Pheng (2005a) (2005b) were identified 53 variation order causes based on the validity of the literature review and grouped under four categories by types. The most frequent causes of variation order and their effects on project cost were determined in educational buildings in Singapore (Arain & Pheng, 2005b). “Change of plan for scope by owner” was identified to be the most significant cause of variation order. The strongest correlation was stated to be between “Lack of communication” and “Contractor’s lack of required data”.

Arain & Pheng (2005a), were identified the most common reasons of the variation order in construction projects in Singapore. In addition, the effects of variation orders in terms of project cost were determined in instructional buildings in Singapore (Arain & Pheng, 2005b). The authors highlighted that the most important causes of change patterns in institutional buildings in Singapore are "changes in plan or scope", "unforeseen problems" (Arain and Pheng, 2005a) and "defective problems" (Arain & Pheng, 2005b).

Moselhi, Assem & El-Rayes (2005) developed the Neural Network Model and explored 117 projects implemented in the US and Canada to examine labor loss due to change orders.

Hanna and Gündüz (2004) developed a linear regression equation and measured the losses in labor productivity due to change orders in electrical and mechanical construction works. To estimate whether the project was affected, the project variables were examined by hypothesis testing. It has been determined that change orders in electrical and mechanical construction works in construction projects in the USA cause a loss of labor productivity (loss of productivity) at a rate of 40.05%.

Hsieh, Lu, and Wu (2004) explored 90 metropolitan public work projects in Taiwan to identify the reasons and impact of change orders on project cost and duration under two main assessment dimensions, "technical" and "administrative". According to statistical findings, most change orders being issued because of problems in planning and design at metropolitan public works projects in Taiwan. In addition, the authors conducted a statistical analysis to determine the percentage of cost variance and the number of frequencies in different road projects according to the categorization of the causes of change order. In addition, change order effects by change order factors were examined by technical and administrative type on various project types. It is concluded that change order cost for metropolitan public works in Taiwan is typically 10-17% to total project cost (COR).

Wu, Hsieh & Cheng (2005) identified the change in highway projects in Taiwan to clarify the causes of the construction change and analyze its effects. The authors concluded that the most common reasons for changes in road projects are "Inadequate Geological Survey" and "Inadequate Site Survey" in road projects in Taiwan. According to the findings, the most important reason for the change orders in highway construction projects realized in Taiwan was determined to be “change orders owing to legislative or policy changes".

Lu & Issa (2005), noted that the most frequent and costly changes were often related to “design changes” and “design errors” in building projects.

At the end of the comprehensive literature review, it was understood that the major reasons for the change vary depending on the organizational, regional and project characteristics, as organizations and regions have their own characteristics, construction law, culture, economics and construction technologies. In recent years, many researchers have analysed the causes and effects of variation order factors on construction projects. In this context, it was felt that more study should be done on reducing and controlling change orders, as there is a lack of research to prevent the occurrence of factors that cause changes.

The next section discusses previous research studies on contractor’s claims in construction projects.

2.10 Previous Studies on Contractor’s Claims in Construction Projects

In recent years, many research studies have been conducted on the contractor’s claims in construction projects. Claims have long been an inherent part of the construction industry. Contractors’ claims are very common are not new to the construction industry (Rybka et al., 2017). Research on the claims dates back to the past, but this issue is still on the agenda today. Today, researches on this subject are still widely carried out. Claims in construction projects have been explored from various aspects over a wide period of time from past to present. In this context, a comprehensive literature review was conducted to understand the status and impact of contractors' claims on construction projects. The findings have been extensively reviewed in related research and presented in the following section:

Enshassi, Kumaraswamy & Al-Najjar (2010a) identified 110 factors causing time delay and 42 factors causing cost overruns by conducting a comprehensive literature review and interviews with professionals in Gaza and these causes are grouped into 12 categories According to the perception of the contractors, the most important factors causing cost / time limitations were determined in the construction projects in

Gaza. Based on the perception of contractors, “Strikes and border closure” and “lack of materials in the market” were the most significant factor causing a delay while “Increment of material prices because of continuous border closures” and “Supply of materials by Contractors” were stated to be the most significant factors causing cost overruns in construction projects implemented in Gaza. These findings showed that the most important factors affecting the performance of construction projects in Gaza were external factors due to regional conditions. External factors were directly related to location and region conditions of construction projects referring to the state of the Gaza strip.

Kocaman, Kuru & Çalış (2020), have analyzed 219.546 tender procedures of construction work data in Turkey between the years 2007 and 2017 to investigate the effect of the tendering procedure and contract type on the contract price. According to unit price contracts; it was emphasized that the possibility of dispute is high due to changes in construction projects with lump sum contracts. The authors revealed that most of the contract prices were below the threshold for works between 2007 and 2017.

Sönmez, Dikmen & Akbıyıklı (2020), has investigated the relationship between time and cost of the construction projects in Turkey, taking into account of two components as changes in the exchange rate and the number of non- working days because of climatic effects. The authors concluded that the consideration of the number of non-working days and the exchange rates can have a powerful effect on the time–cost relationship in building projects in Turkey.

Toor & Olungana (2008) were conducted a study to identify types of problems causing delays in construction projects in Thailand, based on the opinions of professionals working in client, designer, consultants, and contractors organizations. According to the types, problems were grouped, and ANOVA analysis applied to determine that the participants differed in their perceptions concerning the types of problems causing a delay in construction projects in Thailand.

Enshassi, Mohamed & Abushaman (2009) were identified 63 factors affecting the project performance in the Gaza strip, and then factors were placed into 10 groups by types. The most important factors were determined by the relative importance index factors based on the evaluation of the owner, consultant and contractor. Factors and groups are ranked by relative importance index and results are compared between consultant and contractor. According to the opinions of the owners, consultants and contractors, it was concluded that the most important factor affecting the performance of the Project in Gaza is “delay because of closures leading to material shortage”. These findings were shown that there was a consensus of perceptions between these 3 key parties regarding common factors affecting project performance in Gaza Strip.

Hassanein & Nemr (2007) studied the causes of claims and the claim management status in the Egyptian construction industry. The authors highlighted that the most common causes of construction damage are “change orders” in projects and “modification of the Project by owner party”. In the Egyptian construction sector, 54% of the reasons for claims were due to change orders. It was stated that in 57% of the project in Egypt, the change orders created because of poor documentation practices by the contractor’s team.

Zaneldin (2006) investigated the types and causes of construction claims in Dubai and Abu Dhabi Emirate by gathering information about construction claims from organizations in these Emirates. The author explored that change or variation orders were the most common reasons for claim in construction projects implemented in Dubai and Abu Dhabi.

Faridi & El-Sayeng (2006) identified 44 reasons for construction delay, based on the validity of the literature review and interviews with professionals in the UAE. The most important delay factors were determined based on the opinions of contractors and consultants. It has been observed that the most important factors causing delays in construction projects implemented in the U.A.E. are “preparation and approval of drawings” and then “Inadequate early planning of projects”.

Assaf & Hejji (2006) were identified 73 delay factors in the Saudi Arabia construction industry to explore their importance index based on the frequency of occurrence and effects on project duration. The factors were ranked in terms of frequency, severity, and importance index respectively based on owner, consultant, and contractors' point of view to emphasize the perceptions of parties concerning the different delay causes in construction projects in Saudi Arabia. They have demonstrated that “change order” is the most common and important factor that causes delays in Saudi Arabia's construction sectors according to views of consultant, contractor, and owners'.

Sweis et al. (2008) were determined the most critical causes of construction delay on residential projects in Jordan according to contractors, consultants, and owners' point of view. Differences in perceptions of contractors, consultants and owners regarding the reasons for delay were investigated using ANOVA techniques.

Chester & Hendrickson (2005) studied seven schedule impact scenarios in a single project to analyze damages by measuring costs and time-outs incurred by different management problem scenarios at the construction site. The impact on cost and time has been measured because of different management problem scenarios. It is concluded that the scenario for delay issues has the greatest impact on the cost and timing parameters of construction projects.

Flyvbjerg, Holm & Buhl (2002) (2004) investigated the actual and estimated costs of transportation infrastructure projects. In these studies, the authors reported that cost overruns in public transport infrastructure projects were around 50 to 100 percent because of the contractor’s claims.

Odeh & Battaineh (2002) identified the most important causes of delays in traditional type contact construction projects in large public and private buildings, roads, water and sewage projects in Jordan from the perspective of contractors and consultants. The authors pointed out that from the perspective of both parties, the most important causes of construction delay were "client-related factors".

Chapter 3

SHOP DRAWING PRACTICES IN CONSTRUCTION PROJECTS

3.1 Introduction

In this chapter, based on the validity of the literature the definition of shop drawings, the process of shop drawing practices, factors affecting shop drawing practices, the severity of shop drawing practices on construction projects and, existing research studies on shop drawing practices are explained. A variety of literature sources contain extensive and varied information on shop drawing practices in construction projects. In recent years, various researchers have been investigated and analyzed for the causes and effects of shop drawing practices in construction projects based on the various assessment parameters according to the different projects, respondents, and regional characteristics. In this manner, a comprehensive literature review has conducted and presented in this chapter to understand the status and most important findings on shop drawing practices in construction projects.

3.2 What is Shop Drawing?

In his book, Nunnually (2004) noted that shop drawings are “drawings, charts, and other data prepared by the contractor or supplier which describe the detailed characteristics of equipment or show how specific structural elements or items of equipment are to be fabricated and installed” (p. 510).

In their book written by, Fisk & Reynold (2010) noted that the shop drawing is a set of drawings are produced by contractors and suppliers under their contract with the owner. Additionally, the authors stated in their book that shop drawing is a link between design and construction, and such drawings are submitted to the owner's architect/engineer by a contractor or subcontractor (p.118). Shop drawings act as a bridge to fill the gap between contractor and contract documents (Porwal & Hewage, 2013). It is the drawn version of the information shown in the manufacturer's or contractor's construction documents. Shop drawings usually show the proposed fabrication or assembly of project components and also used to show the installation, and fit of materials or equipment and provide the details of various components that help in the construction of a project (Fisk & Reynold, 2010, p. 118). Shop drawings are often more detailed than the information shown in the construction documents to give the architect and engineer the opportunity to review the fabricator's version of the product, before fabrication (Porwal & Hewage, 2013) (Fisk & Reynold, 2010).

Shop drawings are those details and sketches prepared by the contractor or the material suppliers or fabricators that are necessary to assure the fabricator that the basic concept is acceptable before starting costly fabrication. Shop drawings often contain information that is not related to the design concept, or only about the manufacturing process or construction techniques on site, all of which are beyond the scope of the architect's or engineer's duties and responsibilities only shows that the items conform to the design concept of the project and compliance with the plans and specifications (Fisk & Reynold, 2010, p.130). Figure 3.1 presents a sample shop drawing and layout heights and bending charts for steel reinforcement in a foundation wall.

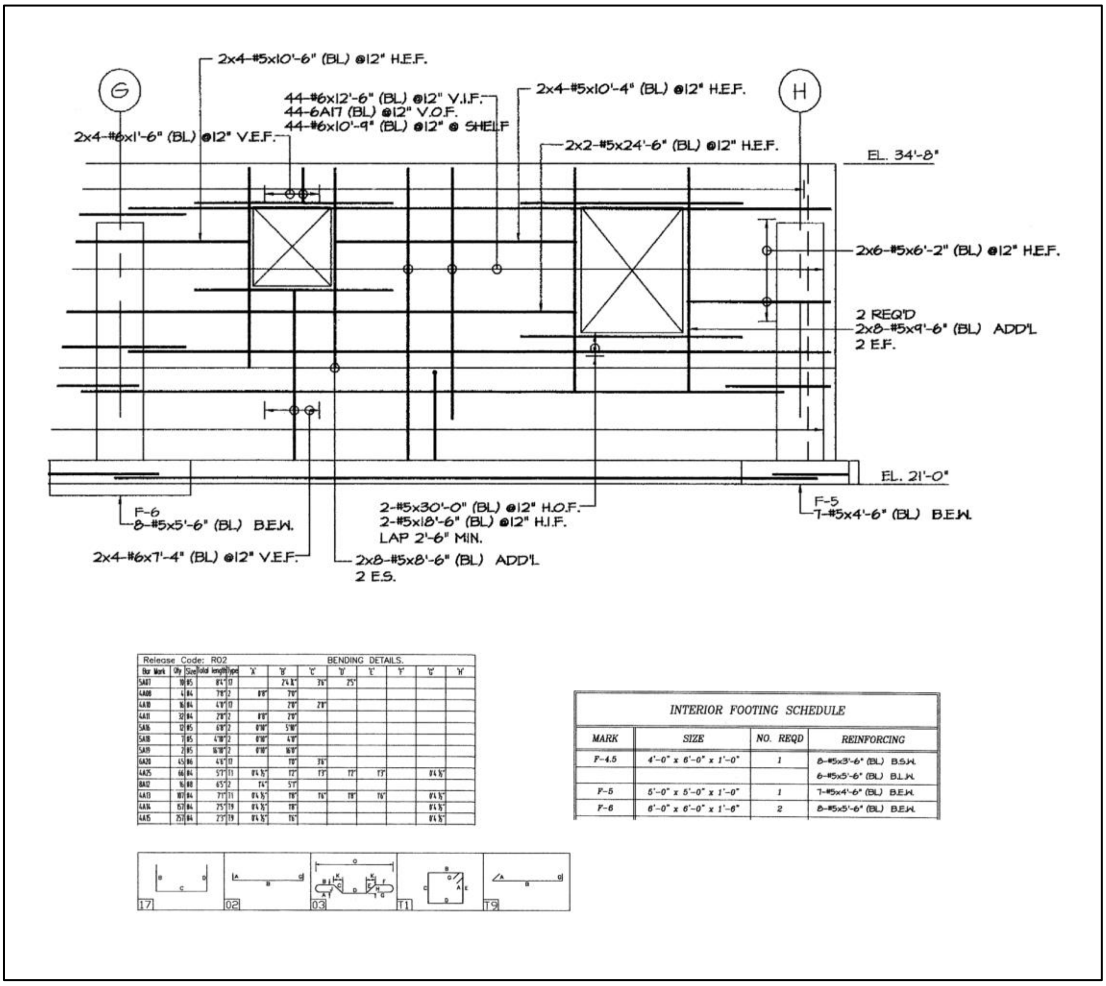

Figure 3.1: Example of steel reinforcement shop drawing on a foundation wall (Shay, 2003)

3.3 Differences between Shop Drawings and Construction Drawings

Porwal & Hewage (2013) noted that construction drawings are the written and graphic record of decisions taken during the design phase. Construction Drawings means the final architectural plans and specifications and engineering plans and specifications documents included in the tender document. While construction drawings are more concerned with the building or structure shop drawings are for various building components (Porwal & Hewage, 2013). While construction drawings are done in the design phase by the design team, shop drawings are done by the manufacturer (by contractors) in the construction phase but before construction of the relevant component of the building (Porwal & Hewage, 2013).

While plans and specifications often define the overall nature of the project, construction methods are expected to be determined by the contractor. Owners and architects/engineers expect this expertise from the contractors. Shop drawings also provide a way for contractors to propose a specific method to fulfill a specific requirement for architects/engineers to approve (Fisk & Reynold, 2010, p. 118).

3.4 Effects of Shop Drawing Practices in Construction Projects

It has been understood that shop drawings practices may be mandatory because of the condition of the project contract and procurement model. The shop drawing practices can cause an increase in the budget and duration of the project and as a result can have a significant impact on project parameters.

In his book, Levy (2018) stated that, shop drawing is one of the most critical elements of project administration. The author also underlined the fact that, claim was made to collect damages because the contractor suffered losses due to an unjustified delay in the architect's processing of shop drawings (p.372). Because of the increasing complexity of today's construction, in recent years, shop drawings have become one of the major sources of a professional liability claim against the designer (Fisk & Reynold, 2010, p.118).

According to the Fisk & Reynold, (2010) two vital reasons and effects of shop drawing practices on construction projects are as follows (p.118):

- Although shop drawings practices improve the quality of construction practices and simplify the execution process, it leads to increases in cost and duration of the project.
- Unreasonable delay in processing shop drawings and ambiguous wording in the

shop drawing approval stamps are the principal sources of trouble. Most specifications require that the contractor refrains from ordering material until the results of the review of the shop drawing submittal from the design organization have received. Any delay in the processing of shop drawings will affect the contractor's scheduling and may cause extra cost to the owner.

Advances in materials and systems make designs more complex, the shop drawings are more accurate than designs created by architects or engineers, as they contain more details (Levy, 2018, p.271). One of the problematic areas in the shop drawing approval process is the cost and specification problems matters arise. When alternate sources and designs of materials and equipment are submitted, there is often disagreement on the quality and equivalence of the alternate products used in the lump-sum bids (Fisk & Reynold, 2010, pp.118-119).

3.5 Shop Drawing Practices and Change Orders

One of the most important and misunderstood facts about shop drawings is that a shop drawing approval normally does not allow changes to the contract provisions. Changes in the work can only be authorized with separate written change orders (Fisk & Reynold, 2010, p.118).

Fisk & Reynold (2010) stated that the principal connections between shop drawing practices and change orders on construction projects are as follow:

- Change orders are issued to accompany a written agreement to modify, add to, or otherwise alter the work from that originally outlined in the contract drawings at the time of opening the bids. A change order is the only legal means available to change the contract provisions after the award of the contract and normally requires the owner’s signature (Fisk & Reynold, 2010, p.130).

- A shop drawing must not a change order, and any variation from the design drawings and specifications must result from a formal change order (Fisk & Reynold, 2010, p.119).
- However, any changes to the contract drawing provided with the contract must comply with authorized change orders; therefore, the contractor must conform to the original detail as shown on the contract drawings. Again, only a change order should be used to authorize a deviation from the contract provisions, and a change order must normally be signed by the owner (Fisk & Reyndol, 2010, p.119).

The following section presents the existing research studies and the most important research findings on shop drawing practices.

3.6 Previous Research Studies on Shop Drawing in Construction Projects

In recent years, based on various parameters, many researchers have conducted research studies on the shop drawing practices in construction projects. A comprehensive literature review was conducted to observe the existing knowledge and to understand the problems regarding the status of shop drawings practices in construction projects. The methods and the findings have been extensively examined in existing research studies and presented as follows.

Marzouk & El-Rasas (2014) and Abd El-Razek, Bassioni & Mobarak (2008) were indicated that, in Egypt, delay in preparation and waiting for approval of shop drawings has become one of the top significant contractors and consultant originated delay factor, respectively. Delay in the approval of shop drawings is one of the most critical owners originated attributes affecting delay in residential construction projects in India (Doloi et al., 2012) (Meghai & Rajiv, 2013), and in the Portugal (Choong Kog, 2018).

Manrique et al. (2015) proposed a method for the automation of shop drawings in the wood-framing design of residential facilities. It was emphasized that the shop drawings have important benefits in increasing the quality of construction, as the shop drawings show all the requirements in construction, thanks to easier inspections and effective quality controls during the manufacturing and assembly of each detail. In addition, it had significant benefits in increasing productivity rates of laborers because of reducing the need for highly skilled laborers because of the easy construction process. As a result, a considerable number of hours could be saved during the drafting and design phase.

Su et al. (2013) were proposed the BIM-based shop drawings (BSDA) system for the BIM manager, BIM engineers, and site engineers to enhance automation and integration of BIM-based shop drawings using 2D barcodes. The developed system was implemented to show the effectiveness of BIM-based shop drawings automation and to verify the integration in practice for building projects in Taiwan. Also, in construction projects in Taiwan, improvement in communication and facilitating implementation were cited as the primary advantages of BIM-based shop drawings with 2D barcodes.

Bramble & Callahan (2011) stated that the delay in reviewing the shop drawings has become one of the most important design-related delays in the US construction projects.

Dossick & Neff (2010) interviewed 65 industry leaders in the United States to explore the use of BIM technologies to identify challenges in mechanical, electrical, plumbing, and fire life safety systems, often referred to as MEP projects. In addition, it was stated that one of the common complaints and difficulties of construction managers in construction projects was “getting insufficient detail and information in the shop drawings”.

Rashid et al. (2006) investigated the impact of different procurement models on construction project performance in Malaysia. Compared to traditional contracting procurement, during the construction stage, “detail design by integrating shop drawing process” can significantly reduce the overall project time in Management Contracting and Professional Construction Management, and even design and build contracting procurement.

Arain, Assaf & Pheng (2004) and Assaf & Al-Hejji (2006) were investigated the importance of 56 delay causes in large building projects in Saudi Arabia. It was emphasized that delay in preparation of shop drawings emphasized as to be one of the most significant contractors related cause, while according to the contractors', approval of shop drawings was noted to be top significant owners related delay cause in large building construction projects in Saudi Arabia (Arain, Assaf & Pheng, 2004), (Assaf & Al-Hejji, 2006).

Love et al. (2002) conducted a case study on 43 six-story apartment projects and investigated the effects of changes in construction projects. It was emphasized that the contractors experienced difficulties as the shop drawings in steel construction were approved by the architects and engineers within 3 weeks. However, it has been stated that architects and structural engineers have difficulty in checking and approving shop drawings quickly because of lack of resources (Love et al., 2002). It was also noted that construction projects suffer from poor communication difficulties due to late response to the information request (RFI). Annual costs for draftsman on correcting shop drawings are estimated to be $16000 (Love et al., 2002).

Al-Yousif (2001) assessed the constructability practices on construction projects in Eastern Saudi Arabia. Arain & Assaf (2007) investigated the interface conflicts between design and construction phases in construction projects in Saudi Arabia. All authors noted that the preparation and approval of construction drawings for construction projects in Saudi Arabia is one of the key processes in the construction phase.

Inadequate or improper checking of shop drawings is cited as one of the common causes of construction failures in Europe (Yates & Lookley, 2002). In addition, in Europe, before the approval of shop drawings, improving structural connection design details, reviewing all shop drawings by design engineers, including bar list and bending details, and checking the field specification appropriately are recommended as common methods to reduce failure in construction (Yates & Lookley, 2002).

3.7 Research Significance Regarding Shop Drawing Practices

It has been seen that in many studies, shop drawings have been examined as one of a factor among many factors. Although there are some studies on shop drawings, which are considered being one of the factors affecting the project parameters, there appears to be very few scientific studies focusing on shop drawings. Apart from this, most of the current studies are related to the factors affecting construction projects rather than focusing on shop drawings. In addition, it has observed that there is a low awareness of shop drawing practices in the construction sector. In many studies, the shop drawing practices for many regions and project types has been highlighted as one of the most important factors that increase the duration and cost of the project. At the end of the comprehensive literature review, it was understood that one of the most important factors affecting the project parameters in the construction sector in many countries is the shop drawing practices. In this context, this study aims to do more focused research to monitor the status of the implementation and impact of the shop drawings practices and drawing attention to the most important factor and thus create awareness for the construction organizations in Turkey. This research aims to fill this gap in the literature not only by examining the shop drawing as one of the many factors that affect the project, but also by evaluating the risks of shop drawing practices.

Since this research is done in Turkey, the findings can be considered as an indicator for countries with similar characteristics.

Chapter 4

CHANGE MANAGEMENT, MITIGATION OF CHANGES AND CLAIMS IN CONSTRUCTION PROJECTS

4.1 General

In this chapter, the definition of change management, historical background of change management, change mitigation measures and preventive methods, claim management and claim resolving methods are examined based on the validity of the literature. Many literature sources contain extensive and varied information on changes management and change mitigation measures in construction projects. In recent years, many researchers have conducted research addressing change management and change control methods in construction projects. Various mitigation methods have been proposed by many research studies based on various projects and regional characteristics to prevent and minimize changes and claims in construction projects. In this manner, a comprehensive literature review has conducted and presented to understand the status of change management and change mitigation methods in construction projects. In addition, previous studies on change management and change and claim mitigation methods have been extensively reviewed in the literature to highlight key findings.

4.2 What is Change Management in Construction Project?

Project Management Body of Knowledge (PMBOK) defines that, the term Change Management is the "process of reviewing all change requests, approving changes and managing changes to the deliverables, organizational process assets, project document, and the project management plan" (PMBOK, 2008, p.93). Also, PMBOK described that, the term change management in construction can sometimes be used as to "change control processes where changes to a project's scope which may have effects on time, cost or quality are assessed and approved" (PMBOK, 2008, p. 93). Change control focused on "identifying, documenting, and controlling changes to the project and the product baseline" (PMBOK, 2008, p. 94).

The CIOB 'Code of practice for project management', defines change control as "a process that ensures potential changes to the deliverables of a project or the sequence of work in a project, are recorded, evaluated, authorized and managed" (CIOB, 2010, p.265).

According to the PMBOK, change management is used to provide a structured approach to help individuals, teams and entire organizations change their approach, attitude, position, and responsibilities within an organization (PMBOK, 2008, p. 94). Also, PMBOK highlighted that change management applications can be appropriate to assist in the redirection or redefinition of; budget allocations, resource use, business process, and other modes of operation (PMBOK, 2008, pp.94-95).

Some researchers defined change management in construction projects as:

- According to the Zhao, Zuo & Zillante (2009), change management as "one of the project management practices that resolve problems when changes occurred in a project or minimize changes that may occur and disrupt the progress of the project" (pp.659-660).

- Sun et al. (2006), stated that the aim of project change management is not to seek the elimination of all project changes, but to minimize the negative impact of necessary changes and to avoid unnecessary ones (p.261).

According to the Hayes (2018) PMI (2008) and Wanner (2013) and Hao et al. (2008) the key steps in general change management organizations are:

a) Identifying the Changes: The first step in controlling the change is to identify the problem. Wu, Hsieh, and Chen (2005) also stated that the first step of change management is to identify change.
b) Assessing Changes: Evaluate the impact on cost, time and project scope to discover how the change will affect the cost, duration, and scope of the project.
c) Approval of Changes: Once the consequence of change is understood, the changes need approval.
d) Implementation of the Changes: Once the change is approved, the coordination between the field and the office team should be ensured and the change should be implemented on the construction site as approved.

Research by Motawa (2005) noted that the evaluation of construction change should strive to establish the following fundamental elements (p.23):

- Project characteristics leading to change
- Reason for the Change
- The likelihood of change occurrence
- The consequence of change should be evaluated

To evaluate the construction changes in the change management process, the above items should be evaluated.

Hayes (2018) emphasized that controlling changes is a key factor in successfully managed projects. The author also underlined that; implementing a good change control procedure will have a significant impact on the project parameters. Besides, it was emphasized that a thorough, definitive, and proper project scope can minimize the changes. However, the author also underlined that changes takes place during the project.

Isaac & Navon (2008) stated that the activities in change management organization are; to forecast changes; to identify changes; to plan preventive measures and to coordinate changes across the entire project.

4.3 Mitigating Changes in Construction Projects

Oxford and Cambridge English dictionaries defined the term 'mitigate' means to make it less severe or painful.

Sun et al. (2006), stated that the change can either be avoided or be anticipated and proactively managed to minimize its negative effects. In project management, changes in projects can lead to significant variations in contract duration, total direct and indirect costs, or both (Viswanathan & Jha, 2020). Therefore, project management teams need to have the ability to respond effectively to change to minimize the impact on the project (Hayes, 2018, p.185).

According to the Society of Construction Law (UK), mitigation in the construction sector can be significant in several situations, such as (SCL, 2017, pp. 10-11):

- Concerning project delay, it refers to minimizing the impact of the delay event. Acceleration can mitigate a delay (i.e.).
- In terms of natural risks, a contingency plan can be enacted to mitigate project risks, such as adverse weather (i.e.).
- To plan policy, planning obligations or planning conditions can mitigate or compensate for the adverse effects of a development.

Olawale & Sun (2010) classified the measures to mitigate the changes. The authors announced three models of mitigation measures to mitigate changes in construction projects. Descriptions regarding the classification of mitigation measures models are explained below (Olawale & Sun, 2010, p.517):

- Preventive Measures: These are precautionary measures taken as a defence to the inhibiting factors. Most of these measures are active measures to be implemented during the planning stage of a project.
- Predictive: These are placed to identify potential future problems with the control process so they can be stopped from happening or prepared if they happen. Most of these measures utilize some tools or techniques to look into the current situation in a bid to spot potential future problems.
- Corrective: These are measures that are used to mitigate the effect of the project control inhibiting factors by acting as a remedy. These measures are only reactive measures that take action after the event. They may not be as effective as preventive or predictive measures.

4.4 Claim Management on Construction Projects

The construction industry agrees that the most common result of changes in construction projects is claims and disputes (Levy, 2018) (Hassanein & Nemr, 2007). Controlling and resolving claims is crucial to the success of projects. Mahamid & Bingönül (2016) stated that the construction industry should develop methodologies and techniques to reduce or prevent claims because project participants are becoming more aware of the high costs and risks associated with claims.

It has been explained as in the previous chapter that the claims for construction contracts are common between the parties. This can result from issues such as delays, changes, unforeseen circumstances, insufficient information, and conflicts. Contractors' claim increases the cost and duration of projects. It is known that the most common reason for disputes between the parties is increased costs and time. Avoiding and managing claims becomes a critical and important task for the success of projects.

The two principal components of claim management in construction projects are avoiding and solving claims. In the literature, some of the basic definitions of claim management are given below.

Song et al. (2015) stated that the primary purpose of the claim management process is to solve a particular problem effectively to resolve the claims. Therefore, the key is to anticipate and prevent problems. The author stated that when a problem arises, the chances of a claim are minimized if each party responds to the problem and resolves it before it gets out of control.

In research study conducted by Bakhary, Adnan & Ibrahim (2017), authors emhasized that claim management is the process of using and coordinating resources to progress from identifying and analyzing a request to preparing and presenting it before negotiation and resolution.

According to Song et al. (2015), the key steps claim processes in construction projects are as follows (p.309):

- Claim Identification
- Claim Notification
- Claim Examination
- Claim Documentation
- Claim Presentation
- Claim Negotiation
- Use of total quality management tools to prevent claims.

Zaneldin (2006) stated that analyzing the various types and causes of claims is an important task in resolving claims. The construction industry needs to develop methodologies and techniques to reduce or prevent claims, as project participants become more aware of the high costs and risks associated with claims and litigation.

According to the Twort & Rees (2004)'s book, the key precautions that can be taken to minimize claims and disputes are as follows (p.223):

- Adequate site investigations
- Checking that the works designed to satisfy the employer's needs
- Completing all design drawings, specifications, and arrangements for

incorporation of separately purchased equipment before seeking construction tenders.

4.5 Existing Research Studies on Change and Claim Management and Claim Mitigation in Construction Projects

In recent years, there have been many research studies addressing how to minimize the impact of change and claims and how to reduce and resolve claims to control costs and time overruns on construction projects. In this context, various methods and suggestions have been proposed to reduce and to resolve the claims in construction projects. A comprehensive literature review was conducted to stay informed of current knowledge and to understand the basic methods for reducing and controlling changes and claims in construction projects. The methods and findings for reducing the changes and claims have been extensively reviewed in the literature and highlighted in the following.

Aness et al. (2013) concluded that in the Egyptian construction sector, “adding clause regulating change order procedures to have clear procedures for handling the change orders in construction contracts” and “negotiation of change order cases by a knowledgeable person” is the most effective change management process to reduce negative impact of change.

Oyewobi et al. (2016) stated that, “improvement on contractual procedure”, “common understanding amongst professionals when interpreting customer’s requirements” and “application of new technology in the design phase as Building Information Modelling (BIM)” is the most effective potential methods to reduce the frequency of change in educational building projects in the Nigeria.

In a research study, Prasad et al. (2019) examined the most effective mitigation measures to prevent the most critical time overrun factors in India construction sector. Authors were developed a checklist for the best mitigation measures and, noted that training and development, adequate plan for resettlement advanced tools such as Building Information Modeling (BIM) are the most effective mitigation measures to prevent time overruns in the India construction sector.

Bakhary, Adnan & Ibrahim (2017) investigated the problems related to the process of claim from contractors' and consultants' point of view by studying common procedure of claim management Malaysian construction industry. As a result of the research, “claim identification”, “claim notification” and “claim documentation” are identified as the three principal issues of claim management process in Malaysian construction sector.

Mohamad, Ali & Al-Harthy (2012) reported that “Allocating sufficient time at the initial design stage to implement clients' ideas properly" and "finalizing the requirements of the proposed work” are the most significant claim mitigation measures in reinforced concrete building projects in Malaysia.

Cagliano, Grimaldi & Rafele (2015) stated that the risk reduction technique is the most effective and is widely used by the construction industries as a risk response, focusing mostly on financial risk reduction in the Italy construction sector. Authors proposed a theoretical framework to classify these techniques with the purpose of providing guidelines for the selection of risk techniques.

Alnuami et al. (2010) were examined for the benefits of change orders and the remedial actions that can minimize the negative effect of change order based on the party's perceptions in construction projects in Oman. The authors highlighted that " revision of registration of consulting offices" would be the most important action, followed by " establishing standard documents for design procedures" and " establishing a national database about soil conditions and services" could be effective remedial actions to control changes.

Stare (2011) developed a model combining risk types and change management functions to identify changes and mitigate their impact on construction projects in Slovenia. Multiple linear regressions was used to measure the effectiveness of risk and change management functions regarding the adverse effects of changes referring to delay and cost overruns. The results showed that the "passive approach" increased time and cost by 4.9% and 4.5%, while "planned corrective measures" reduced time by 14.5% and cost by 6.3%.

Hwang & Low (2012) explored the status of implementing change management activities in the Singapore construction industry to explore the benefits and barriers of implementing change management by cost, structure, and size and project type. The authors concluded that the change management implementation status was relatively low in Singapore, while the improvements in project cost, duration, and quality performance were successful by companies implementing change management in construction projects.

Ijaola & Iyagba (2012) explored potential types of remedial action to minimize and eliminate changes in Nigeria and Oman construction projects. The authors concluded that the most effective change order remedies for construction projects in Nigeria and Oman are “signed of a specialized quantity surveyor and project manager" and” development of a standard document from beginning to completion of projects".

Chai, Yusof & Habil (2015) were examined the seventeen potential mitigation measures that can be adopted to prevent delay in the Malaysian Housing Industry The authors concluded that preventive measures are the most influential category of mitigation measures in preventing delay for Housing construction project in Malaysia.

Iqbal et al. (2015) researched that addressing the most effective techniques in preventing/mitigating different risks in the Pakistan construction industry. The authors concluded that the most effective preventive and remedial risk management techniques in construction projects implemented in Pakistan are “proper schedule by getting update data of the project" and "guidance from previous similar projects" and "close supervision and coordination".

Bröchner & Badenfelt (2011), were compared the contractual changes and change practices in 16 different contractual relationships in construction and Information Technology (IT) projects to discover Industry-specific features of relationship and changes in UK construction and IT projects.

Taylor et al. (2012), emphasized that “front end planning” can be beneficial to mitigate change orders in highway construction projects in Kentuck State (U.S.) because of owner-induced enhancement, and contract item overrun and, contract omissions.

Olawale & Sun (2010), developed 90 mitigation measures to help project managers for better project control in the UK construction industry by addressing the potential problems for the most significant cost and time control inhibiting factors such as design changes, risk/uncertainties, inaccurate evaluation of project time/cost, complexities and non-performance of subcontractors.

A BIM technology, which is increasingly used today, can be an effective in providing a holistic environment in projects by integrating geometric modeling and input of technical and administrative information for work in construction projects (Succar, 2009). BIM technologies is becoming a potential tool for construction project managers in enhancing collaboration between stakeholders, reducing the changes, errors and misunderstanding in projects as well as reducing time required for project documentation, and therefore can be an effective in achieving successful project outputs (Succar, 2009).

Meng (2012) analyzed the impact of relationship management on project performance in the UK in terms of client-contractor relationships. The author noted that poor performances were reduced by replacing the traditional approach in construction projects in the UK with partnership (risk-sharing philosophy) arrangements. Author emphasized that the time delays can be significantly reduced by “encouraging joint and collaborative working”, while the cost overruns can be significantly reduced by “open and effective communication”, “clear and fair risk allocation”, “abandonment of the blame culture”, and, “regular performance measurement”, and, “effective problem solving” in conduction projects implemented in the U.K.

Zhao et al. (2009) applied a Dependency Structure Matrix (DSM) tool to predict changes in Electric power projects in China.

Senaratne & Sexton (2008) introduced a knowledge management perspective to control project changes and successfully resolve change events in construction projects implemented in the UK. The authors stated that different information forms were created during the project change process in construction projects. It was also emphasized that the flow of information during the project change was largely focused on the implicit knowledge and experience of project staff in construction projects in the UK.

Arain (2008) developed a Knowledge-Based decision support system for effective management of variation in educational building projects in Singapore. The authors argued that information technology can be used effectively to provide professionals with an excellent opportunity to learn from similar projects in the past and better control project variations.

Research by Lo, Fung & Tung (2006) stated that "better communication and strong management teams", "good manpower at both technical and managerial level", "better site and ground investigation", "clear and thorough client brief", "good contractor selection considering experience", "reputations and financial capacity", and, "effective decisions on design, specification and construction methods at the preliminary stage of the projects" were suggested as the most effective methods to mitigate construction delays in civil engineering projects implemented in Hong Kong.

Motawa et al. (2007) proposed a change prediction and dynamic planning system as a change management toolkit for predicting change and predicting probability of the change effects. The authors concluded that the projects have a higher probability of change and have a higher impact on the project in the early stages of the project. The proposed toolset is used to monitor the implementation progress of changes. The authors highlighted that the relationship between the cause and effect of change is a useful model for dealing with proactive changes, taking into account the key project characteristics that impact the cause of the change.

Sun et al. (2006) developed a change management toolkit to predict and react to change in construction projects, which includes a change dependency framework, a change prediction tool, a workflow tool, and a knowledge management guide.

Assaf & Hejji (2006) noted that “payment to the contractors on time”, "fast approving of design document” and “checking of resources and capabilities before awarding the contract” are most important owner duties, while “high resource capacity and motivated labors”, “good planning and scheduling” and “effective site management” are the most important duties of contractors in construction projects in Saudi Arabia. On the other hand, “high flexibility” and “comprehensive design document preparations” were noted to be the most important duties of consultants to minimize and control delays in construction projects implemented in Saudi Arabia.

Sambasivan & Soon (2007) noted that disputes and claims arising from changes can minimized in the Malaysian construction sector, especially when the clients’ decision-making is required.

Hassanein & Nemr (2007) explained that establishing standard contract conditions along the same line of FIDIC contracts for the international project could be an effective solution to accurately manage change order claims in the Egyptian construction industry. In addition, the high level of awareness of the construction site team regarding the contract document is beneficial for contractors to manage change orders claims in construction projects in Egypt.

Zou & Lee (2008) investigated the effectiveness of individual project change management implementation elements in controlling project change cost. The relationship between change management application and change cost performance has been determined regarding the project characteristics such as participant type, project nature, industrial type, complexity and cost category. The authors conclude that change management practices are more effective in controlling project change costs for heavy industry, highly complex and $15-50 million contract price projects.

Arain & Pheng (2007) developed a model for managing change orders and reducing the negative effects of change orders in construction projects. The authors proposed variation management processes to help create professionals in evaluating and taking proactive measures to reduce the negative effects of changes.

According to Zaneldin (2006)'s research study, "reasonable time for design"," efficient quality control techniques", "clearly written contracts"," good contract awareness", "establishment of risk-sharing philosophy" and "proper job records" are the most effective claim preventive measures in United Arab Emirates construction projects.

Through implementing comprehensive literature review, it is understood that different change management methods and various mitigation measures are recommended to control changes and reduce their negative effects on projects based on various regional and project characteristics. In this respect, it has realized that changes should be managed with different methods in accordance to the organization and regional characteristics. After the comprehensive literature review, it is revealed that the most appropriate mitigation measure should be applied according to the factor affecting the change to get the most benefit.

The research significance of this thesis has been formed after a comprehensive literature review has been carried out on the change order, contractor claims, and shop drawings, and finally on the measures to prevent changes and claims.

4.6 Critical Thinking of the Thesis

After a comprehensive literature review on change orders, claims and shop drawing practices and, change mitigation methods, the research significance of the thesis studies was structured and presented below. Figure 4.1 in the following presents the structure of the research significance of this thesis.

In this thesis, it is aimed to research on change order first. Also, it was realized that shop drawing practices are one of the most important factors causing "design changes" during the execution process. In addition, it was realized that the major effects of change orders is the “increase in the cost and duration” of the projects. On the other hand, it is realized that the most common result of contractors' claims is increases in the cost and duration of the project. The most common reasons for contractors' claims are change orders. After the literature review, it was realized that change order is one the major contributor to the formation of contractors' claims.

It has been understood that the most important factor causing the projects to be unsuccessful in terms of failing to completion at contract cost and time and disputes between parties are contractor claims. For this reason, to ensure success in the project, the effectiveness of the measures that can be applied in the projects to prevent the changes and therefore contractors’ claims were also examined.

In line with these observations obtained through the literature review, first, in this thesis, research has been conducted on the factors that caused "change orders". In the second phase, the factors causing shop drawing practices were examined. In the third phase, research has been conducted on the factors that cause contractors' claims. As the last step, research has been done on the measures to change and thus reduce the contractors’ claims.

It has been noticed after a comprehensive literature review that top contributor factors varies depending on organizational and regional characteristics. It has been noticed in literature review that the perceptions of organizations and regions regarding change and claim factors and, preventive measures were changeable by organizational and regional characteristics. The parties involved in the construction project may have a different perception due to their organizational characteristics. For this reason, based on the perceptions of different organizational characteristics, the factors influencing the changes and shop drawing practices and, the factors affecting claims and the measures that can prevent the formation of change and claims were examined. Since the organizations in the project have unique characteristics, the research findings are categorized according to the organizations. It is aimed to determine the relationship between the research findings obtained at different stages mentioned above. Also, the relationship between the research findings and the characteristics of the organizations was tried to be determined.

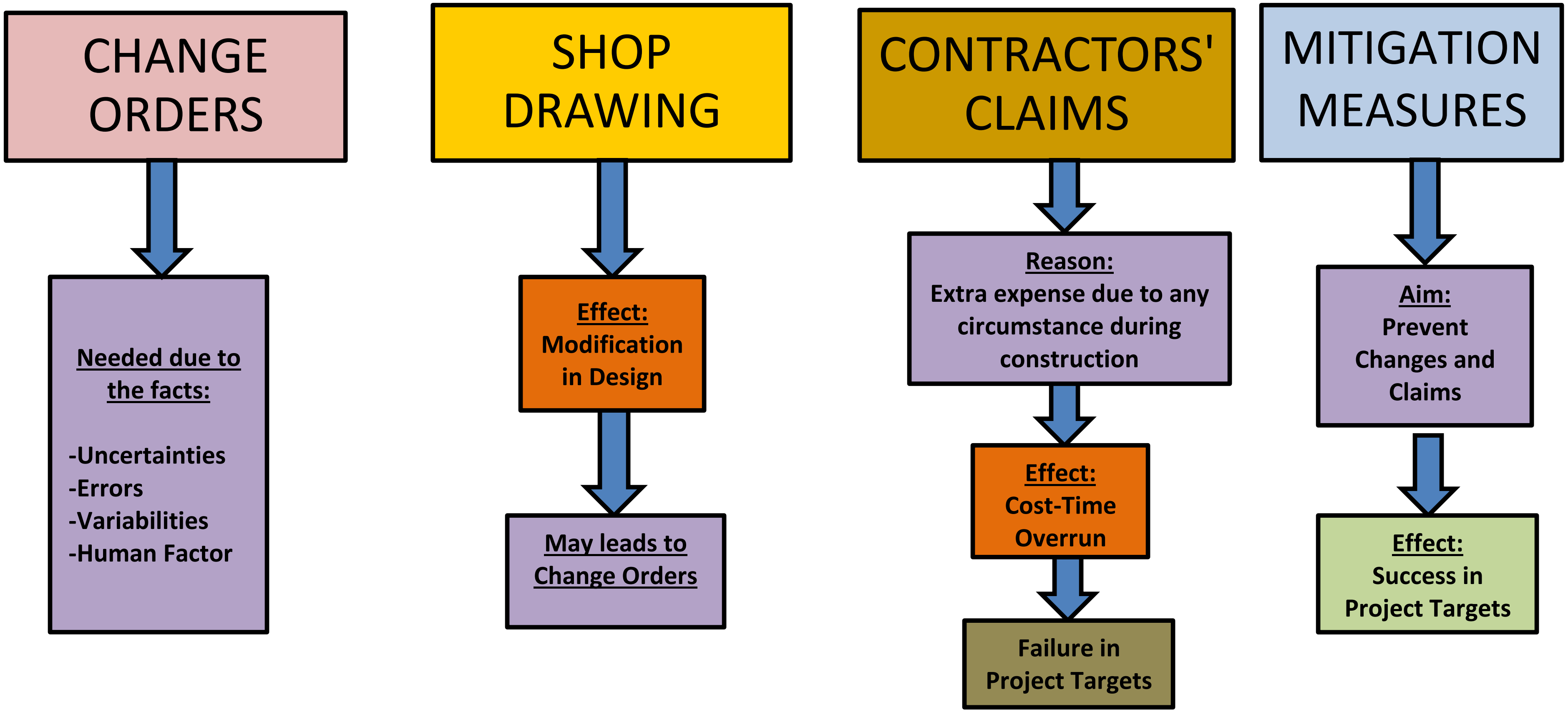

Figure 4.1: Critical thinking of the thesis study

Chapter 5

RESEARCH METHODOLOGY

5.1 Introduction

All kinds of research studies are carried out by applying a certain research methodology and certain research methods. However, research methodology and research method concepts of research studies have different meanings and qualities. The concepts of research method and research methodology are generally perceived the same, but these two definitions have very different concepts from each other. For instance, Taylor et al. (2015) stated the differences of basic meaning of research methods and methodology in their book that, research methods are various procedures, schemes, steps, and algorithms used in research. All methods used by a researcher during a research study are called research methods. However, research methodology is a systematic way of solving a problem. It is a science that examines how to conduct research (Snyder, 2019) (Mishra & Alok, 2017) (Kothari, 2004).

It is worthwhile to highlight at this point the difference in the basic meaning of “research method” and “research methodology”. The terms "methodology" and "method" are the most commonly used terms in the research methodology world. Mishra & Alok, (2017) and Kothari (2004) express the basic differences of terms “research method” and “research methodology” in their book as:

“Research methods” can be understood as all methods / techniques used to conduct research. Research methods refer to the instruments used in selecting and constructing research technique such as making observation, recording data, and techniques of processing data (p. 7). On the other hand “Research methodology” is a way of solving the research problem systematically. It may be understood as a science of studying how research is done scientifically. The various steps a researcher generally takes when examining the research problem, along with the rationale behind it. The researcher needs to know not only the research methods / techniques but also the methodology (p. 8).

On the other hand, another common term frequently encountered in the literature is called "research philosophy". This term is basically used to refer the deeper understanding of research. Therefore, it is worthwhile to highlight at this point the basic meaning of “research philosophy”.

For instance, in his book, Sounders (2009) defined the term research philosophy as refers to a system of beliefs and assumptions about the development of knowledge and the way in which data about a phenomenon should be gathered, analysed and used (p.124).

On the other hand, one of the other common terms used often in research methodology works for research studies is the term “Research Design”. In his book, Kothari (2004) stated the term “research design” as:
“A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure (Kothari, 2004, p.31)”. It’s basically contains the decisions regarding what, where, when, how much, by what means concerning an inquiry or a research study constitute a research design (Mishra & Alok, 2017) (Kothari, 2004).

It was understood that research methods are specific procedures for collecting and analyzing data. Deciding on the research methods is one of the most significant parts on the designing of the research. It was understood that, in order to reach the targeted analysis results from this research, the most accurate research methods should be determined by taking into consideration of the expectations, needs and conditions of the research. For this reason, it has been decided that, it is worthwhile to examine the current research methods options deeper in order to determine the most consistent research methods in line with the needs, expectations and circumstances of the researcher. Therefore, it is aimed to determine the most accurate research methods in line with the expectations, needs and conditions of this research by evaluating the existing types of research methods in terms of their purpose, and characteristics.

In line with the facts stated above, in this part of the thesis, this research study is utilized from all discussed components in detail for development of the theory process focusing particularly how the research methodology and research methods adopted shape the data collection and analysis process.

In the "research methodology" sections of the research, it is often seen that different "research methods" are adapted according to the qualifications, conditions, and objectives of the research. At this point, it is necessary to perform a detailed consideration on the options of research method types in order to determine the most accurate research method for this research.

5.2 Type of Research

In their book about Research methodology, Mishra & Alok (2017), Loeb et al. (2017), Kothari (2004) and Shields et al. (2013) and (Nyce, 2007), expressed several types of research, “descriptive”, “analytical”, “exploratory”, “conceptual”, “empirical” “applied” and “predictive”. At this point, it is necessary to highlight the basic meaning of these research methods in terms of their qualities and purposes as follow:

- **Descriptive Research**: Descriptive research is used to describe characteristics of a population or phenomenon being studied. It does not answer questions about how/when/why the characteristics occurred. Descriptive research can be statistical research. Most descriptive research projects are used for descriptive studies in which the researcher seeks to measure such items as, for example, frequency of shopping, preferences of people, or similar data (Mishra & Alok, 2017, pp.2-3) (Loeb et al., 2015, p.1) (Kothari, 2004, p.3).
- **Analytical Research:** Analytical research is a specific type of research that involves critical thinking skills and the evaluation of facts and information relative to the research being conducted (Mishra & Alok, 2017) (Kothari, 2004). The researcher has to use facts or information already available, and analyze these to make a critical evaluation of the material (Mishra & Alok, 2017, pp.2-3) (Kothari, 2004 p.3). The analytical research usually concerns itself with cause-effect relationships. For instance, to emphasize the basic differences between the descriptive research and the analytical research is that, for instance, examining the fluctuations of U.S. international trade balance during 1974-1995 is an example of descriptive research; while explaining why and how U.S. trade balance move in a particular way over time is an example of analytical research.

- **Exploratory Research:** Mishra & Alok (2017) and Kothari (2004) expressed that, exploratory research is the process of investigating a problem that has not been studied or thoroughly investigated in the past. The goal of exploratory research is to develop hypotheses rather than test them, whereas formalized research studies are those that have an important structure and specific hypotheses to test.
- **Conceptual Research:** Conceptual research is concerned with some abstract idea (s) or theory. It is often used by philosophers and thinkers to develop new concepts or to reinterpret existing ones (Mishra & Alok, 2017, pp.3-4) (Kothari, 2004, p.4).
- **Empirical Research:** Empirical research relies solely on experience or observation, often without considering systems and theory. It is a data-based research that reaches conclusions that can be verified by observation or experiment. Empirical research; it includes observation, experimentation and research based on verifiable evidence (Mishra & Alok, 2017, p.4) (Kothari, 2004, p.4).
- **Predictive Research:** In their book, Kumar & Garg (2018) expressed the method Predictive analytics as a technique that involve a variety of statistical techniques, from data mining, predictive modeling, and machine learning, to analyze current and past facts to make predictions about a future or otherwise unknown event (p.32).
- **Applied Research:** Mishra & Alok, (2017) and Kothari (2004) stated in their book that, this research methods can either be applied (or action) research or fundamental (to basic or pure) research. It is a method aims at finding a solution for an immediate problem facing a society or a business organization (p.3) (p.4).

Based on the descriptions above, this research in general aspect is "exploratory". Because key events leading contact clauses named change orders, shop drawing practices, claims, and key control measures in preventing claims were not examined on the basis of Turkish construction industry. In addition, the events of these contract clauses have not been examined together in the present research studies. The interaction status of these four contract clause events were not examined in any past research. However, for certain research stages, "descriptive research" is adopted. Also for the last research stage, "analytical research" is adopted to particularly state the discussions.

Based on the definitions and purpose of the several types of research methods, this research covers two methods, they are “descriptive” and “analytical”. Because, one of the main expectation of this research is to clarify the views / perceptions of a particular population in a particular region on a particular issue. In accordance with the expectations, goals, objectives and conditions of this research, "descriptive" will be applied to obtain numerical analysis results in the first process. The reason for this is that statistical analysis is needed at the first major stage of the research. Therefore, the first major research stage includes the "descriptive" method. Since there is a need to question the meaning of numerical results more deeply, the second major phase of this research will cover the "analytical" method. In the next major research stage of the research, questions on why and how will be applied in order to give a deeper meaning to the numerical results. There will be a need for in-depth questioning of how and why numerical results result in a certain way. Because numerical data will be obtained in the light of the evaluations provided by the organizations with different characteristics hence, it can be possible to obtain different numerical results according to the characteristics of the organizations. In order to determine the relationship between the numerical data results provided by the different organizations and the characteristics of the organizations, it is planned to make deep inquiries about the basis of the numerical data.

5.3 Type of Research Approaches

In their book, Fellow & Liu (2015) and Kothari (2004) stated that, research studies are carried out with basically two main approaches. These two main research approaches are expressed as "quantitate" and "qualitative" approach. At this point it is worthwhile to consider the basic meanings and features of these two main research approaches.

In his book about Research Methods, Walliman (2017) expressed that, mainly there are two types of data categories, referring not to their source but to their characteristics; basically whether they can be reduced to numbers or presented only in words (p.71). Numbers are used to record much information about science and society, for example pressures, bending forces, population densities, cost indices etc. This type of data is called quantitative data. Numbers can be analysed using the techniques of statistics (p.71). Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity (Goertzen, 2017, p.15), (Kothari, 2004, p.3).

However, a lot of useful information cannot be reduced to numbers. In his book, Walliman, (2017), expressed at this point as, “People’s judgments’, feelings of comfort, emotions, ideas, beliefs etc. can only be described in words. These record qualities rather than quantities, hence they are called qualitative data. At this point, words cannot be manipulated mathematically, so require quite different analytical techniques” (Walliman, 2017, p.71). This type of research aims at discovering the underlying motives and desires, using in depth interviews for the purpose (Mishra & Alok, 2017, p.3) (Kothari, 2004, p.3).

In the context of this research, in accordance with the objectives and conditions of the research, in this research, the application of these two approaches are needed. While "quantification" was adapted at certain stages, for other certain research stages, the "qualification" approach was adapted.

Within the context of this research, for certain research phases, quantitative approaches were adopted. On the other hand particularly after the quantitative data analysis, particularly for the last research process, qualitative approaches were adopted.

In this research, both "quantification" and "qualification" approaches have been applied. While "quantification" was applied at certain stages of the study as required by the research condition, "qualification" approaches were adapted for the other certain stages.

Depending on the needs of the certain research phase, research studies are carried out by implementing certain main categorical methods. It is necessary at this point to consider the main purpose and qualities of these categorical research methods.

5.4 Categories of Research Method

Depending on the research structure and purpose at the particular stage of the research there need to be applying different type of research methods for carrying out research. Basically, for a certain purpose in a certain stage of the research study, research studies consist of three main categorical research methods. These are as follow:

- **Data Collection:** Data collection begins after a research problem has been defined and research design completed. The main purpose of the method is to collect the data for the evaluation / analysis (Kothari, 2004 p.95).
- **Data Analysis:** After the data have been collected, the researcher turns to the task of analyzing them. For this purpose, statistical analysis techniques are used (Kothari, 2004, p. 18).
- **Evaluation of the Analysis:** After analysing the data, the researcher is in a position to evaluate the analysis. Fur this purpose; hypothesis-testing techniques are used to test the accuracy of the analysis results (Kothari, 2004, p.19).

In the light of the description of these research method categories, in order for the data to be adapted to the analysis, it is necessary to collect data in a suitable format with a suitable data collection tool. It is worthwhile at this point to highlight the options of data collection tools for research studies.

5.4.1 Data Collection Tools

In research studies, depending on the conditions and qualities of research study, various types of data collection tools are used. It is considered important to evaluate these options. In his book, Kothari (2004) expressed the commonly used data collection tools are as follows:

- **By Observation:** This method implies the collection of information by way of investigator's own observation, without interviewing the respondents.

- **Through Questionnaire:** The researcher follows a strict procedure and seeks answers to a set of pre-designed questions through personal interviews. This method of data collection is usually performed in a structured way, the output largely dependent on the ability of the interviewer. Survey questionnaire is the common tool used in this method.
- **Case Study:** The case study is a method of data collection that involves careful and thorough observation of a particular unit; can be that a unit of person, a family, an institution, or a unit case, is collected, organized, interpreted and presented in a narrative format (Kothari, 2004 p.113).

This research expects to obtain the opinions of the participants through questions of a certain nature will be asked to a certain population in order to obtain their opinions on a certain subject. In line with the descriptions stated above, it is concluded that the most suitable data collection tool for this research is "questionnaire". In this context, in accordance with the structure of this research, current conditions and objectives, it was decided to collect data with the "questionnaire" method in this study. The type of data is decided to be 5 point Likert- Scale (please See in Section 5.7 for details). The Likert scale is a point scale (rating scale) which is used to allow the individual to express how much they agree or disagree with a particular statement as numerically. Nemanja (2020) stated in his study that, it is the most widely used approach to scaling responses in survey research to specify respondents level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements.

After the research data are collected, it is necessary to analyze the research data with certain tools. At this point, in the context of the purpose and characteristics of the research study, it is necessary to use the most adaptable analysis tool that will allow the analysis of the collected data.

5.4.2 Data Analysis Tools

In this research, data is aimed to be obtained in numerical format through the questionnaire. As the data is in numerical format, the data will be analyzed using statistical analysis tools. In this research, it is aimed to determine the importance levels of certain events numerically in order to determine the importance of certain events based on certain issues. The Relative Importance Index (RII) approach is used to describe the importance of the specific factor based on the certain parameter using the Likert scale of five scales. It is an effective statistical analysis tool in order to numerically score the importance of a certain element on a certain subject (Aibinu & Jagboro, 2002) (Sergeant & Firth, 2006).

For instance, in their two research studies, Gündüz, Nielsen & Ozdemir, (2015), (2013) used five point likert scale for weighting the factors and the Relative Importance Index (RII) methods in order to quantify the probability of delay factors encountered in construction projects in Turkey. In other study, Dixit et al. (2019) used factors weighting (5 point likert scale) as a data collection approach and used R.I.I. analysis method to quantify the significance of the factors affecting productivity in construction projects in India.

By means of the techniques stated in the light of the explanations stated, after the analysis is completed, in this research, it is necessary to evaluate the analysis results in line with the research qualifications and expectations. Analysis results should be evaluated from the most appropriate angle in line with the qualities and objectives of the research and the meanings indicated by the results should be emphasized.

5.4.3 Evaluation of Data Analysis

Within the context of this research, numerical analysis findings were evaluated in order to question the meaning of the numerical data on a particular issue. In this context, it is planned to determine the relationship between numerical analysis results obtained with the statements of the organizations and the characteristics of the organizations. In this context, it is planned to query the numerical analysis results based on the characteristics of the organizations.

Research studies are carried out by performing certain research processes in a certain order. In this respect, it is worthwhile at this point to highlight the research processes and sequences.

5.5 Research Process

In his book about research methodology, Mishra & Alok (2017) and Kothari (2004) defined the term "Research Process" as, "consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps. In general, for a research study, the principal steps typically in a research study are as follow (pp.11-12);

I. Formulating the research problem;
II. Extensive literature survey;
III. Justifying the research problem;
IV. Preparing the research design;
V. Collecting the data;
VI. Analysis of data;
VII. Evaluating the Analysis;
VIII. Generalisations and interpretation, and

IX. Preparation of the report or presentation of the results (pp.11-12).

After considering and evaluating all the descriptions about the qualities and types of the research methodology components stated in the above sections, in the light of all the techniques, methods, tools and approaches discussed and described above, the most appropriate research design is intended to be developed in accordance with the qualities, conditions, expectations, and objectives of this research. The next section introduces the research design developed for this specific research.

5.6 Research Design

In line with the research methodology components presented above, a research design was developed in order to achieve research expectations, aims and objectives.

This research adopted a multi method approach to examine the importance of contractual events. At first, common events/factors of contract clauses identified through comprehensive literature review. Next, questionnaire survey was used as a research tool to collect research data for the research analysis. Through questionnaire survey, research data obtained as quantitative format. Reflection and experience of construction organizations with respect to contract clause events captured as numerical type. Through statistical analysis method, survey data analyzed as quantitate style as the survey data was quantitate type to understand the importance of events as numerical score (descriptive study). A mechanistic understanding achieved concerning the type of events encountered in construction projects.

In order to gain and provide a deeper meaning to the mechanistic understanding, the numerical analysis (quantitate results) results were examined with a qualitative approach (analytical research study).

After quantitative analysis (testing the meaning/importance of events as numerically), Qualitative analysis approached (analytical research study) adopted to understand the meaning of the quantitative results. Through qualitative analysis, the cause and effect relationship was questioned. Organizations perceptions analyzed through establishing link between quantitate results (numerical score of events) and organizational contractual characteristics/obligations. At the end of the qualitative analysis process, organizational perceptions were determined according to the type of events encountered in construction projects. For this specific research, the developed research design model is illustrated in Figure 5.1 below.

Resarch Stage	Tool	Procedure	Outcome
Step 1; Defininng Research Problem & Research Justification	Literature Review	-Reviewing existing knowledge on status of relevant contract clauses -Reviewing the gabs and lack of existing knowledge on contract clauses	Statement of Research Problem /Research Justification
Step 2; Quantitative Data Collection	Literature Review / Survey Example Observation / Hardcopy / Online Survey Tool / E-mail	Designing and conducting a Questionnaire Survey to collect the opinions of organizations in the construction industry on contractual components	Numerical Survey Data
Step 3; Quantitative Data Analysis	Statistical Analysis Methods / Software (M. Excel)	-Categorizing the collected survey data based on regional/organizational classifications -Quantification of the Importance of Factors	Importance level of the factors of contract clauses with respect to various parameters
Step 4; Qualitative Data Analysis	Organizations/Regions Features -Quantitative Analysis Results	- Integration/explanation of quantitative and qualitative findings -Questioning through cause and effect relationship	Discussions based on organizational and regional characteristrics on contract clause events
Step 5; Proposing a Framework	Outcome of Researches: Phase-1, Phase 2, Phase 3 (A),(B)	Arranging the key events of contract clauses and key control measures in specific patterns and order	Building a Conceptual Framework for Turkish Construction Industry

Adopted Research

Descriptive Research;

Importance Index of Change Order Events /Key Driving Events of Change Order **(Organizational/Regional Perceptions)**

Importance Index of Shop Drawing Events /Key Driving Events of Shop Drawing **(Organizational Perceptions)**

Importance Index of Claim Events /Key Driving Events of Contractors's Claims **(Organizational Perceptions)**

Importance Index of Control Measures /Key Control Measures **(Organizational Perceptions)**

Analytical Research;

Discussions on Impact of Organizational Characteristics on their perceptions concerning;

-On Change Order Events
-On Shop Drawing Events
-On Claims Events
-On Control Measure Events

Figure 5.1: General research design (for phase 1, phase 2, phase 3 (A) and (B))

The details of the process to be carried out on the research steps shown in Figure 5.1 above are as follows:

- **Step 1:** In this process, a comprehensive literature search was conducted and the types of existing researches were considered in detail. Subjects and information needs that could not be observed in the current research studies but could be important for the construction sector were understood. Turkey and Northern Cyprus-based research studies were observed and common problems encountered in these regions were identified. The existing problem in need of a solution was determined and the research needed to solve the problem was determined. Accordingly, the information needed by these regions has been determined.
- **Step 2:** In this step, the main process is to conduct the survey. Initially, through a comprehensive literature review, various events encountered in construction projects were listed. Mainly in this step, a survey has been conducted with institutions working in the construction industry in Turkey, Northern Cyprus (developing), and also in the U.S.A (as an indicator of Develop). In this context, the questionnaire was designed (please see chapter 6 for details) in order to obtain existing information, experience, and opinions about the problems identified in the previous stage. The experiences, reflections, and ideas of the organizations on "change order" "shop drawing practices" "claims" and "control measures" were captured in numerical terms. This research step is performed separately for "order change", "shop drawing applications", "contractors' claims" and "control measures" incidents.
- **Step 3:** The questionnaire data obtained in numerical format in previous step were analyzed with statistical analysis techniques (please see Section 5.7 for

details). The aim of this research process is to evaluate the numerical survey data. Before the analysis process, the survey data were clustered according to the organization types. Afterwards, statistical analysis was performed and the numerical importance and ranking of the events / factors included in the questionnaire with respect to various parameters were determined. This research step is performed separately for "change order", "shop drawing practices", "contractors' claims" and "control measures" events.

- **Step 4:** The purpose of this research phase is to give more in-depth meaning to the statistical analysis results. Since organizations have different adjectives/titles in the contract, they have different obligations hence, they have different characteristic features. At this point, it is aimed to determine the relationship between the numerical analysis results obtained in the previous stage and the characteristics of the organizations and aimed to determine how effective the characteristics of organizations on their perceptions of events encountered in construction projects. For this purpose, it was determined how the characteristics of the organizations can affect the numerical analysis results obtained with the perceptions of the organizations by considering cause and effect questioning. At the end, discussions based on organizational and regional characteristics concerning the contract clause events were stated. This research step is performed separately for "change orders", "shop drawing practices", "contractors' claims" and "control measures" events.
- **Step 5:** At this stage, it is aimed to develop a framework with a holistic meaning by integrating the "key events" obtained in all research processes (Phase 1, Phase 2 and Phase 3 (A) and (B)) in a certain order and meaning. The development of this framework is intended to point out key events that

lead to changing orders, shop drawing practices, claims and key control measures in preventing key events, and to identify their interaction status.

As stated in previous of the thesis, this specific research consists by 3 different research phases (Phase-1, Phase -2, Phase 3 (A) and Phase 3 (B)). The research steps except Step 1 and Step 5 (Step 1 is as for general research aspect and Step 5 is after completing three research phases) described here were applied symmetrically in all phases.

In the first phase of the study, the factors affecting changes in construction projects were examined. In the second phase of the study, the factors affecting shop drawing practices, and the risk status of shop drawing practices on construction projects were examined. In the third phase, factors affecting contractors' claims in construction projects and control measures that could reduce contractor claims were examined.

Within the context of this research, the structure and features of the 3 research phases (Phase: 1, Phase: 2, Phase: 3 (A) and (B) of this thesis are illustrated in Figure 5.2 below. In the following, Figure 5.3 illustrates the characteristic features of organizational and regional classifications.

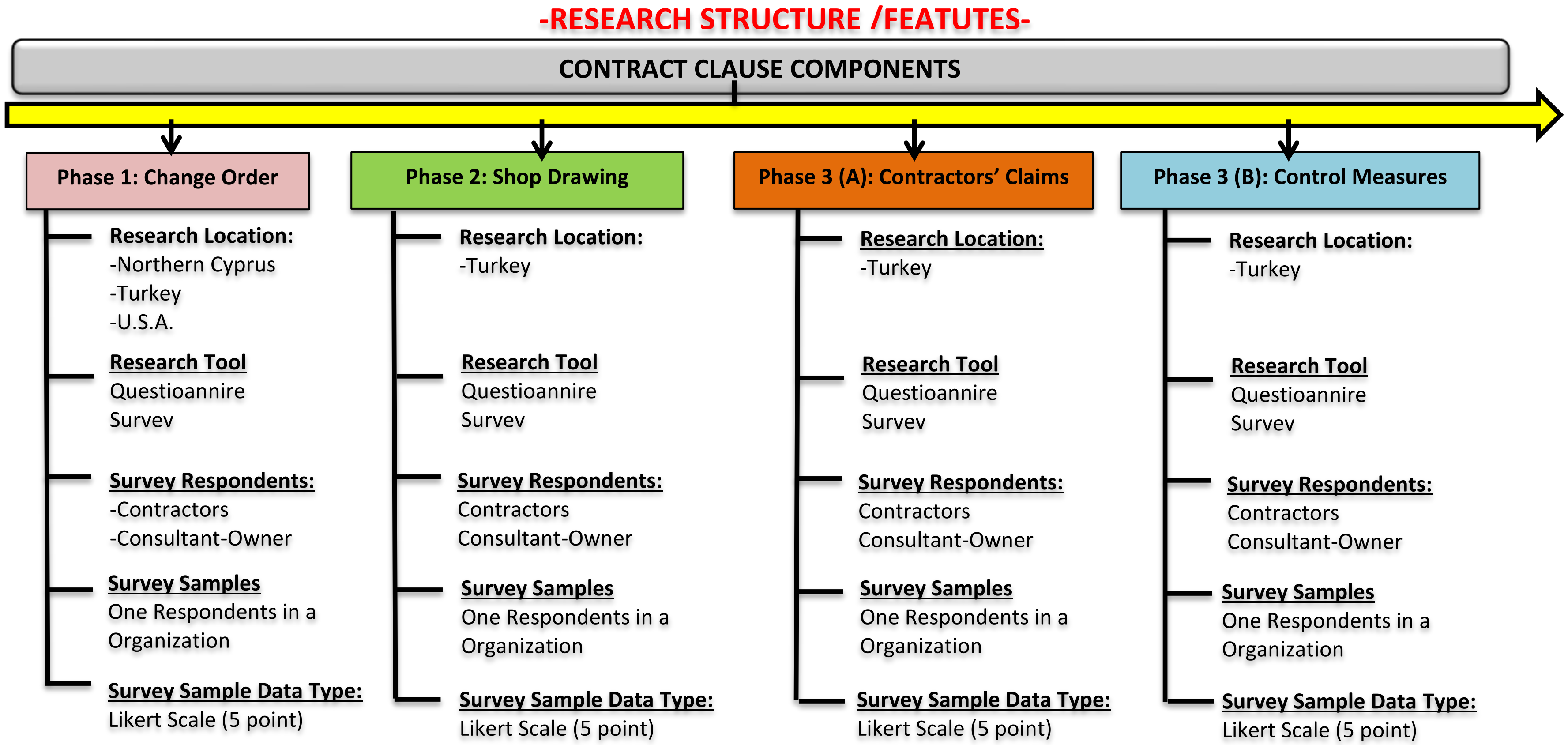

Figure 5.2: Research structure and features (for phase 1, phase 2, phase 3–A and B)

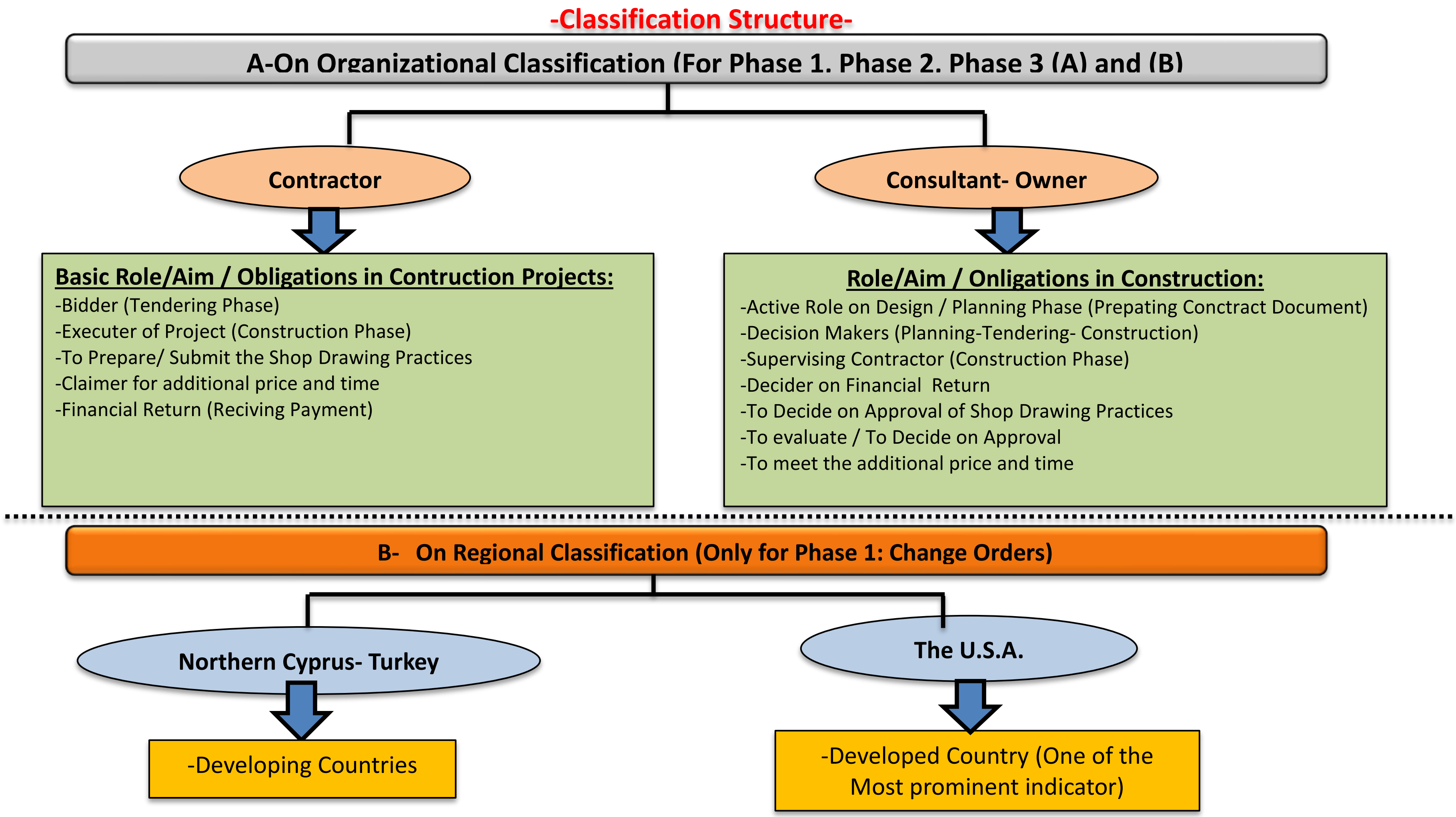

Figure 5.3: Structures and qualities of organizational and regional classifications

In this research, survey data were categorized according to the organizational classifications. Organizational classifications were determined on the basis of strategic position and in respect of their contractual liabilities concerning contract clauses of change orders, shop drawing practices claims, and control measures. Within this context, two different organizational characteristics were discussed based on principal contractual liabilities. The first organization type was recognized as a contractor representing the organization undertaking the implementation of the construction projects and ultimately, aiming to achieve financial benefit.

The second organization is together with the consultant and the owner, both of whom have the authority to make technical and administrative decisions at the project phases and to supervise the contractors and, to decision maker on the financial return in which contractor entitles. Consultants take part in construction projects as the representative of the project owner. In this context, they strategically act in line with the project owner (Levy, 2018) (Sha'ar et al., 2017) (Meng & Boyd, 2017) (Thomas & Wright, 2016).

On the other hand, for the regional classifications, in this research, survey data were categorized on the basis of developing and developed characteristics of regions.

This was only applied for Research Phase: 1 (Change Order events) since, the research in this phase was conducted in Northern Cyprus, Turkey and the U.S.A. Change order events have been evaluated on the basis of developing (Northern Cyprus- Turkey) and the U.S.A. as one the principal indicator of the developed country. The results obtained in Northern Cyprus and Turkey were evaluated together. This is because North Cyprus and Turkey are subject to many similarities and even connected in many subjects. Northern Cyprus and Turkey are close to each other both geographically and culturally. The ethnic origins of the peoples living in these countries are the same. As a result, the cultural characteristics of peoples are similar. There are also the connections between many administrative structures. Many investments are being funded by Turkey in Northern Cyprus. Therefore, companies from North Cyprus and Turkey are collaborators in many projects. On the other hand, the U.S.A. was considered as another individual regional classification as one of a most predominant indicator of the developed country characteristics. The findings on this particular phase can be also considered as an indicator for the similar characteristic countries.

The next section explains the research methods carried out for quantitative analysis (in Figure 5.1, step: 3). In this research, the form of the mathematical equations used for quantitative analysis are explained in the following section.

5.7 Quantitative Analysis

In this section, the details about the quantitative analysis methods used in this research are explained. In the first phase of the research (Phase: 1), the factors affecting changes in construction projects were examined. First, the following section explains the quantitative analysis methods conducted to examine the events affecting changes orders in construction projects.

5.7.1 Quantitative Analysis on Change Order Events (Research Phase: 1)

The first step of the quantitative research is to design the questionnaire. For this purpose, the common factors affecting change orders on construction projects are listed. Detailed explanations about the questionnaire document and the survey process are given in Chapter 6 (please see Chapter 6: Questionnaire and Respondents

Profile for details). In addition, information about the profiles of the respondents who participated in the survey is explained in Chapter 6 (Questionnaire and Respondents Profile). After the questionnaire document designed, the survey and assessment phase was initiated.

In this study, the process of the quantitative research method conducted to examine the factors affecting change orders in the construction projects is shown in Figure 5.4 below.

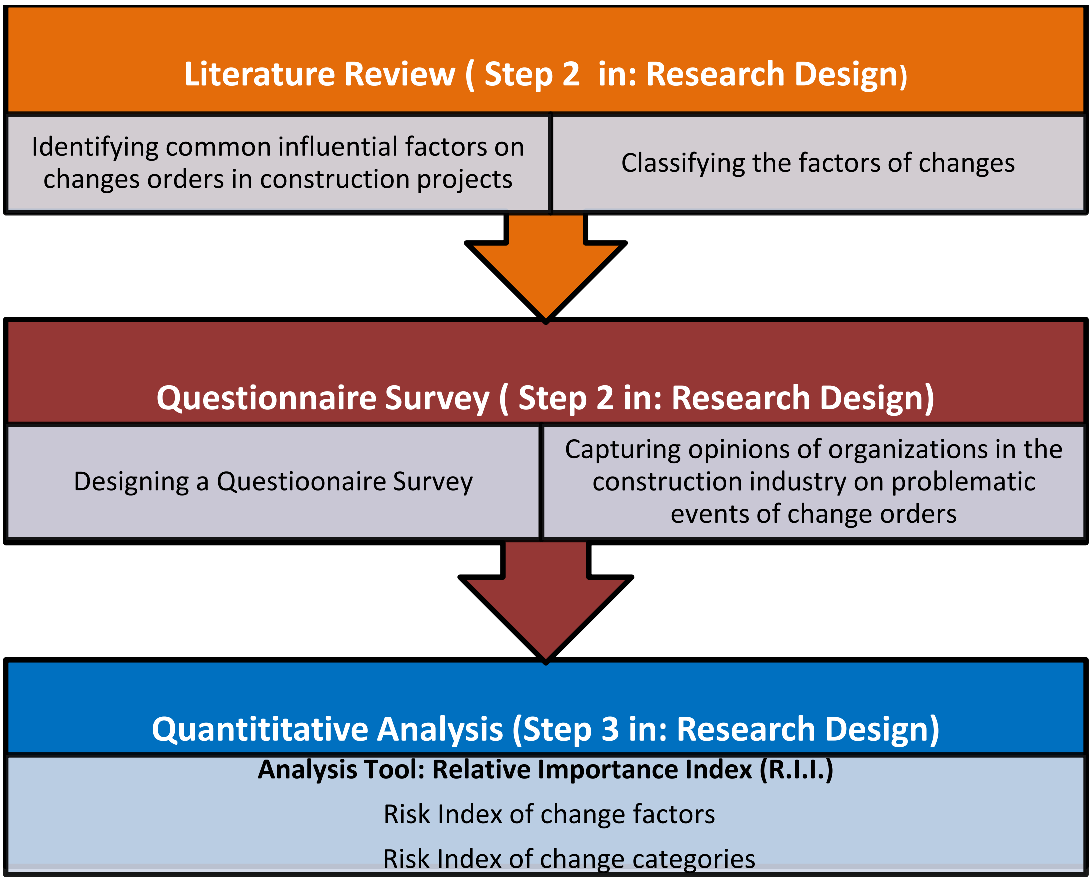

Figure 5.4: Quantitative research process flow on examination of change cause

The following sections explain the data collection and the analysis methods.

5.7.1.1 Factor List

In the first phase of the research, the principal factors affecting change orders were determined and listed based on the validity of the literature. Factors commonly accepted as change causes in literature were listed. At the end of a comprehensive literature survey, it was aimed to include all kinds of change factors representing almost all kinds of events encountered in construction projects. Also, the change causes categorized to provide a better orientation. In this context, change factors are listed whether to represent events arising from technical, administrative, construction process, persons, and external issues. Within this context, after a through comprehensive literature review, a total of 25 different factors affecting changes were listed (See Table 5.1).

Table 5.1: Change factors and references

	Change Factors	**References**
Planning and Design	Errors in Contract Drawings	(Sha’ar et al., 2017) (Oweyobi et al., 2016)(Memon, Rahman & Hasan, 2014) (Senouci et al., 2017) (Lee et al., 2015) (Senouchi et al.,2017) (Desai, Pitroda & Bhavasar, 2015),(Chen, 2008) (Sun & Meng, 2009) (Enshassi, Arain & Al-Raee, 2010)
	Inconsistencies between different Designs	(Senouchi et al.,2017)(Sha’ar et al., 2017) (Sun & Meng, 2009), (Wu, Hsieh & Cheng, 2005) , (Oweyobi et al., 2016)
	Errors and Inadequacy in Specification	(Oweyobi et al., 2016), (Enshassi, Arain & Al-Raee, 2010) (Kazaz, Ulubeyli & Tunçbilekli, 2012), (Sun & Meng, 2009) , (Assaf & Al-Hejji, 2006)
	Conflict among contract documents	(Sha’ar et al., 2017) , (Oweyobi et al., 2016) , (Enshassi, Arain & Al-Raee, 2010) (Lo, Fung & Tung, 2006), (Zaneldin, 2006) (Arain and Pheng, 2005b) (Motawa, 2005)
	Use of Poor design software & Lack of designer Skill	(Sha’ar et al., 2017) ,(Assaf & Al-Hejji, 2006)
	Constructability Ignored	(Motawa, 2005), (Oweyobi et al., 2016) ,(Sha’ar et al., 2017), (Rosenfeld, 2013) (Assaf & Al-Hejji, 2006)
	Error in Cost Estimating and budgeting	(Oweyobi et al., 2016) ,(Assabeihat & Sweis, 2015), (Sha'ar et al., 2017) (Sun & Meng, 2009), (Zaneldin, 2006) (Kazaz, Ulubeyli & Tunçbilekli, 2012),
	Unrealistic imposed contract duration	(Sha'ar et al., 2017) , (Memon, Rahman & Hasan, 2014) (Doloi et al., 2012) (Sun & Meng, 2009), (Zaneldin, 2006)

Table 5.1 (Continued)

Construction-Site	Inadequate site investigation in pre-construction	(Sha'ar et al., 2017) ,(Mohamad, Nekooie & Al-Harthy, 2012) (Assaf & Al-Hejji, 2006) (Kazaz, Ulubeyli & Tunçbilekli, 2012)
	Uncertainties/problems of Subsurface	(Sha'ar et al., 2017) ,(Lee et al.,2015) (Mohamad, Nekooie & Al-Harthy, 2012)) (Zaneldin, 2006)
	Provision of additional shop drawings	(Yap, Abdul-Rahman & Wang, 2016), (Sha'ar et al., 2017) , (Assaf & Al-Hejji, 2006)
	Errors in execution	(Assabeihat & Sweis, 2015) , (Sha'ar et al., 2017) (Sun & Meng, 2009) (Zaneldin, 2006) (Kazaz, Ulubeyli & Tunçbilekli, 2012) (Assaf & Al-Hejji, 2006)
	Material / Equipment / Manpower shortage	(Assabeihat & Sweis, 2015) , (Yap, Abdul-Rahman & Wang, 2016) (Memon, Rahman & Hasan, 2014) (Kazaz, Ulubeyli & Tunçbilekli, 2012) (Arain & Pheng, 2005b) (Enshassi, Arain & Al-Raee, 2010)
	Additions / Omissions of work	(Oweyobi et al.,2016), (Assabeihat & Sweis, 2015) ,(Mohamad, Nekooie & Al-Harthy, 2012) (Ijaola & Iyagba, 2012)
People	Lack of Experience of Project Participants	(Senouchi et al., 2017),(Sha'ar et al., 2017) , (Oweyobi et al.,2016), (Motawa, 2005), (Sun & Meng, 2009) (Assaf & Al-Hejji, 2006) (Enshassi, Arain & Al-Raee, 2010) (Kazaz, Ulubeyli & Tunçbilekli, 2012)
	Poor communication between Parties	(Oweyobi et al., 2016),(Sha'ar et al., 2017), (Motawa, 2005) (Sun & Meng, 2009) (Assaf & Al-Hejji, 2006) Enshassi, Arain & Al-Raee, 2010), (Doloi et al., 2012) (Kazaz, Ulubeyli & Tunçbilekli, 2012)
	Owners Level of Construction Sophistication	(Senouchi et al.,2017)(Enshassi, Arain & Al-Raee, 2010), (Sha'ar et al., 2017) , (Assaf and Al-Hejji, 2006)
Administrative	Poor Contract Management	(Oweyobi et al. 2016) (Doloi et al., 2012) (Sha'ar et al., 2017) (Faridi & El-Sayegh, 2006)
	Inappropriate choice of project delivery system	(Sha'ar et al., 2017) ,(Assaf & Al-Hejji, 2006) , (Oweyobi et al. 2016) (Doloi et al., 2012)

Table 5.1 (Continued)

	Inappropriate choice of contract type	(Oweyobi et al. 2016) ,(Sha'ar et al., 2017), (Assaf and Al-Hejji, 2006),
	Low Contract Price (Competitive Bidding)	(Sha'ar et al., 2017) , (Doloi, 2009) (Arain & Pheng, 2005b) (Assaf & Al-Hejji, 2006)
External	Unforeseeable Natural Conditions	(Assbeihat & Sweis, 2015),(Oweyobi et al, 2016), (Sha'ar et al., 2017), (Kazaz, Ulubeyli & Tunçbilekli, 2012) (Enshassi, Arain & Al-Raee, 2010)
	Fluctuation in Tax / Interest Rate / Material and Labor Cost	(Sha'ar et al., 2017), (Oweyobi et al, 2016) , (Sun & Meng, 2009) (Andersen, Olsson & Onsoyen, 2011) (Love et al., 2002) (Doloi et al., 2012) (Zaneldin, 2006) (Enshassi, Arain & Al-Raee, 2010)
	Change in government laws/ regulations	(Yap, Abdul-Rahman & Wang 2016), (Andersen, Olsson & Onsoyen, 2011), (Sha'ar et al., 2017), (Assabeihat & Sweis, 2015) (Assaf & Al-Hejji, 2006) (Doloi et al., 2012)
	Shortening / Compression in Project Schedule	(Sha'ar et al., 2017) , (Oweyobi et al, 2016) (Sun & Meng, 2009) (Enshassi, Arain & Al-Raee, 2010)

This next section explains the categorization of change factors. Types and definitions of categories of change factors are explained in the section below.

5.7.1.2 Categories of Change Order Factors

In this study, it was deemed appropriate to evaluate change factors in certain categories to obtain more focused results. In this context, change factors have been evaluated in 5 different categories. As shown in Table 5.2 according to factor types, 5 different change categories were created based on the validity of 18 different studies in the literature. Based on the literature, according to the types, the change factors were placed in the relevant category (see Table 5.1). Definitions of the categories of changes are presented:

- **Planning and Design Related:** Yap, Abdul-Rahman & Wang (2016), Sha’ar et al. (2017) and Motawa (2005) defined that change causes are related to errors, omissions, and defects in design and planning, such as inconsistency between drawings and site conditions, mistaken quantity estimates, planning mistakes, citation of inadequate specifications, etc. In a research study conducted by Sha'ar et al. (2017) and Hsieh, Lu & Wu, (2004), the authors noted that the design and planning team are responsible for changes caused by factors in this category. Al-Qershi & Kishore (2017) and Love, Irani & Edwards (2004) were stated that documentation errors and omissions have resulted because of the lack of communication between client and design team members in the design phase of construction projects. In this context, eight factors related to design documentation, design coordination and quantity estimation were included in the planning and design category (See Table 5.1).The next category is as follow:

- **Construction and Site Related:** In their research study, Sha'ar et al. (2017), Lee et al. (2015) and Yap, Abdul-Rahman & Wang (2016), showed that change causes are related to the construction execution process because of adopting new construction techniques/methods, site conditions, difficulties in labor, and difficulties in work execution and control methods. Location and underground conditions are becoming the main project-specific dynamics that affect the construction process (Mohamad, Nekooie & Al-Harthy, 2012) (Love et al., 2002) (Sambasivan & Soon, 2007). Frimpong, Oluwoye & Crawford (2003), were stated that the execution of the project is affected by inherent site conditions. Yap, Abdul-Rahman & Wang (2016), was denoted that the unavailability of material and equipment in the market in execution process may cause changes in projects. Six factors which are related to construction methods, site conditions, resource availability, and shop drawings in the construction process were placed in this category, (See Table 5.1). The next category is as follow:

- **People Related:** In Sha'ar et al. (2017) and Motawa (2005)'s research studies, the authors in both research emphasized that, knowledge and experience of the project team are key components for undertaking successful projects. These research studies denoted that lack of effort of individuals and poor communication because of the cultural issues of organizations taking part in the project may lead to changes. Additionally, Hwang, Zhao & Do (2014) were emphasized that "client-related rework" due to client and client's representatives are the primary cause of rework in construction. "Replacement of materials by the client" and "change of plans or scope by the client" are reported as the most frequent cause and are the most important contributors to client-related rework. Three factors related to the experience, effort, communication level and attitude of the parties involved in the construction project were placed in this category (See Table 5.1).The next category is as follow:
- **Administrative and Contract Related:** Sha'ar et al. (2017) and Oweyobi et al. (2016) were referred that different contract strategies and organizational structures, and management style, are the dynamics of the construction organization. The study was clarified that organization and administrative factors may lead to changes in projects such as the administrative method of procurement, type of contract, method of tendering, type of tender document used, bidding environment and percentage of the adequacy of design document before tender. Arain and Pheng (2005a) were stated that in the case of the low contract price in competitive bids, the contractors' desired profitability may be a potential cause of changes in construction projects, striving to convince the project owner allowing certain changes that provide additional financial benefits for him. In this context, four factors related to the contract, the method of

procurement and the bidding competitiveness were included in the administrative and contract category (see Table 5.1).The next category is as follow:

- **External Related:** Sha'ar et al. (2017) and Alaghbari et al. (2007) were stated that economic conditions, law, and regulation are external factors that can lead to changes. Physical environmental conditions, economic policy, and socio-political conditions are accepted as external factors of the causes of changes. Aiyetan, Smallwood & Shakantu (2011) stated that because of the change in government regulation, external factors have the most impact on the project parameter. Oweyobi et al. (2016) and Hsieh, Lu, & Wu (2004) reported that government rules / regulations of the work in the project could change with the influence of government agencies. Four change factors were included in the external category which associated with uncertain economic conditions, weather, rules/regulations, and decisions of authority (See in Table 5.1). These factors relate to affect arising outside the project and do not comprise the project's technical and administrative facilities, nor are related to the performance of the project and the parties.

The categories of change factors and references were presented in Table 5.2 as follows:

Table 5.2: Categories of changes and references.

Categories	**References**
Planning and Design Related	(Motawa, 2005) (Sun & Meng, 2009) (Yap, Abdul-Rahman & Wang, 2016) (Love, Irani & Edwards,2004)
Construction and Site Related	(Yap, Abdul-Rahman & Wang, 2016) (Motawa, 2005) (Lee et al., 2015) (Doloi, et al., 2012) (Sun & Meng, 2009) (Mohamad, Nekooie & Al-Harthy, 2012) (Hsieh, Lu & Wu, 2004) (Kazaz, Ulubeyli & Tunçbilekli, 2012)

Table 5.2 (Continued)

People Related	(Motawa, 2005) (Doloi, et al., 2012) (Yap, Abdul-Rahman & Wang, 2016) (Hwang, Zhao & Do, 2014) (Sun & Meng, 2009) (Yap, Abdul-Rahman & Wang, 2017) (Kazaz, Ulubeyli & Tunçbilekli, 2012) (Sha'ar et al., 2017) (Enshassi, Arain & Al-Raee, 2010)
Administrative Related	(Oweyobi, et al. 2016), (Sha’ar et al.,2017)(Faridi & El-Sayegh, 2006) ((Kazaz, Ulubeyli & Tunçbilekli, 2012)
External Related	(Yap, Abdul-Rahman & Wang, 2016) (Motawa, 2005) (Sun & Meng, 2009), (Hsieh, Lu & Wu, 2004) (Sha'ar et al., 2017) (Faridi & El-Sayegh, 2006) (Enshassi, Arain & Al-Raee, 2010)

After determining the factors and factor categories, the evaluation phase started. For this purpose, the survey document has been designed. The survey was conducted with construction organizations in the construction industry. The analysis methods and calculations conducted to examine change factors are explained in the following section.

5.7.1.3 Factors Importance Index Scores

After the questionnaire process, the importance level of change factors was determined based on three parameters, designated by the order as the frequency of occurrence, impact on cost, and impact on time of the construction projects.

Factors weighting methods were chosen to obtain the opinions of participant’s ideas through the survey. Five-point Likert scale was used to examine the change factors based on the frequency of occurrence, impact on cost, and impact on time of the construction projects. The factor’s level of significance was determined by calculating factors relative Importance Index scores (R.I.I.) based on the frequency of Occurrence (F.I.), impact on project cost (C.I.) and impact on project time (T.I.). Factors Relative Importance Index scores were calculated using the following equation (1):

$$R.I.I.(\%) = \frac{\sum W_i \times X_i}{A \times N} \tag{1}$$

Where, R.I.I. (%): Relative Importance Index for Frequency of Occurrence (F.I.); Relative Importance Index for impact on project cost (C.I.); Relative Importance Index for impact on project time (T.I.).

Wi: The weight assigned on Likert's scale given to each factor by the respondents and varies between 0 to 4, Here; 0: Never, 1: Rare, 2: Moderate, 3: Frequent, 4: Very Frequent for Frequency of Occurrence; 0: No Effect, 1: Weak, 2: Moderate, 3: Strong, 4: Very Strong for impact on project cost and time; 0: No Effect, 1: Weak, 2: Moderate, 3: Strong, 4: Very Strong for impact on project time.

X_i: Number of choice of the (i) th weight in the Likert's scale for the change factor; A: is the highest weight (i.e. 4 in this case); N: is the total number of respondents.

After determining the factors' importance index, the risk levels of the factors were determined. In the next section, the method for determining the risk levels of change factors is explained.

5.7.1.4 Risk Significance Index of Change Factors

The top risky change factors were identified depending on the outcome of the frequency, cost, and time indexes. For this, the levels of risk of change factors were determined by calculating the Risk Significance index (R.S.I.) scores. The factor with the highest risk significance index (R.S.I.) was expressed as the top risky factor. Factors Risk Significance Index (R.S.I.) scores were calculated using frequency index as the multiplier effect (Kale & Baradan, 2020) and aggregating, cost and time impact indexes (See equation 2 and 3).

$$AV..S.I.(\%) = \frac{(C.I) + .(T.I.)}{2} \tag{2}$$

Where; AV.S.I. = Average Severity Index; C.I. = Cost Impact Index; T.I. = Time Impact Index.

$$R.S.I.(\%) = \frac{(F.I.) \times (AV.S.I.)}{100} \tag{3}$$

Where; R.S.I. = Risk Significance Index; F.I. = Frequency Index; AV.S.I. = Average Severity Index (Equation 2).

After finding the risk indexes of the factors, the risk levels of the categories of change factors were determined. The factors are categorized according to their types. Thus, it was aimed to obtain more focused and categorical results. The next section explains the method for determining the risk levels of change categories.

5.7.1.5 Risk Significance Index of Change Categories

The risk significance index for change categories (Av. R.S.I.) was determined by calculating the average of the risk importance index (Av. R.S.I.) of factors within the category (See equation 4).

$$Av.R.S.I.(\%) = \frac{\sum_{i=1}^{n} (R.S.I.)}{n} \tag{4}$$

Here; AV.R.S.I. = Risk Significance Index of change category; R.S.I. = Risk significance index of the (i) th factor in change category; n = Number of factors in the change category.

All results and discussion of results obtained with the analysis methods described in this section (Section 5.7.1.) are explained in Chapter 7 (please see Chapter 7 for details).

In the second phase of the research (Phase: 2), the factors affecting shop drawing practices were examined. As stated previously (please see Section 4.6 and 5.6) in this research, after examining the change factors, the research was conducted on the basis of examination of the risk status of shop drawing practices.The following section explains the quantitative analysis methods conducted to examine the events affecting shop drawing practices in construction projects.

5.7.2 Quantitative Analysis on Shop Drawing Events (Research Phase: 2)

In this phase, the process of the quantitative research method conducted to examine the factors affecting shop drawing practices in the construction projects is shown in Figure 5.5 below. Figure 5.5 illustrates the main research processes together with their targeted outcomes in each step for the quantitative research process.

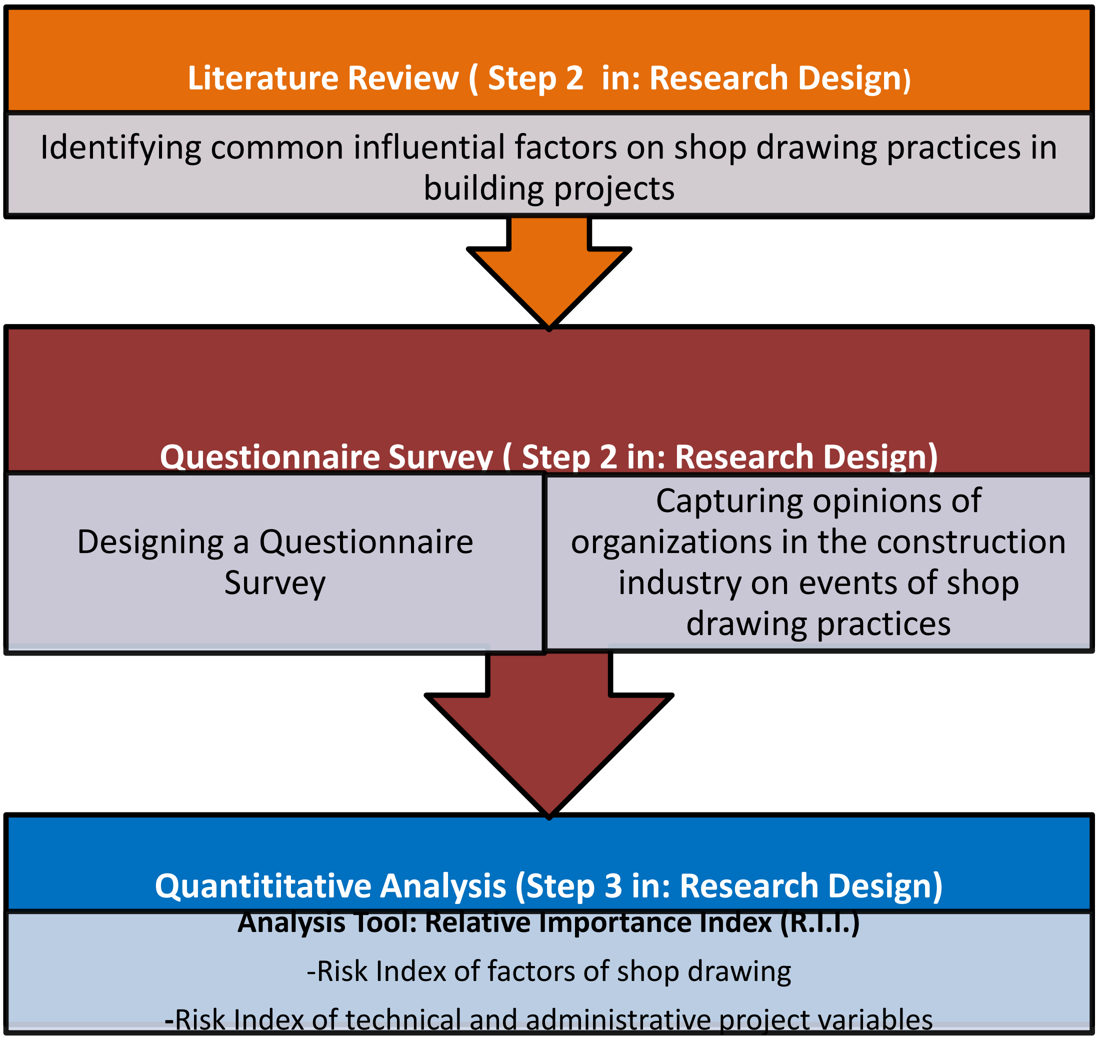

Figure 5.5: Quantitative research process flow on examination of shop drawing practices

The first step of the research is to design the questionnaire. For this purpose, the primary factors and project variables affecting shop drawing practices were determined and listed. Detailed explanations about the survey document and the survey process are given in Chapter 6 (please see Chapter 6: Survey and Responder Profile for details). In addition, information about the profiles of the participants taking part in the survey is explained in Chapter 6 (Survey and Responder Profile). After determining the basic technical and administrative variables of the construction projects and the factors affecting the shop drawing, the evaluation phase was initiated.

The following sections explain the data collection and analysis methods conducted.

5.7.2.1 Relative Importance Index Scores

After the survey process, the importance levels of factors affecting shop drawing practices were determined. In the survey, respondents were examined for the effects of technical and administrative project variables on shop drawing practices and the factor affecting shop drawing practices.

In the questionnaire, the participants expressed their opinions by scaling the importance of the factors based on the assessment parameters. In the questionnaire, factor weighting method (five-point Likert scale) was used to collect data. Respondents weighed the importance of the factors, according to the evaluation parameters.

The Relative Importance Index (R.I.I.) method was chosen as a data analysis tool. The significance level of the factors was measured by calculating the Relative Importance Index scores (R.I.I.). Factors Importance Index scores were calculated using equation (5):

$$R.I.I.(\%) = \frac{\sum W_i \times X_i}{A \times N} \tag{5}$$

Here, R.I.I. (%): Relative Importance Index.

Wi: The weight assigned on Likert's scale given to each factor by the respondents and ranges from 0 to 4, where; 0: Never, 1: Less, 2: Moderate, 3: High, 4: Very High.

X_i: Number of choice of the (i) th weight in the Likert's scale for the factor; A: is the highest weight (i.e. 4 in this case); N: is the total number of respondents.

The importance index of various technical and administrative variables of the projects affecting shop drawing practices were determined based on the various parameters explained below.

After finding the importance index values, the risk levels of the project variables were determined. At first, the risk levels of work items in building projects were determined. The next section explains the method for determining the risk levels of work items in building projects.

5.7.2.2 Risk Significance Index of Work Items in Building Projects

The necessity of shop drawings may vary depending on the construction process. Also, the severity of shop drawings may vary according to the work items. This analysis estimates the risk rate of shop drawing practices according to the various work items in building projects. In this context, at first, the principal work items involved in building construction projects were listed (please see in Figure 6.5 in Chapter 6 for details).

As the first technical variability, the risk of shop drawing practices was examined depending on the work items. Frequency, and, cost and, time overrun indexes were determined by equation 1 (R.I.I.). The risk score of causes of construction hazards in Turkey was determined by combining the probability of occurrence (frequency) of hazard and its impact (severity) after occurred (Kale & Baradan, 2020). The frequency index (F.I.) considered as a multiplier effect and cost overrun (C.I.) and time overrun (T.I.) indexes aggregated (see Equation 6). The Risk Importance Index (R.S.I.) of the work items is calculated by equation (7) presented below.

$$AV.S.I.(\%) = \frac{(C.I) + .(T.I.)}{2} \tag{6}$$

Here; AV.S.I. : Average Severity Index; C.I.: Severity of Cost Overrun Index; T.I.: Severity of Time Overrun Index.

$$R.S.I.(\%) = \frac{(F.I.) \times (AV.S.I.)}{100} \tag{7}$$

Here; R.S.I.: Risk Significance Index of Work Items; F.I.: Frequency Index; AV. S.I.: Average Severity Index (Equation 6).

The highest risk significance index refers to the top risky work item, while the lowest refers to the minimum risky work items in terms of shop drawings implementations.

After finding the risk index of the work items, the risk levels of the various project disciplines involved in building projects were determined. In the next section, the method for determining the risk levels of project disciplines is explained.

5.7.2.3 Risk Index of Project Disciplines

The risk of principal project disciplines for building projects has been discussed, as the frequency of shop drawing practices may vary depending on the work involved in corresponding project discipline. In this context, the risk levels of shop drawing practices were examined according to the main project disciplines involved in building projects.

The principal project disciplines involved in building projects were listed (please see Figure 6.7 in Chapter 6 for details). The Risk Index of Project Disciplines (P.D.R.I.) was determined based on the link between frequency of shop drawings practices due to the project discipline and the average of the risk index of the work items involved in the project discipline. Risk Index (R.D.R.I.) scores were calculated by establishing a link between the shop drawing frequency index of project discipline and the average of the risk index of work items in the project disciplines (See equation 8 and 9). The Risk Index (P.D.R.I.) of the project disciplines is calculated by equation (8) presented below.

$$P.D.R.I. = (P.D.F).X\,(AV.R.I.W.) \tag{8}$$

Where;

$$AV.R.I.W.(\%) = \frac{\sum_{i=1}^{n}(R..I.W.)}{n} \tag{9}$$

Here; P.D.R.I. = Project Discipline Risk Index; P.D.F. = Frequency of shop drawings for project discipline; AV. R.I.W. = Risk Index Average of work items in the project discipline; R.I.W. = Risk Index of the (i) th work item in the project discipline; n= Number of work items in the project discipline.

The highest index refers to the top risky, while the lowest refers to the minimum risky project discipline in terms of shop drawings practices.

5.7.2.4 Frequency Index of Causes of Shop Drawings

The frequency of shop drawings practices can vary depending on the factors encountered in the construction project, as the construction projects are under uncertain conditions and subject to many variables.

The principal factors affecting the execution process of construction projects were listed (please see Figure 6.7 in Chapter 6 for details). In this context, as the importance index of factors, the rate of frequency of shop drawing practices was estimated according to the factors affecting shop drawing practices by equation (5). The higher the frequency index, the more the more common cause, while the lower refers to the less common factor that leads to shop drawing practices.

5.7.2.5 Dispute Potentiality between Parties

Shop drawings may cause disputes between the parties because of the increase in project price and duration (Mahamid, 2016) (Fisk & Reynold, 2009) (Arain, Assaf & Pheng, 2004) (Assaf & Al-Hejji, 2006). Shop drawings have great potential to increase the cost and duration of the project (Fisk & Reynold, 2009) (Arain, Assaf & Pheng, 2004) (Assaf & Al-Hejji, 2006), in which may lead to disputes between the project parties. With this intention, the tendency to disagreement between the parties was predicted. A binary comparison has been made between the key parties involved in construction projects and the potential for conflict has been explored based on cost and overruns (See Figure 6.8). The level of dispute tendency between project parties was determined by calculating the dispute frequency index according to the binary comparison of different parties (See Equation 5 (R.I.I.)). The high dispute index shows that there is a high potential for conflict between the parties. The higher the conflict frequency index the greater the potential for conflict tendency.

5.7.2.6 Benefits on Project Success Parameters

Shop drawings can positively benefit on project performance parameters (Manrique et al., 2015). Shop drawings could have a positive influence in meeting the cost, time and quality limits of the project. In this context, the benefit ratio of shop drawing practices was estimated in terms of project performance parameters. The principal benefits of shop drawing practices in a building project were listed (please see Figure 6.8 (Chapter 6)). As the importance index rate, the Benefit Index (B.I.) of shop drawings practices in meeting the contract cost, duration, and quality was calculated by Equation (5) (R.I.I.).

The highest index refers to the most beneficiary project performance parameter, while the lowest index refers to the least beneficiary project performance parameters.

The following section explains the methods of examining the risk status of shop drawing practices according to the various administrative models of building projects.

5.7.2.7 Risk Index of Project Administrative Model

The contract type and procurement model is the basic features that constitute the administrative structure of the construction projects. The severity of shop drawings practices on the project parameters may vary according to the contract and administrative structure of the project (Rashid et al., 2006). In the sense of the adverse impact of the shop drawing practices on project performance, the risk rate of the project administrative models has been estimated based on the different contract and procurement models. In this context, the risk potential of project management models were determined depending on the frequency of shop drawing practices and their cost increasing effect.

The common contract types and procurement models were listed (See in Figure 6.6. in Chapter 6). In the survey, respondents were examined the frequency and severity of shop drawing according to the basic contract types and procurement models. The risk index of the project administrative models (R.I.A.) was calculated (See Equation 12) with the contract's risk index of contract (R.I.C.) (See Equation 10) and the risk index of procurement model (R.I.P.) (See Equation 11) presented below.

$$R.I.C. = (F.I.C.)X.(C.I.C.) \tag{10}$$

Here; R.I.C. = Risk Index of Contract Type, F.I.C. = Frequency Index of Shop Drawings according to the different contract type, C.I.C. = Cost Impact Index of Shop Drawings according to the contract type.

$$R.I.P. = (F.I.P).X.(C.I.P.) \tag{11}$$

Here; R.I.P. = Risk Index of Procurement Type, F.I.P. = Frequency Index of Shop Drawings according to the different procurement type, C.I.P. = Cost Impact of Shop Drawings according to the procurement type.

$$R.I.A. = (R.I.C.)X.(R.I.P.) \qquad (12)$$

Where; R.I.A. = Risk Index of Administrative model.

The highest risk index refers to the top risky project administrative model, while the lowest refers to the minimum risky project administrative model. The higher the risk score, the higher potential of shop drawing practices to negativity impact construction projects.

All results and discussion of results obtained with the analysis methods described in this section (Section 5.7.2.) are explained in Chapter 8 (please see Chapter 8 for details).

In the third phase of the research (Phase: 3), the factors affecting contractors' claims and claim control measures were examined. As stated previously (please see Section 4.6 and 5.6) in this research, after examining the status of shop drawing practices, the research was conducted on the basis of examination of the risk status of shop claim factors and the effectiveness of con control measures .The following section explains the quantitative analysis methods conducted to examine the events affecting shop drawing practices in construction projects.The following section explains the quantitative analysis methods carried out to examine factors affecting contractors' claims and to examine the control measures in preventing the contractors' claims.

5.7.3 Quantitative Analysis on Claim Events and Claim Control Measures (Research Phase: 3)

In this phase, the process of the quantitative research method conducted to examine the factors affecting contractors' claims and the claim control measures in the construction projects is shown in Figure 5.6 below.

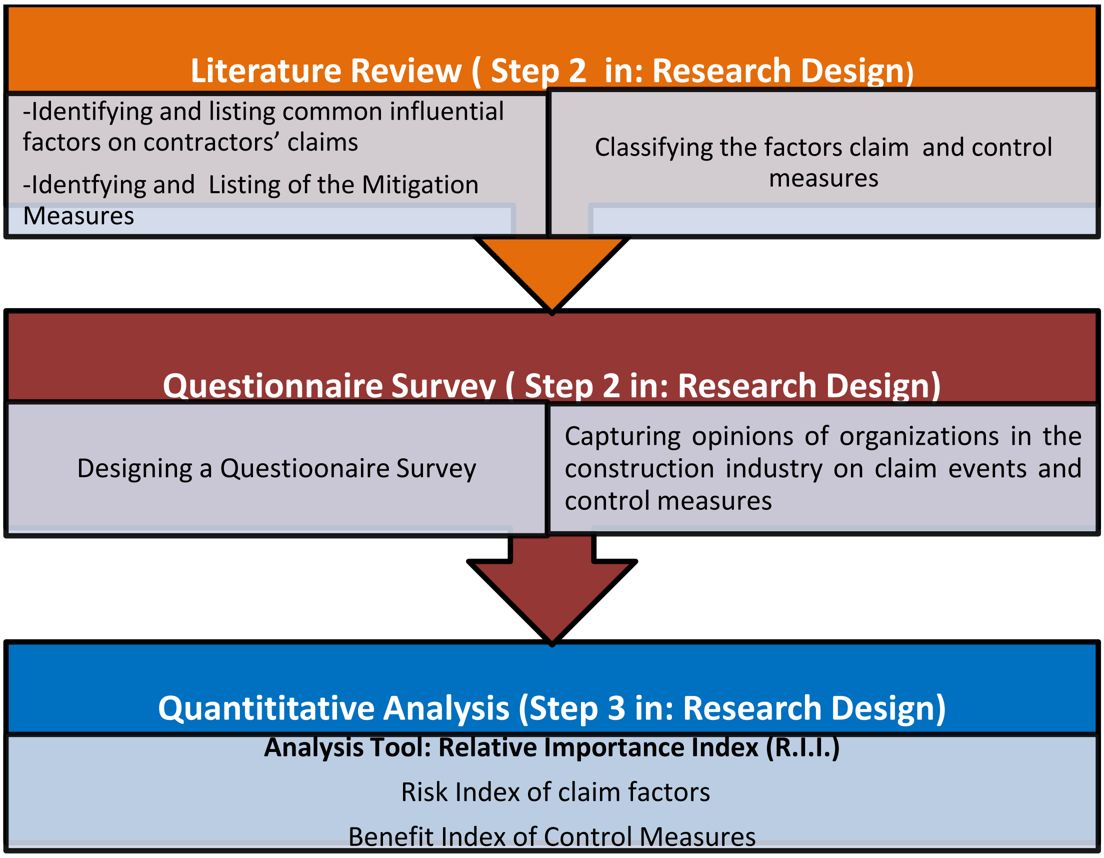

Figure 5.6: Quantitative research process flow on examination of claim factors and control measures

The first step of the research is to design the questionnaire. For this purpose, the basic factors and project variables affecting contractors' claims and mitigation measures were identified and listed. Detailed explanations about the questionnaire document and the survey process are given in Chapter 6 (please see Chapter 6: Questionnaire and Respondents Profile, for details). In addition, information about the profiles of the respondents who participated in the survey is detailed in Chapter 6

(Questionnaire and Respondents Profile). After the survey was designed, the evaluation phase was started.

The following sections explain the data collection and analysis methods.

5.7.3.1 Factors of Claims Causes (Factors List)

In the first phase, principal factors affecting contractor's claims in construction projects were identified based on the validity of the literature. The factors commonly accepted as the cause of the claim are listed. At the end of comprehensive literature research, it is aimed to include all kinds of claim factors representing almost every event encountered in construction projects. Also, the causes of contractors' claims categorized to obtain more focused results. In this context, claim factors that aim to represent events arising from the technical, administrative, construction process, people, and external events are listed. Within this context, based on the validity of the literature, a total of 21 different factors were listed and presented in Table 5.3 below.

Table 5.3: Claim causes and references

	Claim Factor's	**References**
Design-Technical	Inadequacies in Contract Drawings	(Mishmish & El-Sayeng, 2018) , (Al-Qershi & Kishore, 2017) , (Memon, Rahman & Hasan, 2014) , (Gang & Cuiling, 2011) , (Yousefi et al., 2016), (Hayati, Latief & Rarasati, 2019)
	Low Constructability Design	(Al-Qershi & Kishore, 2017) (Rosenfeld, 2013), (Yousefi et al., 2016) , (Mishmish & El-Sayeng, 2018) , (Motawa, 2005) ,(Assaf &Al-Hejji, 2006)
	Inadequacies in Specification	(Hayati, Latief & Rarasati, 2019) ,(Mishmish & El-Sayeng, 2018) ,(Sun &Meng, 2009), (Kazaz, Ulubeyli & Tunçbilekli, 2012)
	Inconsistencies between different designs	(Yousefi et al., 2016) (Mishmish & El-Sayeng, 2018) (Assaf & Al-Hejji, 2006) (Zaneldin, 2006) (Arain & Pheng, 2005b)
	Changes in Scope	(Gang & Cuiling, 2011), (Yousefi et al., 2016) (Mishmish & El-Sayeng, 2018)

Table 5.3 (Continued)

Contractual-Managerial	Inadequacies in Contract	(Mishmish & El-Sayeng, 2018) ,(Al-Qershi & Kishore, 2017) ,(Doloi et al., 2012) (Sha'ar et al., 2016)
	Inadequate knowledge of client	(Al-Qershi & Kishore, 2017) ,(Zaneldin, 2006) (Assaf & Al-Hejji, 2006) , (Yousefi et al., 2016)
	Inadequate Experience of Consultants	(Kazaz, Ulubeyli & Tunçbilekli, 2012) , (Mishmish & El-Sayeng, 2018) ,(Motawa, 2005), (Yousefi et al., 2016) (Al-Qershi & Kishore, 2017),
	Low contract price	(Yousefi et al., 2016) ,(Arain & Pheng, 2005b) (Zaneldin, 2006) (Sha'ar et al., 2016) , (Al-Qershi & Kishore, 2017), (Mishmish & El-Sayeng, 2018)
	Inadequate time in tendering	(Mahamid, 2014) (Sha'ar et al.,2016), (Mishmish & El-Sayeng, 2018), (Hayati, Latief & Rarasati, 2019)
	Inadequacies in Organizations	(Alaghbari et al., 2007), (González, 2014), (Mishmish & El-Sayeng, 2018), (Yousefi et al., 2016),
	Lack of communication between parties	(Yousefi et al., 2016) , (Mishmish & El-Sayeng, 2018), (Doloi et al.,2012) (Kazaz, Ulubeyli & Tunçbilekli, 2012)
Construction	Changes in Construction Method	(Mohamad, Ali & Al-Harthy, 2012), (Zaneldin, 2006) (Sha'ar et al., 2016), (Mishmish & El-Sayeng, 2018)
	Errors of subcontractors	(Al-Qershi & Kishore, 2017), (Yousefi et al., 2016), (Mishmish & El-Sayeng, 2018),
	Inclusion of Shop Drawings	(Yap, Abdul-Rahman & Wang, 2016), (Al-Qershi & Kishore, 2017)
	Inadequate Experience of contractors	(Mishmish & El-Sayeng, 2018), (Motawa, 2005), (Al-Qershi & Kishore, 2017), (Sun & Meng,2009)
External	Inflation in Resources Cost	(Gang & Cuiling, 2011), (Yousefi et al., 2016), (Andersen, Olsson & Onsoyen,2011), (Al-Qershi & Kishore, 2017) ,(Zaneldin, 2006), (Hayati, Latief & Rarasati, 2019)
	Natural Disasters	(Mishmish & El-Sayeng, 2018), (Yousefi et al., 2016), (Motawa, 2005) (Wu, Hsieh & Cheng, 2005), (Al-Qershi & Kishore, 2017), (Sha'ar et al., 2016),
	Subsurface Problems	(Al-Qershi & Kishore, 2017) , (Mohamad, Ali & Al-Harthy, 2012), (Mishmish & El-Sayeng, 2018), (Wu, Hsieh & Cheng, 2005),
	Shortage of Materials	(Yousefi et al., 2016), (Mishmish & El-Sayeng, 2018), (Memon et al., 2014), (Arain & Pheng, 2005)

Table 5.3 (Continued)

	Changes in Law and Standards	(Al-Qershi & Kishore, 2017) , (Hayati, Latief & Rarasati, 2019), (Assaf & Al-Hejji, 2006) (Doloi et al., 2012) , (Yousefi et al., 2016), (Mishmish & El-Sayeng, 2018),

This next section explains the categorization of the contractors' claims factors. The types and definitions of claim factors categories created in this study were explained in the section below.

5.7.3.2 Categories of Claim Causes

As presented in Table 5.3, four types of categories of claim factors were created based on the validity of 17 different research studies in the literature. Claim factors were placed in the relevant category, according to the factor types presented in Table 5.3. Descriptions of claim factors categories were introduced in the section below:

- **Design and Technical Related:** The causes of claims represent weaknesses in planning and design tasks. Design and planning activities are undertaken by the design team and the consultant under the responsibility of the owner (Sha'ar et al. 2017). The design team is usually employed by the owner (Thomas & Wright, 2016) (Hussin & Omran, 2009). The contractors' claims originated from errors, omissions, and inconsistencies in the planning and design documents are considered as design categories (Thomas & Wright, 2016) (Hsieh, Lu & Wu, 2004) (Motawa, 2005). The planning and design team are often responsible for claims arising from design problems (Al-Qershi & Kishore, 2017) (Hsieh, Lu & Wu, 2004) (Motawa, 2005). (Sha'ar et al. 2017). Gang & Guiling (2011) stated that defects in the drawings and specifications should be considered as engineering change and these defects are required being rectified to ensure design quality. In this context, six factors were included in the design category (See in Table 5.3).

- **Contractual-Managerial Related:** The claim factors represent the weaknesses in tasks in the administrative planning and the tendering process. Consultants become responsible for problems arising from administrative problems as the representative of the project owner (Thomas & Wright, 2016) (Hussin & Omran, 2009). The consultant is the party that prepares the design and contract documents, manages the tender process, and supervises the contractor during construction. Consultants are employed by the client and thus become the client’s representative (Sha’ar et al. 2017) (Hussin & Omran, 2009). The procurement method, contract type, tender method, type of tender document used, bidding environment and the adequacy percentage of the design document before the tender are the main administrative factors in the construction organization (Thomas & Wright, 2016) (Al-Qershi & Kishore, 2017). In this context, seven claim factors were placed in the contractual-managerial category (See in Table 5.3).
- **Construction Related:** The claim factors represent the inaccuracies of works carried out during the execution process. Contractors are responsible for inaccuracies in the construction process. Contractors are obliged to construct the projects according to clients and contract requirements (Thomas & Wright, 2016) (Mishmish & El-Sayeng, 2018). Lee et al. (2015), (Al-Qershi & Kishore, 2017) and Motawa (2005) showed that, in this category, the factors are related to the construction process, due to adopting new construction techniques/methods, site conditions, workmanship, and difficulties in work execution and control methods involved in the construction process. In this context, four claim factors were included in the construction category (See in Table 5.3).
- **External Related:** Factors represent problems that develop outside the project

documents, project organization, and project parties (Yap, Abdul-Rahman & Wang, 2016) (Sha'ar et al. 2017) (Thomas & Wright, 2016) (Al-Qershi & Kishore, 2017). These factors do not composed of the project's technical and administrative facilities, nor related to the performance of the project and performance of the parties (Yap, Abdul-Rahman & Wang, 2016). In other words, the factors are related to non-project reasons. The availability of material equipment and tools on the market, economic conditions, external works due to public agencies such as roads, utilities, and public services (Sha'ar et al. 2017), (Alaghbari et al., 2007), law and regulation (Al-Qershi & Kishore, 2017) ,(Hsieh, Lu & Wu, 2004), are the main external factors that lead to claims in construction projects. In this context, five factors were included in the external category (please See in Table 5.3).

Categories of claim factors and references were presented in Table 5.4:

Table 5.4: Categories of claim causes and references

Claim Causes Categories	**References**
Design-Technical	(Yap, Abdul-Rahman & Wang, 2016) (Al-Qershi & Kishore, 2017) (Sha'ar et al. 2017) (Motawa, 2005) (Sun & Meng, 2009)
Contractual-Managerial	(Yousefi et al., 2016) ,(Kazaz, Ulubeyli & Tunçbilekli, 2012) (Al-Qershi & Kishore, 2017), (Faridi & El-Sayegh, 2006) (Enshassi, Arain & Al-Raee, 2010) (Motawa, 2005)
Construction	(Mishmish & El-Sayeng, 2018) , (Yap, Abdul-Rahman & Wang, 2016) ,(Motawa, 2005), (Doloi et al., 2012) (Enshassi, Arain & Al-Raee, 2010), (Sun & Meng, 2009)
External	(Yap, Abdul-Rahman & Wang, 2016), (Sha'ar et al. 2017) , (Al-Qershi & Kishore, 2017) (Motawa, 2005) (Sun & Meng, 2009) , (Hsieh, Lu & Wu, 2004)

This next section explains the identification and listing of the measures that can reduce the contractors' claims.

5.7.3.3 Listing of Control (Mitigation) Measures

In the next step, potential control measures that may prevent the conditions leading contractor's claims in reinforced concrete building construction projects were determined based on the validity of the literature. At the end of a comprehensive literature review, it is aimed to list various control measures that can prevent as many varieties of claim incidents as possible in construction projects. In addition, control measures were categorized to provide better guidance. In this context, control measures aiming to prevent claims due to technical, managerial and construction problems are listed. Control measures and references are presented in Table 5.5 below.

Table 5.5: Control measures and references

	Control (Mitigation) Measure Factors	**References**
Technical	The standard form of Drawings	(Arantes & Ferreira, 2020) ,(Ijaola & Iyagba, 2012) (Hassanein & Nemr, 2007),
	Detailed Drawing/Specification	(Prasad et al.,2019) , (Chai, Yusof & Habil, 2015) (Taylor et al.,2012) (Hao et al.,2008) (Zaneldin, 2006), (Assaf & Al-Hejji,2006)
	Advanced Design Software (BIM)	(Arantes & Ferreira, 2020) (Oyewobi et al., 2016), (Chai, Yusof & Habil, 2015)
	Front-End Planning (Feasibility)	(Chai, Yusof & Habil, 2015) (Ijaola & Iyagba, 2012), (Taylor et al., 2012)
	Qualified Architect-Engineer	(Arantes & Ferreira, 2020) (Ijaola & Iyagba, 2012) (Chai, Yusof & Habil, 2015)
	Easy Constructability Design	(Prasad et al.,2019) , (Chai, Yusof & Habil, 2015) ,(Taylor et al., 2012), (Hao et al., 2008) (Zaneldin, 2006)

Table 5.5 (Continued)

Contractual- Managerial	Effective Communication between parties	(Prasad et al.,2019) ,(Arantes & Ferreira, 2020) , (Chai, Yusof & Habil, 2015) (Enshassi et al., 2009), (Hao et al., 2008)
	Sharing Historical Data	(Ijaola & Iyagba, 2012) , (Arantes & Ferreira, 2020) (Chai, Yusof & Habil, 2015) ,(Arain & Pheng, 2007)
	Qualified Project Manager	(Chai, Yusof & Habil, 2015) , (Arantes & Ferreira, 2020) (Enhassi et al., 2009), (Ijaola & Iyagba,2012)
	Detailed Contract	(Arantes & Ferreira, 2020) ,(Oyewobi et al., 2016) ,(Hassanein & Nemr, 2007), (Zaneldin, 2006)
	Staff training	(Chai, Yusof & Habil, 2015) (Enhassi et al.,2009) (Wang, Dulaimi & Aguria, 2004)
	Contractors well-bidding organization	(Chai, Yusof & Habil, 2015), (Olatunji, Aje & Makanjuola, 2017),
	Risk-sharing philosophy	(Prasad et al.,2019) , Chai, Yusof & Habil, 2015) (Meng, 2012), (Zaneldin, 2006),
	Awarding Right Contractor	(Arantes & Ferreira, 2020), (Chai, Yusof & Habil, 2015) (Assaf & Al-Hejji, 2006) ,
Construction	Effective Site Management	(Chai, Yusof & Habil, 2015) , (Prasad et al.,2019) ,(Assaf & Al-Hejji, 2006)
	Pre investigation of the site	(Chai, Yusof & Habil, 2015) (Hao et al., 2008)
	Effective Quality Control	(Prasad et al.,2019) , (Chai, Yusof & Habil, 2015 ,(Hao et.al. , 2008) (Zaneldin, 2006)

This next section explains the categorization of the measures of contractors' claims in this study. The types and definitions of the categories of measures were detailed in the following section.

5.7.3.4 Categories of Claim Control (Mitigation) Measures

Control measures were analysed in categories to achieve more focused results. At the end of the comprehensive literature review, three types of categories were formed based on the types of measures (See in Table 5.5). In this context, control measures were placed in the relevant category by type. Definitions of categories of control measures for contractors' claims are presented below as follow:

- **Technical Related:** The key aspect of control measures is to improve the design-related works in construction projects. Usually, the owner enters into a contract with an architect/engineer to plan and design a project to satisfy the owner's particular needs. Prior to the design period, the owner takes part during the briefing stage to set criteria for design, cost, and time constraints of the project and to provide decision-making inputs to the architect/engineer (Arantes & Ferreira, 2020). El-Sayegh & Mansour, (2015) and Gang & Guiling (2011) stated that defects in the drawings and specifications should be corrected to ensure the design quality accepted as an engineering change. In this context, six mitigation measures were included in the technical-related category (see Table 5.5).

- **Contractual - Managerial Related:** In particular, the control measures aim to improve the works in the tender process and pre-construction phase. Upon completion of the planning and design process, the project becomes ready for construction, and the selection process begins for qualified contractors (El-Sayegh & Mansour, 2015). Consultants provide professional services to the client on the investment, design, cost, contractual arrangements, and all the other aspects of building and property (Al-Qershi & Kishore, 2017). In research study conducted by El-Sayegh & Mansour, (2015), researchers stated that bidding strategies, design phase, cost management; scheduling, bid evaluation, and help in the contractor's selection, construction-phase management to provide contract administration is another common obligation of consultants in construction projects. Accordingly, eight mitigation measures were included in the Contractual-Managerial category (see Table 5.5).
- **Construction Related:** Control measures represent measures taken to avoid potential construction process problems. In a research study, Al-Qershi &

Kishore, (2017) highlighted that in the contractors are liable directly to the owner or the owner's designated representative to construct the project under the plans, specifications, and local laws (El-Sayegh & Mansour, 2015). Additionally, El-Sayegh & Mansour, (2015) emphasized that, contractors are obliged to construct the works according to the needs of the client and the conditions set out in the tender documents and contracts. Gang & Guiling (2011) stated that engineers may reject the methods and materials adopted by the contractors when they fail to meet the requirements of technical specifications during the construction process. Accordingly, three mitigation measures were included in the construction-related category (See in Table 5.5).

The assessment phase was initiated after identifying factors that could lead to contractors' claims and measures that could prevent contractors' claims. For this purpose, the questionnaire document was designed. The survey was conducted with construction organizations in the construction industry. The questionnaire document was presented and detailed in Chapter 6.

The analysis methods and calculations performed to examine the factor of claims and control measures of claims were explained in the following section.

5.7.3.5 Factors Importance Index (Relative Importance Index Scores)

After the survey process, the importance level of factors of contractors' claims was determined according to three parameters: the frequency of occurrence, impact on cost-time, and the dispute between contractors and owners. On the other hand, the importance levels of factors of claim mitigation measures were determined in terms of effectiveness on preventing the occurrence of claims and, cost and time overruns.

Factors weighting method was chosen to measure how the participants think about the claim factors and claim mitigation measures. The five-point Likert scale was used to evaluate the factors in the evaluation parameters described above. The significance level of the factor (importance) was determined by calculating factors relative Importance Index scores (R.I.I.) with respect to the Frequency Index (F.I.), Cost - Time Impact Index (C.T.I.) and dispute index (D.I.). Claim Prevention Index (C.P.I.) and, Cost Prevention Index (C.P.I.) and, Time Prevention index (T.P.I.) were calculated to determine the importance of the factors of mitigation measures. Factors Relative Importance Index scores were calculated using Equation (13):

$$R.I.I.(\%) = \frac{\sum W_i \times X_i}{A \times N} \tag{13}$$

Here, R.I.I. (%): Relative Importance Index for Frequency of Occurrence (F.I.); Relative Importance Index for impact on project cost and time (C.T.I.); Relative Importance Index for the frequency of disputes (D.I.).

Wi: The weight assigned on the Likert scale given to each factor by the respondents and ranges from 0 to 4, where; 0: Never, 1: Less, 2: Moderate, 3: High, 4: Very High.

X_i: Number of choice of the (i) th weight in the Likert scale for the claim factor; A: is the highest weight (i.e. 4 in this case); N: is the total number of respondents.

After determining the importance index of the factors, the risk levels of the factors were determined. The next section describes the method for determining the risk levels of damage factors.

5.7.3.6 Risk Significance Index of Factors of Contractors' Claims

The risk levels of the claim factors were determined by calculating the Risk Importance Index (R.S.I.) of the claim factors. Kale & Baradan (2020) were estimated the risk score of factors that causes hazards by considering the probability (frequency) and the consequence of its occurrence (severity) on construction projects in Turkey. In this study, the risk score factors that contribute to contractors' claims were valued as the combination of the two components; the probability of the claim (frequency) and its impact after occurred (severity).

Factors Risk Significance Index (R.S.I.) scores were calculated by taking the frequency index as the multiplier effect and aggregating the cost- time impact index (C.T.I.) and dispute index (D.I.) (see Equation 14 and 15).

$$R.S.I.(\%) = \frac{(F.I.) \times (AV.S.I.)}{100} \tag{14}$$

Where; F.I. = Frequency Index; AV.S.I. = Average Severity Index (Equation 15).

$$AV.S.I.(\%) = \frac{(C.T.I.) \times (D.I.)}{2} \tag{15}$$

Where, C.T.I. = Severity Cost-Time Overrun Index;   D.I. = Dispute Index.

The highest risk significance index refers to the top risky factor, while the lowest refers to the minimum risky claim factors in construction projects.

After finding the risk index of the factors, the risk levels of the claim factor categories were determined. In the next section, the method for determining the risk levels of categories of claims was explained.

5.7.3.7 Risk Significance Index of Claim Factor Categories

The Risk Significance index (Av. R.S.I.) of claim categories was determined by calculating the average of the risk importance index of the factors in the relevant category. The Risk Significance Index (Av. R.S.I.) of the claim categories was calculated by equation (16) presented below.

$$AV..R.S.I.(\%) = \frac{\sum_{i=1}^{n}(R.S.I.)}{n} \tag{16}$$

Where, AV. R.S.I. = Risk Significance Index of the claim category; R.S.I. = Risk significance index of the (i) th factor in the category; n = Number of factors in the category.

After analysing the factors of the contractors' claims, in the next process, claim control measures were analysed. The following section explains the methods applied to analyse measures that can reduce contractors' claims.

5.7.3.8 Benefit Level of Claim Control (Mitigation) Measures

The benefit level of control measures was determined by calculating the Benefit index (B.I.) of factors of control measures. The benefit index expresses the effectiveness of the claim mitigation factor in preventing claims. The Benefit Index of measures (B.I.) was calculated based on the claim control effectiveness index as the multiplier effect and aggregating cost- time overrun prevention indexes (please see in Equation 17 and 18 for details).

$$B.I.(\%) = \frac{(E.I.) \times (AV.C.T.P.I.)}{100} \tag{17}$$

Here, E.I. = Claim Control Effectiveness Index; AV. C.T.P.I. = Average Cost-Time Overrun Prevention Index (see in Equation 18).

$$AV.C.T.P.I. = \frac{(C.P.I.) + (T.P.I.)}{2} \tag{18}$$

Here, C.P.I. = Cost Overrun Prevention Index; T.P.I. = Time Overrun Prevention Index.

The highest score refers to the most beneficial factors, while the lowest score refers to the least beneficial claim control measure. The higher the benefit index score, the greater the effectiveness on preventing claims.

After determining the benefit index of the claim control measures, the benefit levels of the claim control categories were determined. The following section describes the method for determining the benefit level of categories of claim control measures is explained.

5.7.3.9 Benefit Index of Claim Control Measures Categories

The benefit index (Av. B.I.) of categories of control measures was determined by calculating the average of the risk importance index of the factors in the relevant category. The Benefit index (Av. B.I.) of control measure categories was calculated by equation (19) presented below.

$$AV.B.I.(\%) = \frac{\sum_{i=1}^{n} (B.I.)}{n} \tag{19}$$

Here, AV. B.I. = Benefit Index of control category; B.I. = Benefit index of the (i) th factor in the category; n = Number of factors in the category.

The highest benefit score refers to the most beneficial category of control measures that have the highest positive impact on construction projects.

After analysing the factors of contractors' claims and claim control measures, claim factors, and claim control measures were analysed in an integrated manner. In this context, claim factors and claim control factors were analysed mutually. The following section describes the methods applied for mutual analysis between claim factors and claim control measures.

5.7.3.10 Cross-Wise Comparison of Claim Factors and Control Measures

A cross-assessment was made between claim factors and control measures. This analysis aims to determine the most appropriate control measure according to the claim factor. In this context, claim factors and mitigation measures were cross-compared to determine the most effective control measure by types of claim factors. In this analysis, the claim factors and control measures were examined in an integrated manner. In the survey, participants were asked to choose the most appropriate control measure according to the claim factor. The most selected control measure factor was deemed the most appropriate control measure for a claim factor.

After the analysis studies for the claim factors and claim control measures were completed as described above, the success level of the project was determined based on all analysis results for the claim factors and claim control measures. The next section explains the method of analysis to determine the level of project success.

5.7.3.11 Project Success Rate

The probability of success of the construction project was determined by establishing the link between the risk index of claim factor (riskiness) and the benefits index of control measures (efficacy). In this context, the success rate of the project was determined by the combination of the risk index of the claim and the benefit index of control measures. The higher the risk of claim factor and the benefit index of the control measure results in a higher success rate.

A high success rate implies that high-risk claim factors can be controlled with control measures. In other words, greater control of claim events means that the project can be completed despite high-risk claim events. In this analysis, the risk status of claim factors and the benefit status of control measures were taken into account.The project success rate was determined for the claim factors. The project success rate was calculated by equation (20) presented below:

$$P.S.S.(i) = \frac{1}{(R.S.I.(i))} x \frac{\sum_{j=1}^{j} (N.O.S.) * (B.I.)}{n} \tag{20}$$

Here, P.S.S. (i) = Project Success Rate for (i) th factor of claim, R.S.I. (i) = Risk Significance Index of (i) th factor of claim, N.O.S. (j) = Number of a choice of (j) th factor of control measure for (i) th factor of claim, B.I. (j) = Benefit index of (j) th factor of control measure, n= Number of Participants.

After determining the project success rate according to the claim factors, the project success rate was determined according to the claim factor categories. In this way, it is aimed to achieve more focused results. The method for determining the project success rate of claim categories was explained in the section below.

5.7.3.12 Project Success Rate Average

Project Success scores were determined according to the classifications of claim factors. In this context, the Project Success index (Av. P.S.S.) of the claim factors, categories was determined by calculating the average of the project success index of the claim factors in the relevant category. Project success rates were obtained according to the categories of claimfactors. In this way, the project success rate was obtained according to the categories of claim factors, considering the categories of claim factors. In previously, the type of claim factor categories and the type of claim factors included in each category of claim factors were stated (please see Section 5.7.3.2).The Project Success Rate Average (Av. P.S.S.) of the claim factors categories was calculated by equation (21) presented below.

$$AV.P.S.S.(\%) = \frac{\sum_{i=1}^{n}(P.S.S.)}{n} \quad (21)$$

Where, AV. P.S.S. = Project Success Rate of the claim category; P.S.S. = Project Success Rate for (i) th factor of claim in the category; n = Number of factors in the category.

All results and discussion of results obtained with the analysis methods described in this section (Section 5.7.3.) are explained in Chapter 9 (please see in Chapter 9 for details).

Chapter 6

QUESTIONNAIRE SURVEYS AND RESPONDENTS PROFILE

6.1 Introduction

In this chapter, the questionnaire studies conducted in this thesis study are explained. In this thesis, the questionnaire was used as a research tool. In this study, the data required for conducting the research was obtained through questionnaires. This study consists of three different research phases. In this context, three different surveys were conducted for three research phases. In the first phase, a survey was conducted to obtain the opinions of the participants on changes in the construction projects. In the second phase, a survey was conducted to obtain the opinions of the organizations regarding the risk status of shop drawing practices in construction projects. In the third phase of the study, a survey was conducted to get the opinions of the participants regarding the contractor claims and the measures that could reduce the claims on the construction projects. The section below explains the questionnaires conducted in this study. In addition, the profiles of the respondents who participated in the surveys were detailed.

6.2 Questionnaire Study: One - Investigation on Events of Change Orders

As stated above, the first survey conducted in this thesis was based on an examination of the factors affecting changes in construction projects. After determining the factors of change, the evaluation phase was started. Change factors were assessed by taking the survey in the construction industry. The questionnaire document prepared to examine the change causes is shown below (Figure: 6.1, 6.2, and 6.3).

QUESTIONNAIRE: 1

QUESTIONNAIRE FOR THE INVESTIGATION OF THE FACTORS AFFECTING CHANGES ON CONSTRUCTION PROJECTS

ENGLISH VERSION

1) Please Choose the Type of Your Organization in Construction Projects.

A- Contractor
B- Consultant-Owner

2) Please write the name of the country where the organization you work in is located.…………………………………………………………

3) Please write your title in the organization. (i.e: Architect (Head office)…etc)…………………………………………………………………

4) How many years have you been working at the organization?

………………………………………………………………………. (Year)

Guidance for the Survey:

In the following tables (for questions 5), please evaluate the factors of changes on the basis of the lump-sum and, design-bid-build contracted reinforced concrete building projects sized up to 5000 m2.
Also, please make your assessments based on the experience of your organization rather than your personal experience.

Figure 6.1: Questionnaire “one” document (page 1)

5) According to the experience of the organization, Please Evaluate the Factors Causing Changes in Construction Projects according to the parameters designated in the Table below.

	Parameter 1					**Parameter 2**					**Parameter 3**				
	Frequency of Occurrence of Changes					**Cost Overrun Severity**					**Time Overrun Severity**				
Causes of Changes	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High
Errors in Contract Drawings															
Inconsistencies between different Designs															
Errors and Inadequacy in Specification															
Conflict among contract documents															
Use of Poor design software															
Constructability Ignored															
Error in Cost Estimating and budgeting															
Unrealistic imposed contract duration															
Inadequate site investigation in pre-construction															
Uncertainties / problems of Subsurface															
Provision of additional shop drawings															

Figure 6.2: Questionnaire “one” document (page 2)

5) Continue	Frequency of Occurrence of Changes					Cost Overrun Severity					Time Overrun Severity				
Causes of Changes (Continue)	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High
Errors in execution															
Material / Equipment / Manpower Shortage															
Additions / Omissions of work															
Lack of Experience of Project Participants															
Poor communication between parties Parties															
Owners Level of Construction Sophistication															
Poor Contract Management															
Inappropriate choice of project delivery system															
Inappropriate choice of contract type															
Low Contract Price (Competitive Bidding)															
Unforeseeable Natural Conditions															
Fluctuation in Tax / Interest Rate / Material and Labor Cost															
Change in government laws/ regulations															
Shortening / Compression in Project Schedule															

Figure 6.3: Questionnaire “one” document (page 3)

First, the participants were asked to provide information about themselves and the organization they work for. In the next stage, the participants were asked to evaluate the change factors according to the three parameters determined as the frequency of occurrence, the impact on the project cost, and the impact on the project duration, respectively. The participants were asked to examine the change factors based on lump-sum and, design bid build contracted reinforced concrete building projects sized up to 5000 m2. Since this study was intended to make an organizational based assessment, the participants were asked to evaluate the change factors based on the experience of the organization rather than their personal experience.

In the questionnaire, the opinions of the participants were obtained through the factors weighting methods. In this context, the five-point Likert scale was used to examine the change factors based on the frequency of occurrence (parameter 1), impact on the project cost (parameter 2), and impact on the project time (parameter 3). In the survey, frequency of occurrence (parameter 1) was assessed using the scale options referred to “never”, “rare”, “average”, “frequent” and “very frequent”, however, impact on the project cost (parameter 2) and impact on the project time (parameter 3) were assessed through the scale options referred to “no effect”, “weak”, “moderate”, “strong” and “very strong” (for parameter 2 and 3). Analysis methods were explained in the research methodology section (Section 5.7.1 in Chapter 5).

6.2.1 Questionnaire Study One: Distribution of Respondents Profile

After the questionnaire was designed, surveys were conducted with the organizations involved in the construction projects. In this phase, change factors were examined based on a survey of professionals in the construction industry in North Cyprus, Turkey, and the U.S.A.

Civil engineers and architects were interviewed on behalf of their organizations in North Cyprus and Turkey and the U.S.A. One participant from each organization was included in the survey to make organizational based evaluation. Since respondents participated on behalf of the organization, they were asked to evaluate the questionnaire based on the organization's experience. The survey document was sent to the organizations in Northern Cyprus as a hard copy, however; an electronic survey to organizations in Turkey and the U.S. document file was sent using an online survey tool. A total of 96 organizations have participated in the survey. Table 6.1 shows the participant's distribution by region, organization, and profession types. The distribution of respondents' profiles was presented in Table 6.2.

Table 6.1: Respondent's professions

	North Cyprus (41)		Turkey (31)		The U.S.A. (24)	
	Civil Engineer	Architect	Civil Engineer	Architect	Civil Engineer	Architect
Contractor	17	3	13	2	8	2
Consultant	11	4	9	2	8	1
Owner	3	3	4	1	3	2
Total	31	10	26	5	19	5

Table 6.2: Distribution of the regions, organizations and respondents profiles

		North Cyprus and Turkey				The U.S.A.				Total
		Experience (Years)				Experience (Years)				
	Position	0-5	5-15	>15	Total	0-5	5-10	>15	Total	
Contractor	Site Engineer	4	7	10	21	2	0	0	2	23
	Design Engineer (Head Office)	0	4	5	9	0	4	2	6	15
	Site Architect	0	1	1	2	0	0	0	0	2
	Design Architect (Head Office)	0	0	3	3	0	1	1	2	5

Table 6.2 (Continued)

	Total	4	12	19	**35**	2	5	3	**10**	**45**
Consultant-Owner	Site Engineer	1	1	6	8	0	0	2	2	10
	Design Engineer (Head Office)	2	5	12	19	0	0	9	9	28
	Site Architect	0	0	2	2	0	0	1	1	3
	Design Architect (Head Office)	0	6	2	8	0	2	0	2	10
	Total	3	12	22	**37**	0	2	12	**14**	**51**
Total		7	24	41	**72**	2	7	15	**24**	**96**

In this phase of the study, two different organizational and regional characteristics were discussed based on the factors of change. The first organization type was recognized as a contractor representing the organization undertaking the implementation of the construction projects and ultimately, aiming to achieve financial success. The second organization is together with the consultant and the owner, where both have the authority to make technical and administrative decisions at the project phases and to supervise the contractors and to decide on the financial return in which contractor entitles.

On the other hand, the selected first region type has been Northern Cyprus and Turkey together, where both have similar characteristics and developing countries. The second region chosen was the United States of America (USA), which has unique characteristics and represents developed countries. In this regard, Northern Cyprus and Turkey were discussed together because they are similar, however, the USA, which has unique characteristics was discussed as the second region type. The research findings were categorized and discussed to emphasize the impact of organizational and regional characteristics across organizations and region types. The findings of this study were explained in the research findings and discussion section (Chapter 7).

The next section explains the survey study conducted in the second research phase of this study. As mentioned before, in the second phase of the research, it was aimed to examine the factors affecting the shop drawing practices and the risk status of shop drawing practices in construction projects. The survey process was conducted to assess the factors influencing shop drawing practices and technical and administrative variables, and the survey study was explained in the section below. Besides, the profiles of the respondents who participated in the survey were detailed.

6.3 Questionnaire Study: Two - Investigation of the Events of Shop Drawings Practices in Construction Projects

As stated above, in this study, the second questionnaire was based on examining the factors affecting shop drawing practices and the risk status of shop drawing practices in construction projects.

In the second phase of the study, it is aimed to reveal the top critical administrative and technical project variables that can affect shop drawing practices during the execution process of the project. Thus, it is aimed to examine the effectiveness of administrative and technical variables on shop drawing practices.

In this process, a variety of technical and administrative variables affecting the shop drawing practices were assessed by taking the survey in the construction industry in

Turkey. Firstly, a questionnaire document was designed (see in Figure 6.4, 6.5, 6.6, 6.7, 6.8). Accordingly, the basic administrative and technical variations in construction projects were listed. The project variations were evaluated in different evaluation parameters. Initially, the participants were asked to provide information about themselves and the organization they work for. In the next stages, the respondents were asked to assess the impact of the common technical and administrative project variables based on the various parameters. Data collection and analysis methods were described in the sections below. The designed questionnaire document was presented in the following (Figure: 6.4, 6.5, 6.6, 6.7, and 6.8).

QUESTIONNAIRE: 2

QUESTIONNAIRE FOR THE INVESTIGATION OF THE IMPACT OF SHOP DRAWINGS IN CONSTURCUTION PROJECTS IN TURKEY

ENGLISH VERSION

1) Please Choose the Type of Your Organization in Construction Projects.

A- Contractor

B- Consultant-Owner

2) Please write your title in the organization. (i.e: Architect (Head office)…etc)

………………………………………………………………………………………

3) How many years have you been working at the organization?

………………………………………………………………………. (Year)

Guidance for the Survey:

For the following questions (Questions. 4-10), please do your evaluations according to reinforced concrete building construction projects up to 5000 m2.

Also, please make your assessments based on the experience of your organization rather than your personal experience.

Figure 6.4: Questionnaire "two" document (page 1)

4) According to the experience of the organization, Please Evaluate the items of Construction work processes according to the parameters designated in the Table below.

	Parameter 1					**Parameter 2**					**Parameter 3**				
	Shop Drawings Requirement Frequency					**Effects of Shop Drawings on the Project's Cost Increase**					**Effects of Shop Drawings on the Project's Time Increase**				
Construction Works Process	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High
Excavation and Foundation Works															
Carcass Construction															
Electrical Works															
Waste Water Mechanical Works															
Domestic Water Mechanical Works															
Brickworks/ Plastering/ Surface Covering Works															
Windows/doors other installations															

Figure 6.5: Questionnaire "two" document (page 2)

5) According to the experience of the organization, Please Evaluate the Contract Types according to the parameters designated in the Table below.

	Parameter 1 Shop Drawings Requirement Frequency					Parameter 2 Effects of Shop Drawings on the Project's Cost Increase				
Contract Types	Never	Less	Moderate	High	Very High	Never	Less	Moderate	High	Very High
Lump-Sum Contract										
Unit Price Contract										
Cost+ Fixed Fee Contract										
Cost + Percentage of Cost										

6) According to the experience of the organization, Please Evaluate the Project Procurement Models according to the parameters designated in the Table below.

	Parameter 1 Shop Drawings Requirement Frequency					Parameter 2 Effects of Shop Drawings on the Project's Cost Increase				
Project Procurement Models	Never	Less	Moderate	High	Very High	Never	Less	Moderate	High	Very High
Design-Bid-Build										
Design-Build										
Partnering										

Figure 6.6: Questionnaire “two” document (page 3)

7) According to the experience of the organization, Please Evaluate the items of Project Disciplines according to the frequency of implementation of the shop drawings in construction projects.

	Frequency of Shop Drawing Implementation				
Project Disciplines	**Never**	**Less**	**Moderate**	**High**	**Very High**
Static					
Architectural					
Mechanical					
Electrical					

8) According to the experience of the organization, Please Evaluate the items of Project Disciplines according to the frequency of implementation of the shop drawings in construction projects.

	Frequency of Shop Drawing Implementation				
Causes of Shop Drawings	**Never**	**Less**	**Moderate**	**High**	**Very High**
Errors/ Inadequacies in Contract Drawings					
Incompatibility between different designs					
Incompatibility between Drawings and Specifications					
Errors / Inadequacies in Specification					
Low Constructability Design					
Health and Safety Precautions					
Inadequate Ground Investigation					
Errors in Construction Methodology Plan					
Lack of Experience of Contractor					
The attitude of Project Consultants					
Changes in Technology					
Shortage of Materials					

Figure 6.7: Questionnaire “two” document (page 4)

9) According to the experience of the organization, Please evaluate how often conflict occur between project parties as a result of shop drawings.

	Frequency of Conflict between Project Parties				
Project Parties	**Never**	**Less**	**Moderate**	**High**	**Very High**
Contractor-Consultant					
Contractor-Owner					
Contractor-Subcontractor					
Consultant-Owner					
Consultant-Consultant-Owner					

10) According to the experience of the organization, Please evaluate how often conflict occur between project parties as a result of shop drawings.

	Frequency of Conflict between Project Parties				
Project Success Parameters	**Never**	**Less**	**Moderate**	**High**	**Very High**
Completion at the Time Limit					
Completion at the Budget Limit					
Completion at the Quality Limit					
Completion with Successful Occupational Health and Safety					

Figure 6.8: Questionnaire “two” document (page 5)

In the survey, the factor weighting method was used as a data collection method. A five-point Likert scale was used to evaluate the factors according to the various parameters. The weight assigned on the Likert scale given to each factor varies between 0 to 4, where; 0: Never, 1: Less, 2: Moderate, 3: High, 4: Very High. In the survey, all parameters were assessed using the scale options named: “never”, “less”, “moderate”, “high” and “very high”. Respondents were used those scale options to assess all various parameters in the questionnaire. Analysis methods were explained in the research methodology section (Section 5.7.2 in Chapter 5).

6.3.1 Questionnaire Study Two: Distribution of Respondents Profile

Following the survey design, surveys were conducted with the organizations involved in the construction projects. At this stage, the factors affecting the shop drawing practices were examined based on a survey of professionals in the construction industry in Turkey. The survey document was provided to the organizations as a hard copy. The distribution and profile of the participants were described in the section below.

Interviews were held with civil engineers and architects on behalf of their organizations. One participant from each organization was included in the survey to make an organization-based assessment. Respondents were asked to evaluate the survey based on reinforced concrete building projects up to 5000 m2. Besides, respondents were asked to carry out the survey based on the organization’s experience, as they participated in the organization's name. A total of 91 organizations participated in the survey. The distributions of organizations and respondents profiles were presented in Table 6.3.

Table 6.3: Distribution of organization and respondents professions

		Architect			Civil Engineer			Overall
		On-Site	Head Office	Total	On-Site	Head Office	Total	**Overall**
Contractor	0-5 Years	1	1	2	2	2	4	6
	5-10 Years	-	3	3	-	2	2	5
	5-15 Years	2	5	7	7	8	15	22
	>15 Years	2	2	4	3	7	10	14
	Total	5	11	16	12	19	31	47
Consultant	0-5 Years	-	-	-	-	1	1	1
	5-10 Years	1	1	2	-	3	3	5
	5-15 Years	-	1	1	3	6	9	10
	>15 Years	-	4	4	2	3	5	9
	Total	1	6	7	5	13	18	25
Owner	0-5 Years	-	-	-	-	-	-	-
	5-10 Years	-	-	-	-	-	-	-
	5-15 Years	1	3	4	3	1	4	8
	>15 Years	-	7	7	-	4	4	11
	Total	1	10	11	3	5	8	19
Overall		7	28	34	20	37	57	91

In this phase of this study (second phase), as in the other analysis phases, two different organizational characteristics were discussed. In this context, the research results were classified according to two types of organizational characteristics. Here, organizations refer to parties involved in construction projects, namely contractors, consultants, and owners. As in the previous survey, the first organization was designated to be the contractor referring the organizations undertaking the implementation of the construction projects and receiving financial benefit in return. The second type of organization was designated together the consultant and owner, both of whom had the authority to make technical and administrative decisions during the project phases and to supervise contractors in execution phase. As explained earlier, contractors were considered as a separate organization feature, while consultant-project owners were considered together. As explained in Chapter 2 (Chapter 2, section 2.2.3), consultants take part in construction projects as the representative of the project owner. In this context, they strategically act in line with the project owner (Sha'ar et al., 2017) (Thomas & Wright, 2016). The research findings were compared to emphasize the differences and consensus of organizations' views on the impact of shop drawing practices. The findings of this study were explained in the research findings and discussion section (Chapter 8).

The next section explains the survey study conducted in the third phase of this study. As stated before, in the third phase of the research, it was aimed to examine the factors affecting the claims of the contractor and the mitigation measures that can prevent the claims. The survey process conducted to assess claim factors and claim mitigation measures were explained in the section below. Besides, the profiles of the respondents participating in the survey were explained in detail.

6.4 Questionnaire Study: Three - Investigation on Events of Claims and Control (Mitigation) Measures

As stated at the beginning of this chapter, the third survey conducted in this study was based on the examination of the factors that lead to contractor claims and mitigation measures that prevent contractors' claims in construction projects.

In the third phase of the study, it was aimed to examine the factors that cause the claims of the contractors, as the changes in the project causing the claims. In this way, it was aimed to establish a relationship between the factors causing the changes and the factors of the contractor's claims. Claim factors and claim mitigation measures were assessed by taking the survey in the construction industry. This questionnaire consisted of four different stages. Initially, the participants were asked to provide information about themselves and the organization they work for. In the second stage of the survey, respondents were asked to assess the factors that lead to contractors’ claims. In the third stage of the survey, it was aimed to examine the measures that can prevent the contractors’ claims in construction projects. In this context, in the third stage, respondents were asked to assess the claim mitigation measures.

In the fourth stage of the survey, factors that lead to contractor claims and measures that could reduce the contractors’ claims were evaluated as integrated. For this purpose, the cross-assessment method applied to perform an integrated assessment between factors of contractors’ claims and claim-reducing measures. In this context, respondents were asked to use a cross-comparison method to assess the factors of contractors’ claims and the factors of claim preventing measures. Claim factors and mitigation measures were assessed by taking the survey in the construction industry in Turkey. The questionnaire document prepared to examine the causes of contractors’ claims and claim mitigation measures is shown below (see in Figure 6.9, 6.10, 6.11, 6.12, 6.13, and 6.14).

QUESTIONNAIRE: 3

QUESTIONNAIRE FOR THE INVESTIGATION OF THE CONTRACTORS' CLAIMS AND MITIGATION MEASURES ON CONSTRUCTION PROJECTS
ENGLISH VERSION

1) Please Choose the Type of Your Organization in Construction Projects.

A- Contractor

B- Consultant-Owner

2) Please write the name of the country where the organization you work in is located.

…………………………………………………………………………

3) Please write your title in the organization. (i.e: Architect (Head office)…etc)…………………………………………………………………………

4) How many years have you been working at the organization?

………………………………………………………………………. (Year)

Guidance for the Survey:

In the following tables (for questions 5,6, 7), please evaluate the factors of changes on the basis of the lump-sum and, design-bid-build contracted reinforced concrete building projects sized up to 5000 m2.
Also, please make your assessments based on the experience of your organization rather than your personal experience.

Figure 6.9: Questionnaire "three" document (page 1)

5) According to the experience of the organization, Please Evaluate the Factors Causing Contractor Claims in Construction Projects according to the parameters designated in the Table below.

	Parameter 1					**Parameter 2**					**Parameter 3**				
	Frequency of Occurrence of Claims					**Cost-Time Overrun Severity**					**Frequency of Disputes between Contractors and Consultants**				
Causes of Contractors' Claims	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High
Inadequacies in Contract Drawings															
Low Constructability Design															
Inadequacies in Specification															
Inconsistencies between different designs															
Changes in Scope															
Inadequacies in Contract															
Inadequate knowledge of client															
Inadequate Experience of Consultants															
Low contract price															
Inadequate time in tendering															
Inadequacies in Organizations															

Figure 6.10: Questionnaire “three” document (page 2)

5) Continue

	Frequency of Occurrence of Claims					**Cost-Time Overrun Severity**					**Frequency of Disputes between Contractors and Consultants**				
Causes of Contractors' Claims	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High
Lack of Communication between parties															
Changes in Construction Method															
Errors of subcontractors															
Inclusion of Shop Drawings															
Inadequate Experience of contractor															
Inflation in Resources Cost															
Natural Disasters															
Subsurface Problems															
Shortages of Materials															
Changes in Law and Standards															

Figure 6.11: Questionnaire “three” document (page 3)

6) According to the experience of the organization, Please Evaluate the Factors of Claim Mitigation Measures in Construction Projects according to the parameters designated in the Table below.

		Parameter 1					**Parameter 2**					**Parameter 3**				
		Claim Prevention Effectiveness					**Cost Overrun Prevention Effectiveness**					**Time Overrun Prevention Effectiveness**				
No	**Factors of Mitigation Measures**	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High
1	Standard form of Drawings															
2	Detailed Drawing/Specification															
3	Advanced Design Software (BIM)															
4	Front-End Planning (Feasibility)															
5	Qualified Architect-Engineer															
6	Easy Constructability Design															
7	Effective Communication															
8	Sharing Historical Data															
9	Qualified Project Manager															
10	Detailed Contract															
11	Staff training															
12	Contractors well bidding organization															
13	Risk sharing philosophy															
14	Awarding Right Contractor															

Figure 6.12: Questionnaire “three” document (page 4)

6) Continue

No	Factors of Mitigation Measures	Claim Prevention Effectiveness					Cost Overrun Prevention Effectiveness					Time Overrun Prevention Effectiveness				
		Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High	Never	Less	Mod.	High	Very High
15	Effective Site Management															
16	Pre investigation of site															
17	Effective Quality Control															

7) Please choose the Most Appropriate factor of Mitigation Measures according to the factors of Contractors' claims in Construction Projects in the table below. Please select a mitigation measure factor for each claim factor.

Causes of Contractors' Claims	Factors of Mitigation Measures (Factor Number referred to in Question 6)																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Inadequacies in Contract Drawings																	
Low Constructability Design																	
Inadequacies in Specification																	
Inconsistencies between different designs																	
Changes in Scope																	
Inadequacies in Contract																	
Inadequate knowledge of client																	
Inadequate Experience of Consultants																	

Figure 6.13: Questionnaire "three" document (page 5)

7) Continue

Causes of Contractors' Claims	Factors of Mitigation Measures (Factor Number referred to in Question 6)																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Low Contract Price																	
Inadequate time in tendering																	
Inadequacies in Organizations																	
Lack of Communication between parties																	
Changes in Construction Method																	
Errors of subcontractors																	
Inclusion of Shop Drawings																	
Inadequate Experience of contractor																	
Inflation in Resources Cost																	
Natural Disasters																	
Subsurface Problems																	
Shortages of Materials																	
Changes in Law and Standards																	

Figure 6.14: Questionnaire “three” document (page 6)

After the survey document has been designed, the evaluation phase started. In the survey, factors of contractors' claims were assessed according to three parameters designated as the frequency of occurrence, impact on cost-time, and frequency of disagreement between contractors and owners. Claim mitigation measures were assessed in terms of effectiveness in preventing the occurrence of claims and, cost and time overruns.

Participants were asked to examine the claim factors and mitigation measures based on lump-sum and design bid build contracted reinforced concrete building projects sized up to 5000 m2. Since this study aimed to make an organizational-based assessment, the participants were asked to evaluate the factors of claims based on the experience of the organization rather than their personal experience.

In the survey, the factors weighting method was used to obtain the views of the participants regarding the claim factors and mitigation measures. A five-point Likert scale was used to evaluate the factors according to the parameters described above. The weight assigned on the Likert scale given to each factor ranges from 0 to 4, where; 0: Never, 1: Less, 2: Moderate, 3: High, 4: Very High. In the survey, all parameters were assessed using the scale options named: “never”, “less”, “moderate”, “high” and “very high”. Respondents were used those scale options to assess all parameters in the questionnaire. The analysis methods were explained in the research methodology chapter (Chapter 5, Section 5.7.3).

6.4.1 Questionnaire Study Three: Distribution of Respondents Profile

After the questionnaire was designed, factors were examined based on the survey of professionals in the construction industry in Turkey. Civil engineers and architects were interviewed on behalf of their organizations. A participant from each organization was included in the survey to make an organizational evaluation. Participants were asked to conduct the survey based on the organization's experience, as they participated on behalf of the organization. The survey document was provided to the organizations as a hard copy. A total of 103 organizations participated in the survey. The distributions of organizations and respondents' profiles were presented in Table 6.4.

Table 6.4: Distribution of organization and respondents' professions

		Architect			Civil Engineer			**Overall**
		On-Site	Head Office	Total	On-Site	Head Office	Total	
Contractor	0-5 Years	-	-	-	4	-	4	8
	5-10 Years	2	1	3	3	5	8	11
	5-15 Years	4	3	7	7	6	13	20
	>15 Years	2	9	11	6	14	20	31
	Total	8	13	21	21	24	45	66
Consultant	0-5 Years	-	-	-	-	-	-	-
	5-10 Years	-	-	-	2	1	3	3
	5-15 Years	-	3	3	1	2	3	6
	>15 Years	-	5	5	4	6	10	15
	Total	0	8	8	7	9	16	24
Owner	0-5 Years	-	-	-	-	-	-	-
	5-10 Years	-	-	-	-	-	-	-
	5-15 Years	-	-	-	-	2	2	2
	>15 Years	-	5	5	-	6	6	11
	Total	0	5	5	0	8	8	13
Overall		8	26	34	28	41	69	103

As in previous survey phases, two different organizational characteristics were discussed based on the contractors' claims. The first organization was considered being a contractor representing the party that undertakes the implementation of the construction projects and who claims and receives a financial benefit in return. Consultants and owners both of whom are contractors' supervisor and have the authority to produce technical and administrative decisions in project phases. As explained in previous of this chapter (section 6.2.1 and 6.3.1.), contractors are treated as separate organization characteristics, while the consultant and the project owner together were recognized as the second organizational characteristics. The research findings were classified to emphasize the differences and consensus of the organizations' opinions on the contractor's claims and mitigation measures. The analysis results were explained in Chapter 9.

6.5 Comments on the Number of Respondents in Surveys

In this thesis, as stated before, three survey phases were conducted. A participant from each organization was included in the surveys to make an organizational evaluation. As it was illustrated in Table 6.2, in the first survey process a total of 96 organizations have participated. A total of 96 respondents constituted the sample size in the first survey study. As it was illustared in Table 6.3, in the second survey process, a total of 91 organizations have participated. A total of 91 respondents constituted the sample size in the second survey study. As it was indicated in Table 6.4, a total of 103 organizations participated in the third survey process. A total of 103 respondents constituted the sample size for the third survey study.

Comparing the number of participants in all three survey processes, the total number of participants between three survey periods was resulted as quite balanced.

Also, according to the statistical authority in the literature, for instance, Dworkin (2012) stated in his book that, “while some experts in survey research avoid the topic of “how many” interviews “are enough,” there is indeed variability in what is suggested as a minimum”. Additioannly, Dworkin, (2012) stated that, according to the recommendations and guidance in extremely large number of articles, book chapters, and books, anywhere from 5 to 50 participants as adequate.

On the other hand, compared to the past researches examples, for instance Muhwezi et al. (2014), used survey as a data collection tool to assess the factors causing delay in building construction projects. As in this research, the type of data collected by the survey was 5 point likert –scale, and type of data analysis was R.I.I. In that research study, a total of 52 respondents constituted the sample size. In another past research, for instance, Mishmish & El-Sayegh (2018) were analysed causes of claim factors in construction projects in U.A.E. In that research study, a total of 51 respondents constituted the sample size. Zaneldin (2020), were analyzed the type , causes and severity of claim factors in construction sector in U.A.E based on R.I.I., and a total of 43 respondents constituted the sample size.

Within this context, compared to the past researches examples, in this research, the number of respondents in all three survey phases is quite valid and consistent with the number of respondents in similar survey models conducted in past research studies.

Chapter 7

RESEARCH FINDINGS AND DISCUSSIONS ON CHANGE ORDER EVENTS

7.1 Introduction

This chapter presents the research findings obtained through the quantitative analysis methods described in Chapter 5 (please see Section 5.7.1 in Chaper 5 for details) and discussions about the findings are presented. As explained in previous of the thesis, the first research phase is based on the examination of the change order events (Research Phase 1: Change Order Events). In this chapter, the research findings and discussions about the events leading to change orders (Research Phase: 1) are presented. As explaine in previous of the thesis (please see Section 5.7.1 in Chapter 5 for details), research finginsgs and discussions concerning change order events were presented according to the organizational and regional classificantions. Withing this context, the following sections presents the research findings and discussions about the events leading to change orders (Research Phase: 1) on the basis of organizational and regional classifications.

7.2 Key Events of Change Orders in the Organizational Perceptions

In the following section, the quantitative research findings on change order events and discussions about the quantitative findings concerning key events of change orders are presented, on the basis of organizational classifications.

7.2.1 Risk Index of Change Order Events

This section presents the results obtained by the quantitative analysis method described in Section 5.7.1.4 of the thesis (Risk Significance Index of Change Order Events). The Risk Significance Index (R.S.I.) of events of change orders, by organization types, were presented in Table 7.1 below (please See Appendix-A for parameter values).

Table 7.1: Factors r.s.i. according to the organization types

	Causes of Change Orders	**Contractor**		**Consultant - Owner**		**Overall**	
		R.S.I.	**Rank**	**R.S.I.**	**Rank**	**R.S.I.**	**Rank**
Planning And Design	Errors/Inadequacies in Contract Drawings	48.6	1	37.2	3	40,9	1
	Inconsistencies between different Designs	34.7	3	34.7	4	35,0	4
	Errors and Inadequacy in Specification	31.7	6	28.3	13	29,1	12
	Conflict among contract documents	30.8	8	33.4	6	31,7	6
	Un-use of advanced design software	24.2	16	18.7	21	18,2	23
	Constructability Ignored	28.3	10	31.2	10	29,6	11
	Error in Cost Estimating and budgeting	26.1	13	22.7	17	24,0	15
	Unrealistic imposed contract duration	20.4	20	32.3	8	26,1	13
Construction	Inadequate site investigation in pre-construction	30.2	9	31.6	9	31,2	7
	Uncertainties / problems of Subsurface	22.7	17	25.8	14	24,4	14
	Provision of additional shop drawings	31.0	7	29.7	12	29,7	10
	Errors in execution	16.4	24	25.2	15	20,2	20
	Material / Equipment / Manpower shortage	18.1	23	18.2	22	16,9	24
	Additions / Omissions of work items	41.7	2	38.5	2	38,2	3
People	Lack of Experience of Project Participants	32.3	5	33.5	5	34,8	5
	Poor communication between Parties	28.0	12	33.3	7	30,9	8

Table 7.1 (Continued)

	Owners Knowledge on Construction Projects	24.2	15	22.5	18	22,2	17
Administrative	Poor Contract Management	28.3	11	30.9	11	29,9	9
	Inappropriate choice of project delivery system	22.2	18	22.7	19	21,8	18
	Inappropriate choice of contract type	24.3	14	23.6	16	22,5	16
	Low Contract Price (Competitive Bidding)	34.3	4	43.6	1	39,8	2
External	Unforeseeable Natural Conditions	21.6	19	17.3	24	19,1	22
	Fluctuation in Tax / Interest Rate / Material and Labor Cost	19.1	22	17.5	23	19,4	21
	Change in government laws/ regulations	10.7	25	10.2	25	10,8	25
	Shortening / Compression in Project Schedule	20.3	21	22.3	20	20,7	19
Average R.S.I. (%)			26.80		27.40		26.7

7.2.2 Discussions on Key Problematic Events of Change Order in the Perceptions of the Organizations

Based on the results in the Table 7.1 presented above, the following views were reached:

A) According to the Contractors: The top risky changes are because of the poor quality of the contract drawings. This finding showed that, according to the contractors, the most frequent and most severe changes were because of errors and poor quality in project drawings. The project owners have a great responsibility in preparing drawing documents, as in design-bid-build model projects, preparing project drawings is undertaken by consultants under the owner's responsibility. In this context, contractors strived to state the lack of responsibility of the project owners and consultants, as the project drawing documents are issued under the responsibility of the owners and consultants. In addition, in the contractors' evaluation, the risk importance index score of this particular factor was found to be quite higher than the consultant-owners evaluation. These findings were interpreted as defects in the drawing may pose a higher risk for contractors than consultants and owners.

B) **According to the Consultants-Owners:** Based on the results obtained from the opinions of all consultant-owner, "low contract price due to the competition" expressed as the highest risk change factor, which means the most frequent and severe factor leading costs and time overruns. Consultants and owners interpreted that the most risky changes occurred because of the lower bid price associated with the contractor selection method. In research conducted by Mohamad, Nekooie & Al-Harthy (2012) this issue was also emphasized. In this research, the authors highlighted that contractors can lead to design changes by proposing to use existing materials and alternative construction methods to save money and time. In this way, financial losses are tried to be deducted (Mohamad, Nekooie & Al-Harthy, 2012). The money and time claimed by the contractor for changes may be higher as a competitive environment no longer exists in the execution process. When the bidding environment is highly competitive, there is more chance to cost / time overruns (Arain & Pheng, 2005a). This can be interpreted as that the likelihood of the tendency of cost and time overruns increases when contractors have a strong willingness to bid because of keeping their costs below other bidders.

C) **Top Critical Second Events:** According to the responses of both contactors and "consultant-owner", "Adding or omitting of work items" which related to conditions of the construction execution process and poor scope definition were ranked as the second-highest risky change factor by both organization characteristics. Adding or omitting items can be requested by any party for many reasons. This can be a consequence of the side effects of many factors. Both the quality of the design and the sophistication of other project documentation and the level of organization as well as the communication can cause the addition of extra work items. The contractor's desired profitability can be a potential cause of changes in construction projects. The addition of work items can be used as a means to generate extra income. In this context, additional work can be interpreted as a common resource for contractors to achieve the desired profitability, as contractors may include additional work in order to achieve financial benefits (Assbeihat & Sweis, 2015). This can be interpreted as the unethical behavior of contractors to achieve the highest level of profit. Besides, poor scope definition is one of the major triggers that can cause works to be added during execution (Memon, Rahman & Hasan, 2014) (Sha'ar et al., 2017). The addition of extra work items can be reduced by preparing comprehensive project documents, along with detailed project design and scope definition.

D) The Botton Line: The results also showed that compared to contractors, consultants and owners are more concerned about changes, as the average risk index is higher than the contractor (please See Table 7.1). Consultants have great responsibility in case of any disruption caused by changes and disputes between the parties. This finding can be interpreted as the consultants having great difficulties in solving the problems related to the changes in order for the project to proceed smoothly. The project owners may incur additional costs because of the need for a financial resource for change.

The diagram in Figure 7.1 below presents the top risky factors affecting changes resulting, based on the views of organizations.

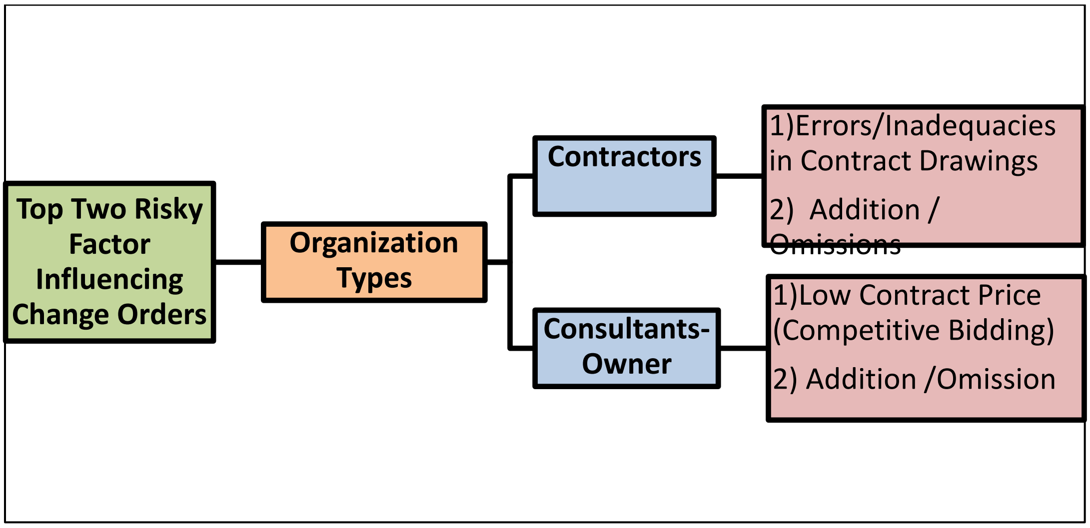

Figure 7.1: Top risky factors of change orders in the perceptions of the organizations

7.3 Key Events of Change Orders based on the Regional Characteristics

As stated in the introduction of this chapter, "change order events" were also evaluated according to two different regional characteristics. In this context, according to the results, the discussions are presented below.In the following section, the quantitative research findings on change order events and discussions about the quantitative findings concerning key events of change orders are presented, on the basis of regional classifications.

7.3.1 Risk Index of Change Order Events

This section presents the results obtained by the quantitative analysis method described in Section 5.7.1.4 of the thesis (Risk Significance Index of Change Order Events). The Risk Significance Index (R.S.I.) of events of change orders, by regional types, were presented in Table 7.2 below (please See Appendix-B for parameter values). Table 7.3

presents the Risk Significance Index (R.S.I.) of events of change orders according to the organizational classifications in Norther Cyprus-Turkey. Table 7.4 below presents the the Risk Significance Index (R.S.I.) of events of change orders according to the organizational classifications in the U.S.A.

Table 7.2: Factors risk significance index (R.S.I.) based on regional types

	Causes of Change Orders	**N. Cyprus and Turkey**		**The U.S.A.**		**Overall**	
		R.S.I.	**Rank**	**R.S.I.**	**Rank**	**R.S.I.**	**Rank**
Planning-Design	Errors/Inadequacies in Contract Drawings	43,1	2	35,2	3	40,9	1
	Inconsistencies between different Designs	32,2	6	43,5	1	35,0	4
	Errors and Inadequacy in Specification	30,5	10	26,7	11	29,1	12
	Conflict among contract	34,6	5	26,9	10	31,7	6
	Un-use of advanced design software	15,9	23	22,9	17	18,2	23
	Constructability Ignored	29,8	11	28,9	7	29,6	11
	Error in Cost Estimating and budgeting	23,9	17	24,5	15	24,0	15
	Unrealistic imposed contract duration	27,3	13	23,6	16	26,1	13
Construction-Site	Inadequate site investigation in pre-construction	31,8	9	30,3	6	31,2	7
	Uncertainties / problems of Subsurface	26,5	14	20,7	19	24,4	14
	Provision of additional shop drawings	28,5	12	32,5	5	29,7	10
	Errors in execution	18,7	19	22,6	18	20,2	20
	Material / Equipment / Manpower shortage	16,8	22	17,1	23	16,9	24
	Additions / Omissions of work items	35,9	4	42,4	2	38,2	3
People	Lack of Experience of Project Participants	40,7	3	25,5	13	34,8	5
	Poor communication between Parties	32,2	8	28,0	8	30,9	8
	Owners Level of Construction Sophistication	22,9	18	20,3	20	22,2	17

Table 7.2 (Continued)

Administrative	Poor Contract Management	32,2	7	26,4	12	29,9	9
	Inappropriate choice of project delivery system	24,8	16	16,1	24	21,8	18
	Inappropriate choice of contract type	25,1	15	18,2	22	22,5	16
	Low Contract Price (Competitive Bidding)	44,0	1	33,4	4	39,8	2
External	Unforeseeable Natural Conditions	18,6	20	20,3	21	19,1	22
	Fluctuation in Tax / Interest Rate / Material and Labor Cost	15,9	24	27,2	9	19,4	21
	Change in government laws/ regulations	11,0	25	10,1	25	10,8	25
	Shortening / Compression in Project Schedule	17,9	21	25,3	14	20,7	19
Average R.S.I. (%)			**27,2**		**25,9**		**26,7**

Table 7.3: Factors risk significance index (R.S.I.) according to the organizations in Northern Cyprus and Turkey

	Northern Cyprus and Turkey						
	Causes of Change Orders	**Contractors**		**Consultant-Owner**		**Overall**	
		R.S.I.	**Rank**	**R.S.I.**	**Rank**	**R.S.I.**	**Rank**
Planning And Design	Errors/Inadequacies in Contract Drawings	49.9	1	37.8	3	43.1	2
	Inconsistencies between different Designs	36.3	5	29.2	11	32.2	6
	Errors and Inadequacy in Specification	32.2	7	29.2	12	30.5	10
	Conflict among contract documents	32.2	6	36.8	4	34.6	5
	Un-use of advanced design software	18.3	21	13.8	23	15.9	23
	Constructability Ignored	25.6	13	33.9	6	29.8	11
	Error in Cost Estimating and budgeting	26.1	12	22.2	19	23.9	17
	Unrealistic imposed contract duration	21.3	18	33.2	8	27.3	13

Table 7.3 (Continued)

Construction-Site	Inadequate site investigation in pre-construction	31.6	10	32	10	31.8	9
	Uncertainties / problems of Subsurface	23.8	14	28.3	13	26.5	14
	Provision of additional shop drawings	32.1	8	25.6	16	28.5	12
	Errors in execution	14.2	24	22.4	18	18.7	19
	Material / Equipment / Manpower shortage	16.2	23	17.3	21	16.8	22
	Additions / Omissions of work items	39.1	3	33.6	7	35.9	4
People	Lack of Experience of Project Participants	38.3	2	39.1	2	40.7	3
	Poor communication between Parties	28.4	11	35.8	5	32.2	8
	Owners Level of Construction Sophistication	21.3	19	24.2	17	22.9	18
Administrative	Poor Contract Management	31.9	9	32.5	9	32.2	7
	Inappropriate choice of project delivery system	22.2	16	27.1	14	24.8	16
	Inappropriate choice of contract type	21.9	15	24.9	15	25.1	15
	Low Contract Price (Competitive Bidding)	36.9	4	48.9	1	44	1
External	Unforeseeable Natural Conditions	22.1	17	16.2	22	18.6	20
	Fluctuation in Tax / Interest Rate / Material and Labor Cost	19	20	13.4	24	15.9	24
	Change in government laws/ regulations	10.7	25	11.2	25	11	25
	Shortening / Compression in Project Schedule	17.4	22	18.3	20	17.9	21
Average R.S.I. (%)		**26.76**		**27.48**		**27.2**	

Table 7.4: Factors risk significance index (R.S.I.) according to the organizations in the U.S.A.

	The U.S.A.						
	Causes of Change Orders	Contractors		Consultant-Owner		Overall	
		R.S.I.	Rank	R.S.I.	Rank	R.S.I.	Rank
Planning And Design	Errors/Inadequacies in Contract Drawings	43.3	1	30.2	7	35.2	3
	Inconsistencies between different Designs	36	3	48.5	1	43.5	1
	Errors and Inadequacy in Specification	30.9	5	23.6	16	26.7	11
	Conflict among contract documents	27.9	9	27.6	9	26.9	10
	Un-use of advanced design software	24.6	13	21.7	18	22.9	17
	Constructability Ignored	27.1	11	30.2	6	28.9	7
	Error in Cost Estimating	24	14	24.2	15	24.5	15
	Unrealistic imposed contract duration	18.8	21	26.7	10	23.6	16
Construction-Site	Inadequate site investigation in pre-construction	28.8	8	31.4	5	30.3	6
	Uncertainties / problems of Subsurface	21.6	17	20.1	20	20.7	19
	Provision of additional shop drawings	29.8	6	34.2	3	32.5	5
	Errors in execution	16.8	23	26.1	12	22.6	18
	Material / Equipment / Manpower shortage	16.7	24	16.8	22	17.1	23
	Additions / Omissions of work items	40	2	44.1	2	42.4	2
People	Lack of Experience of Project Participants	26.8	7	23.2	17	25.5	13
	Poor communication between Parties	25.8	12	26.6	11	28	8
	Owners Level of Construction Sophistication	22.9	16	18.6	21	20.3	20
Administrative	Poor Contract Management	27.8	10	25.4	13	26.4	12
	Inappropriate choice of project delivery system	19.6	19	13.7	24	16.1	24
	Inappropriate choice of contract type	20.2	18	14.1	23	18.2	22
	Low Contract Price (Competitive Bidding)	31.2	4	32	4	33.4	4

Table 7.4 (Continued)

External	Unforeseeable Natural Conditions	19.4	20	20.9	19	20.3	21
	Fluctuation in Tax / Interest Rate / Material and Labor Cost	23.1	15	24.6	14	27.2	9
	Change in government laws/ regulations	9.9	25	10	25	10.1	25
	Shortening / Compression in Project Schedule	18.7	22	29.7	8	25.3	14
Average R.S.I. (%)			**25.27**		**25.77**		**25.9**

7.3.2 Discussions on Key Problematic Events of Change Order in the Perceptions of the Regions

Based on the results in the Table 7.2 presented above, the following views were reached:

A) **According to the Respondents in Norther Cyprus-Turkey (Developing Characteristics):** Based on the results obtained from the opinions of all respondents in Northern Cyprus-Turkey, "Low contract price" associated with bidding evaluation and tendering process was identified as the top risky change factor in Northern Cyprus and Turkey. "Low contract price due to competition" which associated with bidding evaluation and tendering process was determined as the top risky change factor according to the respondents in North Cyprus and Turkey. Contractors in this region are awarded based on prices. For this reason, evaluation based on quantity (price) rather than qualification is often preferred, and therefore owners may in tend to award the lowest bidder contractors. Thus, contractors strive to offer the lowest bid price to be awarded during the tendering process (Ahmed et al., 2016) .Construction projects face many difficulties, such as slow progress and quality degradations due to the low bid price contracts (İlter & Çelik, 2018), whereby contractors may claim changes to compensate financial loss due to low bid price (Assbeihat & Sweis, 2015 (Arain & Pheng, 2005a). The changes can be a potential opportunity for the contractor's desired profitability. Additional works resulting from changes can be a common source for the contractors to increase earnings (Shrestha & Shrestha, 2017). Contractors' financial difficulties caused by the low bidding may meet by additional payments because of changes. In other studies, Cooke & Williams (2008) pointed out that one of the most common tendering risks is the contractors may be that contractors tend to bid below net cost tend to at a negative margin achieving by transferring the risk to others, mainly to the domestic subcontractors. It is stated that contractors may incline to gamble as they may not squeeze down subcontractors' prices after the contract is awarded, or that the anticipated returns from variations and claims may not be forthcoming (pp.82-83). Lower prices may be more attractive to project owners in the short term. However, in the long run, project owners may experience difficulties because of the tendency of contractors to increase their income through additional work.

Based on the results obtained from the opinions of all respondents in the U.S.A. (please see Table 7.2), the following views were reached:

B) According to the Respondents in the U.S.A. (Developed Characteristics): However, according to the U.S.A., "inconsistencies in different design" were cited as top risky change factor. According to the respondents in the USA, the top risky changes are caused by "discrepancies between unique designs". In this context, it was stated that the most common reason for the changes in construction projects in the USA is the conflict between project designs. Such problems are more common, especially in large-scale projects. Today, the scale and scope of projects is in a growing trend. Multifunctional buildings are being built with an increasingly global competitive environment trend. The compatibility and integrity between different designs becomes more difficult because of the increase in project complexity. Today, with the increasing trend of complex designs, the quality and function of contract drawings are becoming more and more important. In this context, the consistency of different designs becomes one of the most important factors affecting changes in today's global construction industry due to the implementing large-scale, multi-functional and complex projects.

In addition, the differences between the views of Contractors and "consultant-owner" organizations in different regions were also discussed. The following sections present discussions of results in table 7.3 (according to the organizations in Northern Cyprus and Turkey) and 7.4 (according to the organizations in the U.S.A.) Based on comparison of the results in the table 7.4 and 7.5 (please see chapter 7), the following views were reached:

C) **Comparison of Contractors Perceptions' in Northern- Cyprus and The U.S.A.:** Based on the results obtained by the opinions of contractors in "Northern Cyprus-Turkey" and in the "U.S.A.", in both regions, changes due to the weakness in drawings pose the greatest risk. Also, since the risk index score is much higher than the US, these factors pose a greater risk in Northern Cyprus and Turkey. Meanwhile, lack of experience of organizations and people involved in construction projects lead to one of the top risky changes according to the contractors in North Cyprus and Turkey, however, these factors were stated as to be lower risk for the contractors in the United States. In addition, changes due to the addition / omission of work items were observed to be at almost the same risk level in both regions.

D) Comparison of Consultants-Owners Perceptions' in Northern- Cyprus and The U.S.A: Based on the results obtained from the opinions of consultant-owners in "Northern Cyprus-Turkey" and in the "U.S.A.", the low bid price was led to the top risky changes in North Cyprus-Turkey, while it was emphasized to be much less risky in the U.S.A. While in the U.S.A., changes due to the inconsistencies between unique designs creating the greatest risk, this factor was emphasized to be much less risky in Northern Cyprus and Turkey.

The diagram in Figure 7.2 below shows the top risky factors affecting change order resulting, based on the views of regions.

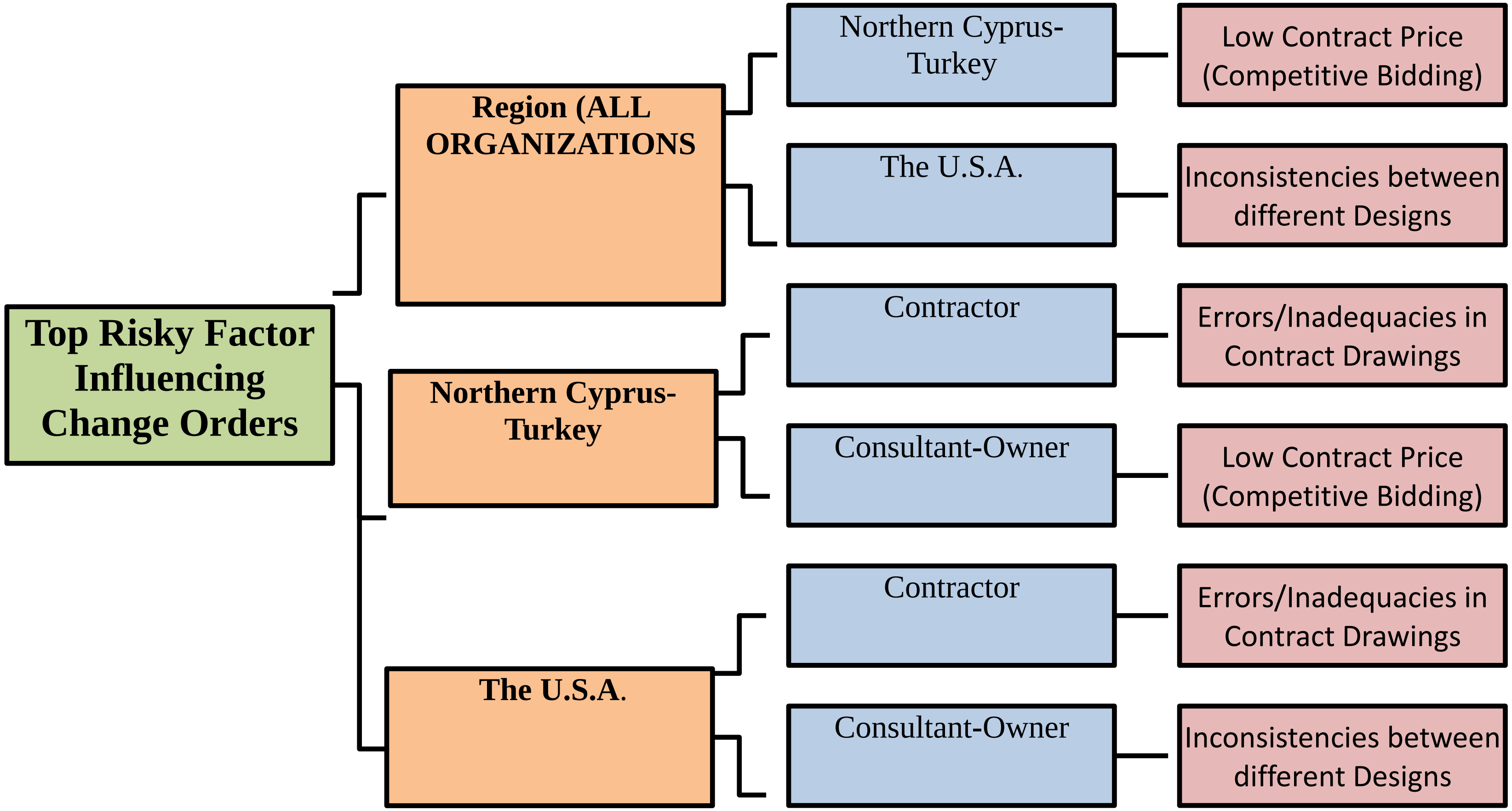

Figure 7.2: Top risky factors of change orders according to the opinions of organizations in different regions

As explaine in Section 5.7.1.2 (please see Chapter 5 for details), "events of change orders" are categorized by type to achieve more focused results. The following section presents the research findings and discussions regarding the key problematic categories of change events, by organizational types.

7.4 Key Problematic Categories of Change Order Events, in the Organizational Perceptions

In the following section, the quantitative research findings on categories of change order events and discussions about the quantitative findings concerning most critical categories of change order events are presented, on the basis of organizational classifications.

7.4.1 Risk Index of Categories of Change Order Events according to the Organizations

This section presents the results obtained through the quantitative analysis method described in Section 5.7.1.5 (Risk Significance Index of Change Categories). The values of the parameters in the Risk Importance index calculations are given in section Appendix (See Appendix-A). The Risk Significance Index (R.S.I.) of the categories of change order events, by organization types is presented in Table 7.5 below.

Table 7.5: Risk significance index (R.S.I.) of factor of change orders categories according to the organization types

	Contractor		**Consultant-owner**		**Overall**	
Change Order Category	**Av. R.S.I.**	**Rank**	**Av. R.S.I.**	**Rank**	**Av. R.S.I.**	**Rank**
Planning and Design	30.6	1	29.81	2	29.3	1
Construction and Site	26.7	4	28.17	4	26.8	4
People	28.2	2	29.77	3	29.3	2
Administrative	27.3	3	30.20	1	28.5	3

Table 7.5 (Continued)

External	17.9	5	16.83	5	17.5	5
Average	26.10		26.95		26.3	

7.4.2 Discussions on Key Problematic Events Categories of Change Order in the Perceptions of the Organizations

Based on the results in the Table 7.5 presented above, the following views were reached:

A) **According to the Responses of Contractors:** Based on the results obtained from the opinions of all contractors, the most risky changes consist because of the flaws in "Planning and Design". In general, activities in the "Planning and Design" phases are more related to the liabilities of the owner. In this context, the greatest importance should be given to the planning and design process in project organizations.

B) **According to the Responses of Consultant-Owner:** The consultant-owner emphasized that most risky change causes were due to administrative based issues in which associated with the contract management and tendering process.

C) **Top Critical Second Category:** Based on the results obtained from the opinions of all contractors and consultant-owner, “Planning and Design” category was ranked as one of the highest risk (second highest) by consultants and project owners where, “people” related events was ranked as second by contractors.

D) **The Bottol Line:** The bottom line is that, poor planning; design and administrative structure related to the pre-construction process can significantly trigger changes and therefore have a great impact on cost and duration of the project. These findings showed that the liabilities of organizations in the design and tendering processes pose the greatest risks on construction projects. In addition, the risk index levels in both organizational characteristics are fairly close in all categories except "external". According to the overall participants, “Planning / Design” and “People” were found to be the top risky, where “external factors” were found to be the least risky category of change factor. It has been understood that the experience and efforts of the organizations in the design, tender, and construction-related activities triggered changes significantly.

The diagram in Figure 7.3 below presents the top risky categories of change order events, based on the views of organizations.

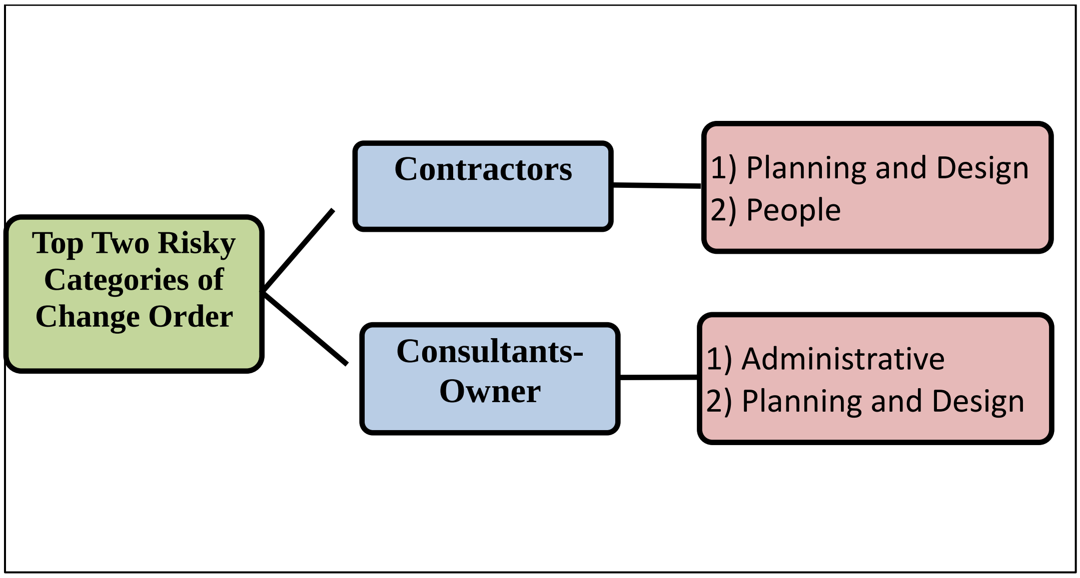

Figure 7.3: Top risky categories of factors of change orders according to the organizational classification

The following section presents the research findings and discussions regarding the key problematic categories of change events, by regional types.

7.5 Key Problematic Categories of Change Order Events, in the Regional Perceptions

In the following section, the quantitative research findings on categories of change order events and discussions about the quantitative findings concerning most critical categories of change order events are presented, on the basis of regional classifications.

7.5.1 Risk Index of Categories of Change Order Events according to the Regions

This section presents the results obtained through the quantitative analysis method described in Section 5.7.1.5 (Risk Significance Index of Change Categories). The values of the parameters in the Risk Importance index calculations are given in section Appendix (See Appendix-B). The Risk Significance Index (R.S.I.) of the categories of change order events, by regional types is presented in Table 7.6 below.

Table 7.7 presents the Risk Significance Index (R.S.I.) of the categories of change order events according to the organizational classifications in Norther Cyprus-Turkey. Table 7.8 below presents the the Risk Significance Index (R.S.I.) of categories of events of change orders according to the organizational classifications in the U.S.A.

Table 7.6: R.S.I. of factor of change orders categories according to the regions

	N. Cyprus and Turkey		**The U.S.A.**	
Factor Group	**Av. R.S.I.**	**Rank**	**Av. R.S.I.**	**Rank**
Planning and Design	29.66	3	29.03	1
Construction and Site	26.37	4	27.60	2
People	31.33	1	24.27	3
Administrative	31.23	2	23.20	4
External	15.85	5	20.73	5
Average	26.89		24.96	

Table 7.7: R.S.I. of factor of change orders categories according to northern Cyprus-Turkey

	North Cyprus and Turkey					
	Contractor		Consultant-Owner		Overall	
Factor Group	**Av. R.S.I.**	**Rank**	**Av. R.S.I.**	**Rank**	**Av. R.S.I.**	**Rank**
Planning and Design	30.24	1	29.51	2	29.66	3
Construction and Site	26.17	4	26.53	4	26.37	4
People	29.33	2	33.03	3	31.33	1
Administrative	28.23	3	33.35	1	31.23	2
External	17.30	5	14.78	5	15.85	5
Average	26.25		27.44		26.89	

Table 7.8: R.S.I. of factor of change order categories according to the U.S.A.

	The U.S.A.					
	Contractor		Consultant-Owner		Overall	
Factor Group	**Av. R.S.I.**	**Rank**	**Av. R.S.I.**	**Rank**	**Av. R.S.I.**	**Rank**
Planning and Design	29.08	1	29.09	1	29.03	1
Construction and Site	25.62	2	28.78	2	27.60	2
People	25.17	3	22.80	3	24.27	3
Administrative	24.70	4	21.30	4	23.20	4
External	17.78	5	21.30	5	20.73	5
Average	24.47		24.65		24.96	

7.5.2 Discussions on Key Problematic Events Categories of Change Order in the Perceptions of the Regions

Based on the results in the table 7.6 (please see chapter 7), the following views were reached.

A) According to Respondents in "Northern Cyprus-Turkey": Based on the results obtained from the opinions of all respondents in Northern Cyprus-Turkey, top risky changes were caused by the “People” related factors in Northern Cyprus and Turkey. These findings show that in North Cyprus and Turkey, the problem due to profile and performance of people involved in the project and project administrative status were shown as the source of a very high risks.

B) According to Respondents in The U.S.A.: Based on the results obtained from the opinions of all respondents in the U.S.A., Top risky changes were caused by the “Planning and Design” related factors in the U.S.A. Unlike “Northern Cyprus-Turkey”, people origin events pose a relatively low risk in the U.S.A. In the U.S.A., problems arising from the design and construction execution phase have observed as the source of the greatest risks.

C) The Bottom Line: In North Cyprus and Turkey, the fundamental defects were mostly related to human and administrative defects, whereas in the U.S.A., the fundamental defects were observed to be mostly technical based.

In addition, the differences between the views of Contractors and "consultant-owner" organizations in different regions were also discussed.

The following sections present discussions of results in table 7.7 (according to the organizations in Northern Cyprus and Turkey) and 7.8 (according to the organizations in the U.S.A.) Based on comparison of the results in the table 7.7 and 7.8 (please see chapter 7), the following views were reached:

A) Comparison of Perceptions’ of Contractors in Northern- Cyprus and the U.S.A.: Based on the results obtained from the opinions of contractors in “Northern Cyprus-Turkey” and in the “U.S.A.”, it was emphasized that the most risky changes in both regions were caused by the problems in planning and design activities. According to the contractors in the Northern Cyprus-Turkey, changes arising from the influence of the people involved in the project pose a greater risk than the U.S.A. In all categories, contractors have been observed to be less concerned against change risks in the U.S.A as the risk index score is low compared to North Cyprus-Turkey.

B) **Comparison Of Perceptions' of Consultants-Owners in Northern- Cyprus and The U.S.A.:** Based on the results obtained from the opinions of consultant-owners in "Northern Cyprus-Turkey" and in the "U.S.A.", changes resulting from the administrative based defects posed more risk; however, it was stated that this is much less risky for consultants and owners in the USA, as the risk index score in the USA is low. On the other hand, changes resulting from the planning and design based flaws posed the same risk level for consultants and owners in North Cyprus-Turkey and the U.S.A. Also, changes due to administrative defects posed a greater risk to contractors compared to the consultants and owners in the U.S.A.

The diagram below in Figure 7.4 presents the top risky change order factor categories, based on the views of regions.

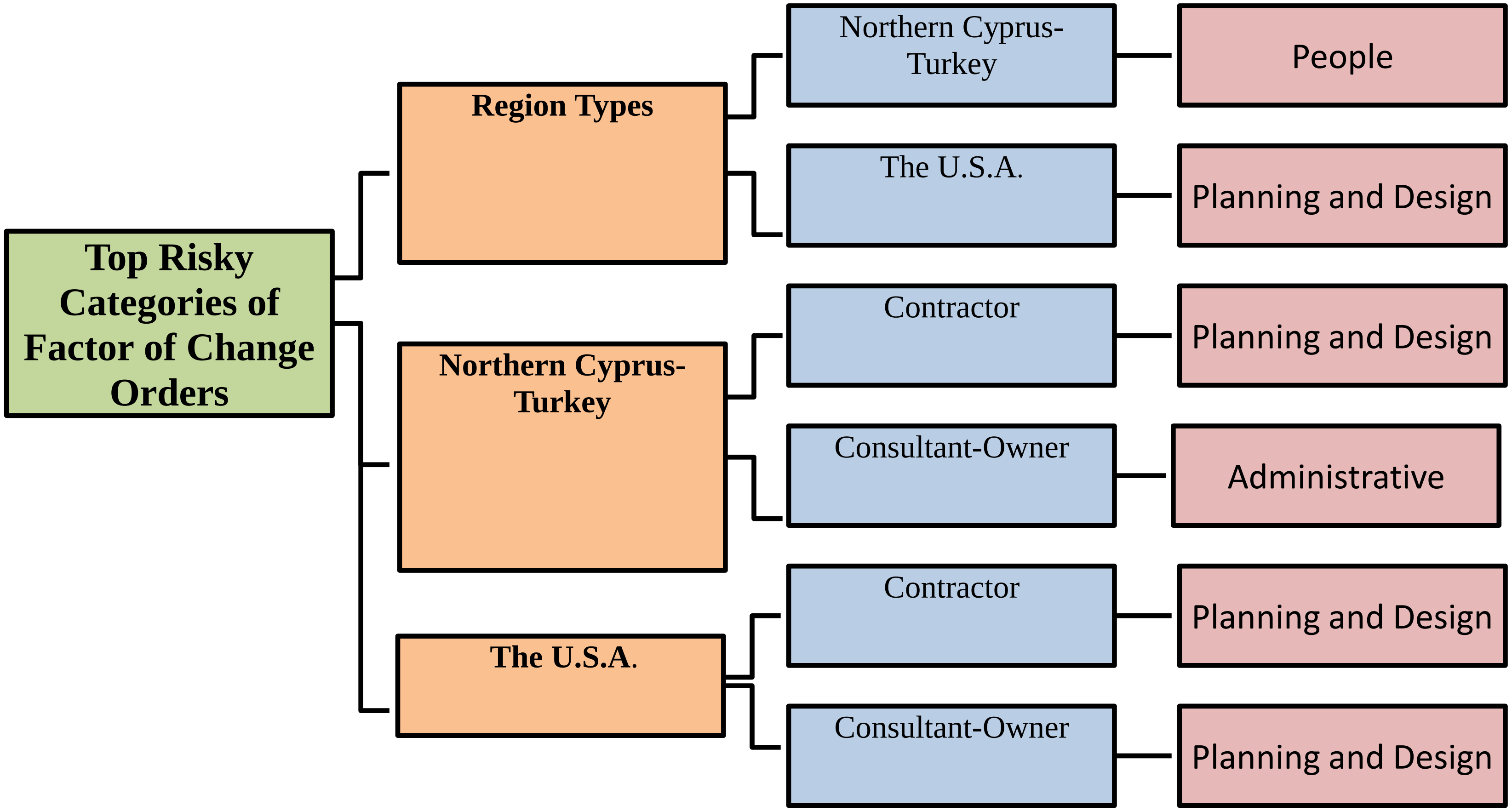

Figure 7.4: Top risky categories of factor of change orders according to the opinions of organizations in different regions

Chapter 8

RESEARCH FINDINGS AND DISCUSSIONS ON THE EVENTS OF SHOP DRAWING PRACTICES

8.1 Introduction

This chapter presents the research findings obtained through the quantitative analysis methods described in Chapter 5 (please see Section 5.7.2 in Chaper 5 for details) and discussions about the findings are presented. In section 5.7.2 of the thesis, the analysis methods conducted to examine the factors affecting shop drawing practices and the severity of project variables on shop drawing practices were explained.As explained in previous of the thesis, the second research phase is based on the examination of the events of shop drawing practices (Research Phase 2: Shop Drawing Events). In this chapter, the research findings and discussions about the shop drawing events (Research Phase: 2) are presented. In this research phase, research findings were presented and discussed according to the of organization types. Withing this context, the following sections presents the research findings and discussions about the factors affecting the shop drawing practices (Research Phase: 2) on the basis of organizational classifications.

8.2 Most Critical Work Items

In the following section, the quantitative research findings concerning risk status of work items in building projects and discussions about the quantitative findings concerning most critical work items are presented, on the basis of organizational classifications.

8.2.1 Risk Index of Work Items

In this section, the results obtained through the quantitative analysis method described in Section 5.7.2.2. (Risk Significance Index of Work Items) are presented. The Risk Importance Index (R.S.I.) of work items concerning the shop drawing practices is presented in Table 8.1 below (See Appendix-C, Appendix-D, and Appendix-E for parameter values).

Table 8.1: Risk index of work items according to the organizations.

	Risk Index of Work Items (R.I.W.)					
Work Items	Contractors	Rank	Consultant -Owner	Rank	Overall	Rank
Excavation and Foundation	0,444	3	0,413	2	0,429	3
Structural Frame	0,508	1	0,399	3	0,453	1
Electrical Works	0,316	5	0,257	5	0,287	5
Waste Water	0,242	6	0,173	7	0,207	6
Domestic Water	0,240	7	0,180	6	0,210	7
Construction works after structural frame	0,475	2	0,430	1	0,453	2
Doors, Windows and other fine works	0,418	4	0,395	4	0,407	4
Average	0,378		0,321		0,349	

8.2.2 Discussions on Key Problematic Work Items of Building Projects, in the Perceptions of the Organizations

Based on the results in the Table 8.1 presented above, the following views were reached:

A) **According to the Responses of Contractors:** Based on the results obtained by the contractors, the top risky work items are those undertaken for the

"Superstructure" construction.

B) **According to the Responses of Consultant-Owner:** According to the consultants and owners, the construction works undertaken in "post superstructure" process were indicated as the top risky work items. However, the risk index obtained in the "Consultant-Owner" assessment for "post superstructure" was relatively low compared to the contractors. This reveals that the shop drawing practices pose a higher risk in construction projects according to the perceptions of contractors.

C) **The Bottom Line:** Rather, the higher risk index average was obtained by contractors, while the average of the risk index was very low in the "Consultants-Owners" evaluation (please See Table 8.1). Based on this finding, it was seen that contractors are more concerned about the risks arising from shop drawing practices. In addition, both the contractors and the consultant-owner drew attention to the fact that the application of the shop drawings in "excavation and foundation" works may pose serious risks to the project. This finding also point out that uncertainty in ground conditions may cause a change in construction methods and thus a change in design.

According to the opinions of organizations, Figure 8.1 below shows the work items that cause the top risky shop drawing practices.

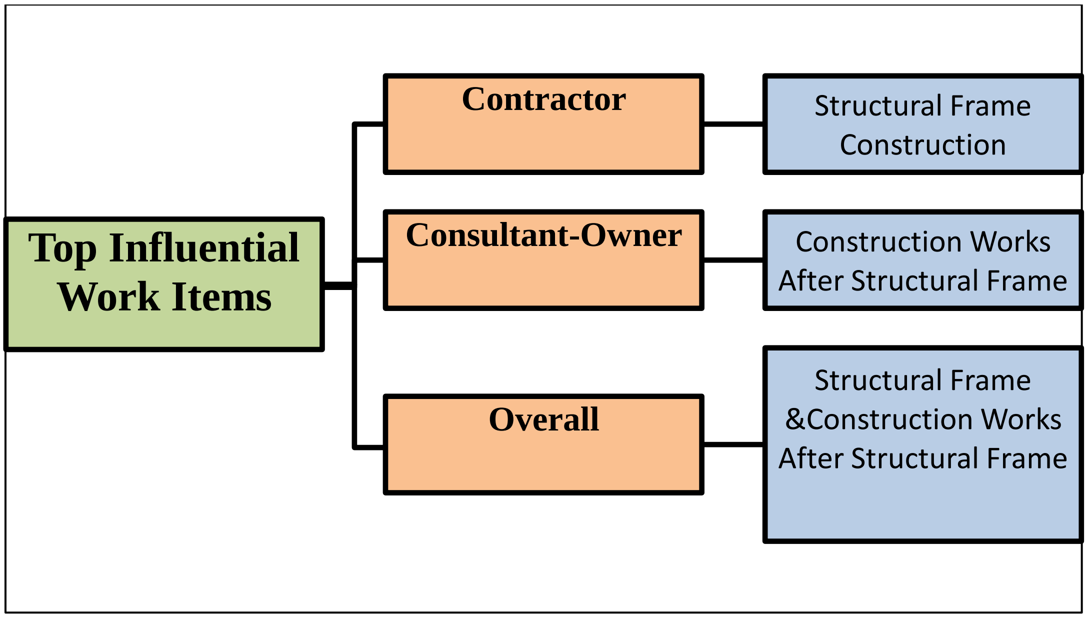

Figure 8.1: Top influential “work items" causing top risk shop drawing practices according to the opinions of organizations.

8.3 Top Risky Project Disciplines in Building Projects

In the following section, the quantitative research findings concerning risk status of project disciplines in building projects and discussions about the quantitative findings concerning most critical project disciplines are presented, on the basis of organizational classifications.

8.3.1 Risk Index of Project Disciplines in Building Projects

This section presents the results obtained through the quantitative analysis method described in Section 5.7.2.3 (Risk Index of Project Disciplines). The Risk Significance Index (R.S.I.) of the Project disciplines related to shop drawing practices by organization types was presented in Table 8.2 below (See Appendix F for parameter values).

Table 8.2: Risk index of project disciplines according to the organization types.

	Risk Index of Project Discipline (R.I.P.D.)					
Project Disciplines	Contractors	Rank	Consultants-Owner	Rank	Overall	Rank
Static Project Works	0,384	1	0,332	2	0,358	1
Architectural Project Works	0,364	2	0,353	1	0,359	2
Mechanical Project Works	0,141	4	0,112	4	0,127	4
Electrical Project Works	0,187	3	0,166	3	0,177	3
Average	0,269		0,241		0,255	

8.3.2 Discussions on Key Problematic Project Disciplines of Building Projects, in the Perceptions of the Organizations

Based on the results in the Table 8.2 presented above, the following views were reached:

A) According to the Responses of Contractors: Based on the results obtained by the contractors, the top risky work items take place in structural projects. Any change in "structural work" may be more costly for projects, as any change in structural work can affect the entire structural system. Also, work items related to structural work are more costly due to the extensive amount of work. It has observed that contractors are more concerned about the change in the "structural system" that may occur because of shop drawing practices.

B) According to the Responses of Consultant-Owner: While according to consultants and owner; maximum risk arises by work items involved in architectural projects. Compared to structural projects, as general in architectural project, finer works are involved.

C) **The Bottom Line:** It has been found that compared to the Mechanical-Electrical Projects (M.E.P.), shop drawing practices for both structural and architectural project works pose the maximum risk in construction projects according to the perceptions of both contractors, and consultant-owners. According to the contractors, the shop drawing practices in the rough construction process constitute higher risk, while the shop drawing practices for the construction work after the rough construction phase constitute maximum risk, according to the consultants-owners. On the other hand, compared to the consultant-owner, the higher risk index average resulted by contractors, (please See Table 8.2). Contractors have observed to be more concerned about shop drawing practices than consultants-owners.

8.4 Most Frequent Causes of Shop Drawings Practices in Building Projects

In the following section, the quantitative research findings concerning frequency of shop drawing practices according to the various factors that may be encountered in the building projects and discussions about the quantitative findings concerning most frequent events affecting shop drawing practices are presented, on the basis of organizational classifications.

8.4.1 Frequency Index of Events Leading to Shop Drawing Practices in Building Projects

This section presents the results obtained by the analysis method described in Section 5.7.2.4 (Frequency Index of Events of Shop Drawings). The Frequency Index (F.I.) of the factors that cause shop drawing practices in building projects, according to organization types, is presented in Table 8.3 below.

Table 8.3: Frequency index of causes of shop drawings according to the organizations.

	Frequency Index of Factors (F.I.F.)					
Causes of Shop Drawings	Contractors	Rank	Consultants-Owner	Rank	Overall	Rank
Errors/ Insufficiencies in Design	0,796	1	0,731	1	0,764	1
Inconsistencies between different design disciplines	0,787	2	0,683	2	0,736	2
Inconsistencies between drawings-specifications	0,713	3	0,587	3	0,651	3
Errors / Insufficiencies in Specifications	0,630	4	0,577	4	0,604	4
Low Constructability Design	0,611	5	0,538	5	0,575	5
Health and Safety Precautions	0,509	8	0,356	11	0,434	10
Insufficient ground investigation	0,519	7	0,356	12	0,439	9
Errors in Construction Methods	0,500	9	0,471	8	0,486	7
Lack of Contractor's experience	0,565	6	0,481	7	0,524	6
Supervisor characteristics	0,481	10	0,385	10	0,434	11
Changes in Technology	0,435	12	0,433	9	0,434	12
Shortage of Materials	0,481	11	0,490	6	0,486	8
Average	0,586		0,507		0,547	

8.4.2 Discussions on Most Frequent Events Leading to Shop Drawing Practices, in the Perceptions of the Organizations

Based on the results in the Table 8.3 presented above, the following views were reached:

A) **According to the Responses of Contractors:** Based on the results obtained by the contractors, most frequent cause of shop drawing practices are due to the "design errors and deficiencies".

B) **According to the Responses of Consultant-Owner:** Likewise, according to the consultant-owner, the most frequent cause of shop drawing practices are due to the "design errors and deficiencies".

C) **The Bottom Line:** All organizations expressed that, "design errors and deficiencies" is the most common reason leading the shop drawing practices in building projects. According to the findings, it has observed that there is a consensus among organizations on issues that may lead to shop drawing practices in construction projects. On the other hand, based on the general aspect of results, since the ranking of the first five factors gives the same results for both organizational characteristics, it has observed that all organizations agree on the factors that lead to shop drawing practices in projects. Apart from that, the highest frequency index resulted in the contractor's evaluation (please See Table 8.3). This revealed that, according to contractors, construction projects are to be more demanding for shop drawings practices.

8.5 Greatest Dispute Potentiality

In the following section, the quantitative research findings concerning the dispute potentiality between the parties due to the shop drawing practices and, discussions about the quantitative findings concerning greatest dispute potentiallity among the project parties are presented, on the basis of organizational classifications.

8.5.1 Dispute Potentiality Index of Events Leading to Shop Drawing Practices in Building Projects

In this section, results obtained with the analysis method described in Section 5.7.2.5. (Dispute Index of Shop Drawings) were presented. The conflict index, referring to the level of conflict tendency between the project parties, by type of organization, was presented in Table 8.4.

Table 8.4: Dispute potentiality index of shop drawing according to the organizations.

	Dispute Index (D.I.)					
Project Parties	**Contractor**	**Rank**	**Consultants-Owner**	**Rank**	**Overall**	**Rank**
Contractor-Supervisor	0,796	1	0,712	1	0,755	1
Contractor-Owner	0,620	3	0,510	3	0,566	3
Contractor-Sub Contractor	0,611	4	0,587	2	0,599	2
Supervisor-Owner	0,463	5	0,385	5	0,425	5
Contractor-Supervisor-Owner	0,704	2	0,442	4	0,575	4
Average	0,639		0,527		0,584	

8.5.2 Discussions on Greatest Dispute Potentiallity between the Parties Due to Shop Drawing Practices, in the Perceptions of the Organizations

Based on the results in the Table 8.4 presented above, the following views were reached:

A) **According to the Responses of Contractors:** According to contractors, the greatest potential for dispute arising from shop drawing practices is between contractors and consultants.

B) **According to the Responses of Consultant-Owner:** Likewise, according to the consultant-owner, the greatest potential for disputes due to shop drawing practices is between the contractor and the consultant.

C) **The Bottom Line:** All organizations stressed that, the greatest potential for dispute due to the shop drawing practices is between contractors and consultants. However, it has observed that, contractors are most concerned about dispute issues, as the highest average index resulted by contractors. Within the context of this result, it was indicated that greatest disputes occurred between the “contractor- consultant” because of the shop drawings practices. Particularly, during the shop drawing processes, the principal role of consultants is to supervise contractors. In other words, consultants' titles become "supervisors" in this process (Levy, 2018) (Koshe & Jha, 2016). Based on the literature knowledge, it is well known that changes and modification may take place in the project due to the shop drawing practices (Manrique et al., 2015). It is also known that any change or addition to the project can increase the cost and duration of the project. As a result, contractors request a claim to cover the cost and time increase caused by the changes. In project organizations, one of the responsibilities of supervisors is to evaluate and approve or reject contractors’ claims. It is also known that the supervisor is the technical representative of the owners. It is frequently experienced that serious problems may arise between contractors and supervisors, especially with regard to resolution of the claims. The finding in this analysis reinforces this idea.

8.6 Most Beneficiary Project Parameter

In the following section, the quantitative research findings concerning the benefit potentiality of shop drawing practices on project success parameters in building projects and, discussions about the quantitative findings concerning most beneficiary project parameter are presented, on the basis of organizational classifications.

8.6.1 Benefit Potentiality Index on Project Success Parameters Due to Shop Drawing Practices, in Building Projects

In this section, the results obtained through the quantitative analysis method described in Section 5.7.2.6 (Benefit Index of Shop Drawings) were presented. The benefit index (B.I.), referring to the level of benefit provided by shop drawing practices on to the project success criterions was presented in Table 8.5. The higher the index the greater of benefit in meeting the success criterion of the project.

Table 8.5: Benefit index of shop drawings on project success criteria according to the organizations

	Benefit Index (B.I.)					
Project Success Parameters	**Contractors**	**Rank**	**Consultant-Owner**	**Rank**	**Overall**	**Rank**
Meeting in Contract Duration	0,787	2	0,663	3	0,726	2
Meeting in Contract Cost	0,667	3	0,673	2	0,670	3
Meeting in Contract Quality	0,824	1	0,721	1	0,774	1
Meeting in Health and Safety	0,630	4	0,558	4	0,594	4
Average	0,727		0,654		0,691	

8.6.2 Discussions on Most Beneficiary Project Parameter Due to Shop Drawing Practices, in the Perceptions of the Organizations

Based on the results in the Table 8.5 presented above, the following views were reached:

A) **According to the Responses of Contractors:** Based on the results obtained by the contractors, shop drawings provide the most benefit in meeting quality limits.

B) **According to the Responses of Consultant-Owner:** Likewise, according to the consultant-owner, the most beneficiary project parameter is the project quality.

C) **The Bottom Line:** According to both organizational classifications, shop drawings provide the most benefit in meeting quality limits. On the other hand, for this parameter, the highest risk index resulted in contractors' evaluation. Apart from that, compared to consultant-owner, the highest index average resulted in contractors' evaluation. This revealed that, according to the contractors, shop drawing practices are much more beneficial in meeting the success limits in construction projects. It is also known in the literature that shop drawing practices can increase the quality of construction works, as it contains more detailed drawings and information for construction works (Jiang & Leicht, 2015). In addition, as the shop drawings are prepared during the construction execution process, it is highly integrated with market and site conditions. According to the findings, it was understood that the organizations agree the shop drawing practices increase the quality of construction works.

8.7 Most Risky Project Administrative Model in Building Projects

In the following section, the quantitative research findings concerning the risk potentiality of the project administrative model because of the impact of shop drawing practices in building projects and, discussions about the quantitative findings concerning the most risky project administrative model are presented, on the basis of organizational classifications.

8.7.1 Risk Index Level of Project Administrative Model in Building Projects

In this section, the results obtained through the quantitative analysis method explained in Section 5.7.2.7 (Risk Index of Project Administrative Model) were presented. The risk index referring the risk status of shop drawing practices according to different project administrative models was presented in Table 8.6 (See Appendix-G, Appendix-H, Appendix-I and, Appendix-J for parameter values). According to the different contract types, figure 8.3, 8.4 and, 8.5 shows the risk index of shop drawing practices based on "Design-Bid-Build (Traditional Contracting)", "Design-Build" and "Partnering" procurement models, respectively. The higher the index, the greater the risk of project administrative features due to shop drawing practices.

Table 8.6: Risk index of project administrative models according to the organizations.

	Procurement Model								
	Design-Bid-Build (Traditional Contracting)			Design-Build			Partnering		
Contract	**Contractor**	**Consultant -Owner**	**Overall**	**Contractor**	**Consultant -Owner**	**Overall**	**Contractor**	**Consultant -Owner**	**Overall**
Lump Sum	0,078	0,080	0,080	0,084	0,084	0,084	0,067	0,064	0,066
Unit Price	0,101	0,099	0,101	0,108	0,104	0,107	0,087	0,079	0,083
Cost+ Fixed Fee	0,116	0,082	0,099	0,124	0,087	0,105	0,100	0,065	0,082
Cost+ Percentage of Cost	0,087	0,072	0,080	0,094	0,076	0,085	0,075	0,057	0,066
Average	**0,095**	**0,083**	**0,090**	**0,102**	**0,088**	**0,095**	**0,082**	**0,066**	**0,074**

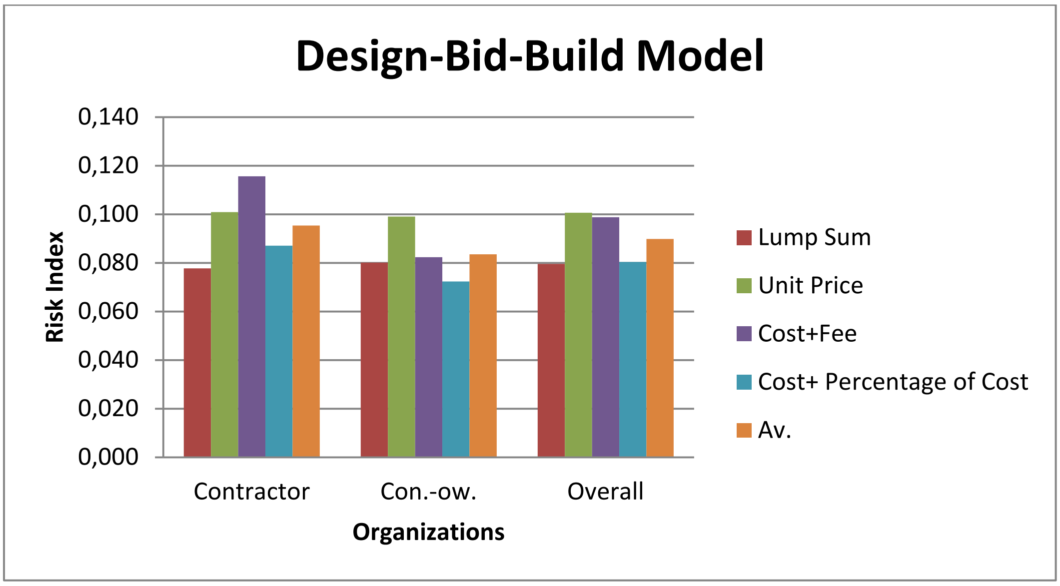

Figure 8.2: Risk index of project administrative model under "design-bid-build" procurement model

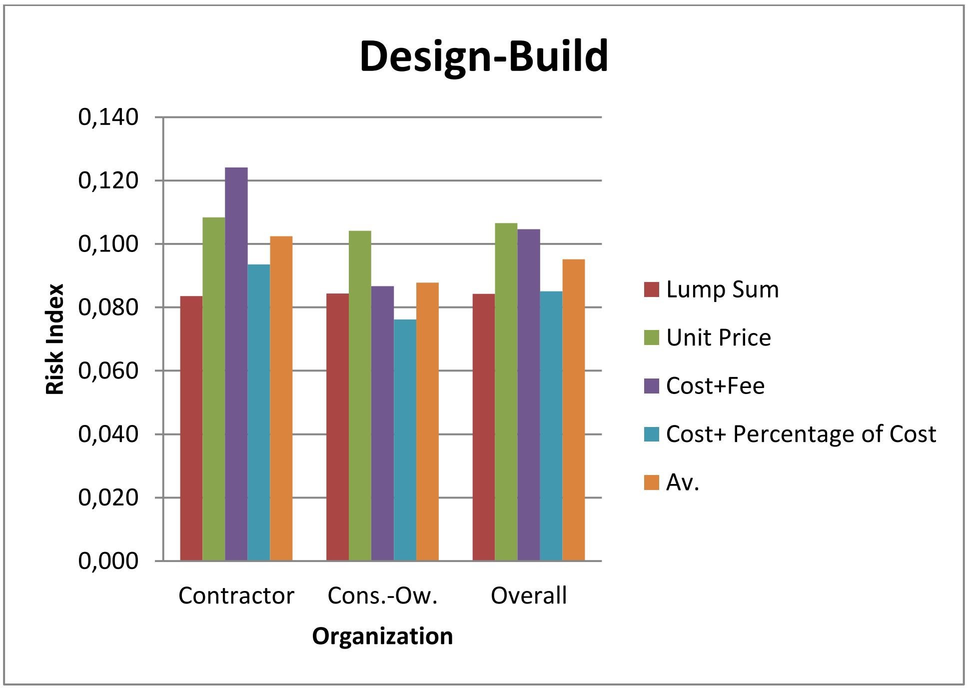

Figure 8.3: Risk index of project administrative model under the "design-build" procurement model

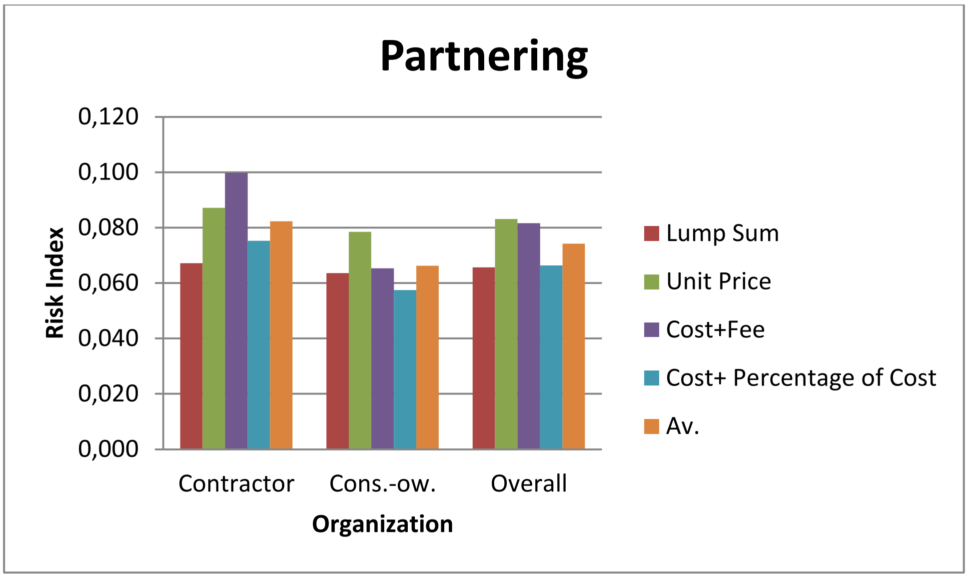

Figure 8.4: Risk index of project administrative model under “partnering” procurement model

8.7.2 Discussions on Most Risky Project Administrative Model in Building Projects, in the Perceptions of the Organizations

Based on the results in the Table 8.6 presented above, the following views were reached:

A) **According to the Responses of Contractors:** Based on the results obtained by the contractors, regardless of the procurement model, the “Cost + Fixed Fee” contract types constitute the greatest risk in the construction projects in terms of shop drawing practices. On the other hand, contractors expressed that, choosing "partnering" as the procurement model would create less risk than other procurement models.

B) **According to the Responses of Consultant-Owner:** Based on the results obtained by the consultant-owner, Consultants and owners emphasized that the “Unit Price” contract poses the greatest risk in all procurement models. Likewise, consultant-owner stated that, choosing "partnering" as the procurement model would create less risk than other procurement models.

C) The Bottom Line: In the "Cost + Fixed Fee" contract model, contractors were observed to be worried, as cost increases are not paid more than a certain amount. It was observed that the "consultant-owner" is more concerned about the "unit price" contract model. In "unit price" contracted construction projects, contractors may claim high amounts of payments because of changes. Contractors may request higher amounts of payments than contract prices for newly created works and / or additional work items to increase profits. In this sense, the determination of "unit price" as the most risky contract model by the "consultant-owner" can interpreted in this way. These findings are consistent with the organization's interests in meeting cost increases that can lead from the shop drawing practices.

Both types of organization indicated that choosing the "partnering" as the procurement model would constitute less risk than other procurement models (design-bid build or design build) in terms of shop drawing practices.

According to all procurement models, the highest average risk index was achieved by contractors (please see in Table 8.6). In other words, according to the contractors, shop drawings pose more risks for the projects depending on the administrative structure of the project.

According to the types of organizations, Figure 8.5 below shows the most risky project administrative model in terms of shop drawing practices.

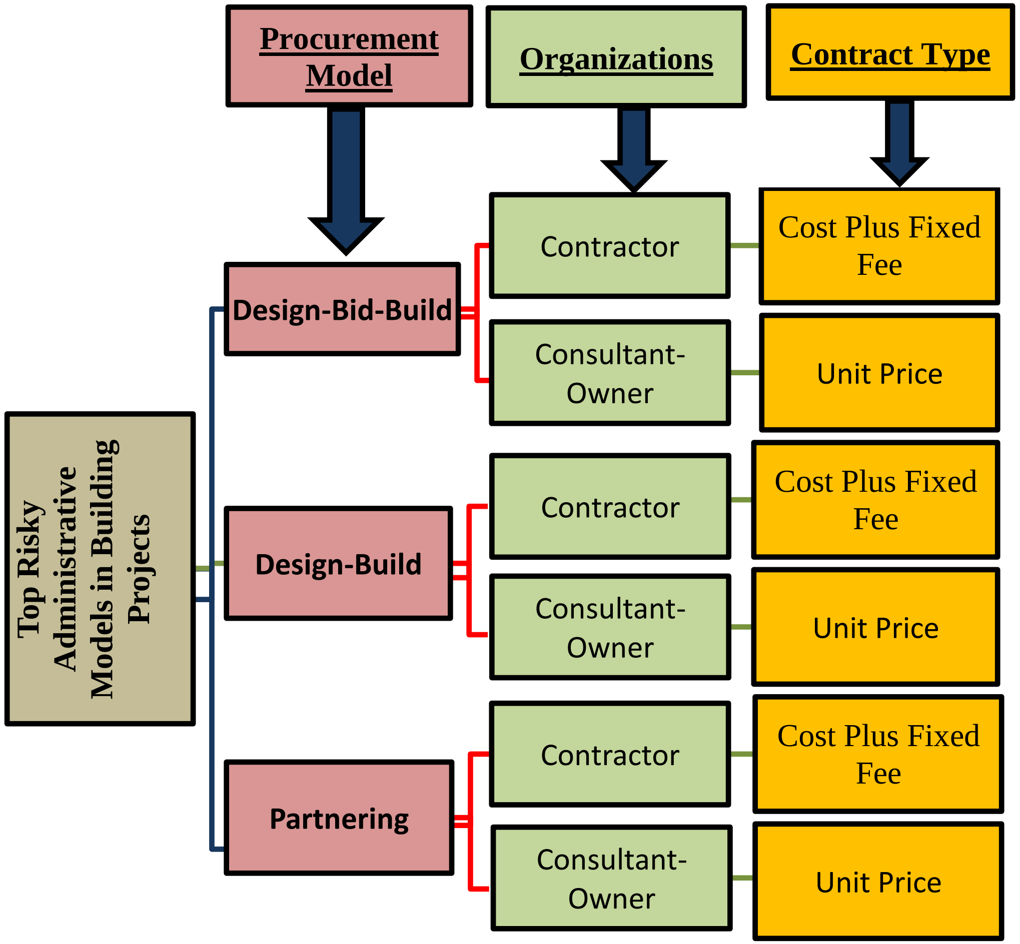

Figure 8.5: Top risky project administrative models according to the opinions of the organization

Chapter 9

RESEARCH FINDINGS AND DISCUSSIONS ON EVENTS OF CONTRACTORS' CLAIMS AND, CLAIM CONTROL MEASURES IN CONSTRUCTION PROJECTS

9.1 Introduction

This chapter presents the research findings obtained through the quantitative analysis methods described in Chapter 5 (please see Section 5.7.3 in Chaper 5 for details) and discussions about the findings are presented. In section 5.7.3 of the thesis, the quantitative analysis methods used to examine the events affecting the claims and the quantitative analysis methods to examine the effectiveness claim control measures (mitigation) were explained. In this chapter, the research findings and discussions about the events leading claims and control measures in preventing claims (Research Phase: 3) are presented. As explained in previous of the thesis, the third research phase is based on the examination of the events leading to claims (Research Phase 3 (A): Claim Events) and control measures in preventing claims (Research Phase 3 (B): Claim Control Measures). In this research, there are two sub-research stages in the third research phase. The first sub-research stage is based on events of contractors claims (Previously Indicated as Phase: 3 (A)). The second sub-research stage is based on control measures (Previously Indicated as Phase: 3 (B)). Within this context, in this chapter, the results and discussions were presented as in three main sections. In the first section, discussions were presented based on the results of factors influencing contractor claims. In the second section, the discussions were presented regarding the findings on control measures. In the third section, the discussions were presented based on the findings of integrated evaluation of claim events and control measures. The following section presents the discussions based on the results of key events of contractors' claims.

In this research phase, research findings were presented and discussed according to the of organization types. Withing this context, the following sections presents the research findings and discussions about the events affecting contractors' claims and control measures in preventing claim incidensts (Research Phase: 3), on the basis of organizational classifications.

In this chapter, discussions are stated based on the most critical findings concerning "events of contractors' claims" and "control measures". Within the context of the following section, it is intended to draw attention to the key events leading to most risky events of contractors' claims and top beneficial control measures in preventing claims in Turkish construction industry.

The following sections present research findings and discussions based on the analysis of events affecting contractors' claims on construction projects (First Part).

9.2 Key Problematic Events of Contractors' Claims

In the following section, the quantitative research findings concerning events leading to contractors' claims and, discussions about the quantitative findings concerning most problematic claim evemts are presented, on the basis of organizational classifications.

9.2.1 Risk Index of Events of Contractors' Claims

This section presents the results obtained by the analysis method described in Section 5.7.3.6 (Risk Significance Index of Events of Contractors' Claims). The values of the parameters in the Risk Importance index calculations are given in section Appendix (please See Appendix-K).The Risk Significance Index (R.S.I.) of the factors affecting contractors' claims, by organization types were presented in Table 9.1 below.

Table 9.1: Risk significance index (R.S.I.) of factors of contractors claim according to the organizations

	Factors Affecting Claims	Contractor	Consultants - Owners	Overall
Design-Technical	Inadequacies in Contract Drawings	0.58	0.44	0.54
	Low Constructability Design	0.37	0.27	0.33
	Inadequacies in Specification	0.51	0.26	0.43
	Inconsistencies between different designs	0.54	0.28	0.46
	Changes in Scope	0.47	0.35	0.4
Contract /Administrative	Inadequacies in Contract	0.46	0.36	0.43
	Inadequate knowledge of client	0.51	0.29	0.43
	Inadequate Experience of Consultants	0.53	0.31	0.46
	Low contract price	0.36	0.37	0.36
	Inadequate time in tendering	0.39	0.39	0.39
	Inadequacies in Organizations	0.37	0.40	0.38
	Lack of Communication between parties	0.37	0.21	0.33
Construction	Changes in Construction Method	0.34	0.28	0.32
	Errors of subcontractors	0.36	0.41	0.38
	Inclusion of Shop Drawings	0.49	0.38	0.45
	Inadequate Experience of contractor	0.38	0.36	0.37
External	Inflation in Resources Cost	0.38	0.38	0.38
	Natural Disasters	0.36	0.20	0.32
	Subsurface Problems	0.44	0.30	0.41
	Shortages of Materials	0.43	0.38	0.41
	Changes in Law and Standards	0.33	0.20	0.3
Average Score		**0.43**	**0.32**	**0,39**

9.2.2 Discussions on Key Problematic Events of Claims

Based on the results in the Table 9.1 presented above, the following views were reached:

A) **According to the Responses of Contractors:** Based on the results obtained by the contractors, it was stated by the “contractors” that, the most risky factors of affecting claims were "Inadequacies in Contract Drawings". In addition, contractors emphasized that “inconsistencies between different designs” and “Inadequate Experience of Consultants” is other major risks in construction projects.

B) **According to the Responses of Consultant-Owner:** Likewise, according to the consultants-owners, the most critical events affecting claims is "Inadequacies in Contract Drawings". However, compared to the “contractors”, in the “Consultant-Owner” assessment, the risk index score was relatively low. According to this result, this event poses less risk in the perception of "consultant-owners". On the other hand, “consultants-owners” stressed that “subcontractor' mistakes” and “faulty organizations” are the other most risky claim factors in construction projects.

C) **The Bottom Line:** Contractors referred that, factor for which consultants and owners have more responsibility lead to more claims. However, according to consultant-owner, factors related to contractors' liabilities were cited as the principal reasons for the claims. Contractors often drew attention to the obligations of consultants and owners, while consultant-owners drew attention to factors associated with the contractor's responsibilities.

On the other hand, the highest risk score average was obtained by the contractors (please See Table 9.1). According to the opinions of the contractors, it was emphasized that construction projects have become more prone to claims. In other words, according to the contractors, claims because of defects experienced in construction projects in Turkey often emerge. It has observed that contractors are more concerned about the claims on construction projects.

Figure 9.1 shows the top three risky events of claim based on the types of organizations.

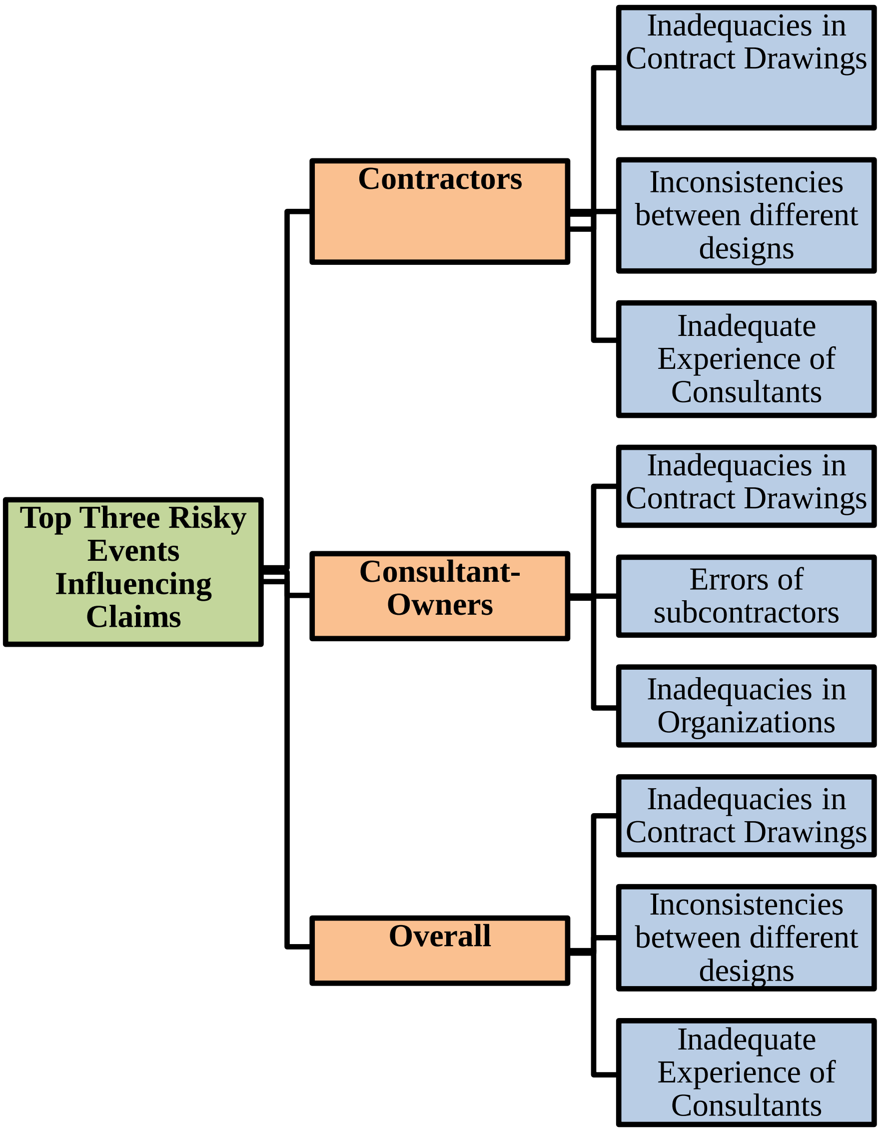

Figure 9.1: Top three risky events of claims according to the organization types.

As explaine in Section 5.7.3.2 (please see Chapter 5 for details), "events of claims" are categorized by type to achieve more focused results. The following section presents the research findings and discussions regarding the key problematic categories of claim events, by organizational types.

9.3 Key Problematic Categories of Claim Events, in the Organizational Perceptions

In the following section, the quantitative research findings regarding the categories of events leading to contractors' claims and, discussions about the quantitative findings concerning most problematic categories of claim evemts are presented, on the basis of organizational classifications.

9.3.1 Risk Index of Categories of Claim Events

This section presents the results obtained through the quantitative analysis method described in Section 5.7.3.7 (Risk Significance Index of Claim Event Categories). The Risk Significance Index (AV. R.S.I.) of the categories of claim events, by organization types is presented in Table 9.2 below.

Table 9.2: Risk significance index (R.S.I.) of categories of claim factors according to the organization types.

Categories of Claim Factors	**Contractors**	**Rank**	**Consultants -Owners**	**Rank**	**Overall**	**Rank**
Design-Technical	0,49	1	0,32	3	0,43	1
Contractual-Managerial	0,43	2	0,33	2	0,40	2
Construction	0,395	3	0,36	1	0,38	3
External	0,39	4	0,29	4	0,36	4
Average	**0,43**		**0,33**		**0,39**	

9.3.2 Discussions on Key Problematic Categories of Events of Claims

Based on the results in the Table 9.2 presented above, the following views were reached:

A) **According to the Responses of Contractors:** According to the contractors, the most risky claim event category was expressed as "Design-Technical". Contractors have referred that most risky claims are originated from design and technical issues. On the other hand, "Contractual-Managerial" has been described by contractors as the other most risky category. Factors in this category are principally associated to the procurement process and consultant-owner experiences. Within this context, contractors meant that most claim incidents were caused by the consultants and owners' defects hence, these parties were predominantly responsible for claim-related issues in construction projects.

B) **According to the Responses of Consultant-Owner:** However, the “Construction category”, which is mostly related to the execution process, resulted in the most risky damage factors category according to consultants and owners. On the other hand, although “contractual-managerial” category is resulted as second, compared to the “contractors”, the risk index score of this category was relatively low. Within the context of this result, contractual related events poses less risk in the perception of "consultant-owners".

C) **The Bottom Line:** Contractors are most concerned about the design and planning-based issues encountered in construction projects. In general, the design process and preparation of other technical components of the project are undertaken by the owners and consultants. The performance of consultants and owners has an important role in the pre-construction process as factors related to the design process are more associated to the owner and the consultant's obligations. It was stated that consultants and owners are more responsible for claims than contractors due to the design and technical issues. Since the contractors express themselves as victims, they have tried to express that they may claim additional budget and time because of the claims arising from technical and design problems.

However, in the "consultant-owner" perception, the most serious problems arise from events associated with "construction execution activities". Principally, success of the project is subject to the performance of the contractors during construction process. In the construction process, the performance of contractors become essential for the success of the project as the factors related to "Construction" are more concerned with the obligations of the contractors. Within this context, “consultant-owner” are in struggle to point out that contractors are more responsible for claims due to the “construction execution” based events.

In the perceptions of both organizations, these findings revealed that the most risky claims are due to the flaws of other organizations. In this context, according to the opinions of the contractor and the consultant-owner, it is meant that the counterparty is responsible for claims based on claims.

Based on overall respondents, "Design-Technical” and “Contractual-Managerial” were ranked as the top two top risky categories while, “External Factors” became the least risky category. The highest average of the risk index score resulted in contractors’ assessment (please See in Table 9.2). Within this context, contractors have observed to be the most concerned party regarding claims. Claims can provide additional returns and sometimes cause costs for contractors. The contractors can benefit by claims when claim cost could meet by the project owner (Shrestha & Shrestha, 2017) (Song et al., 2015).

Figure 9.2 shows the top two risky categories of claim factors according to the opinions of organizations.

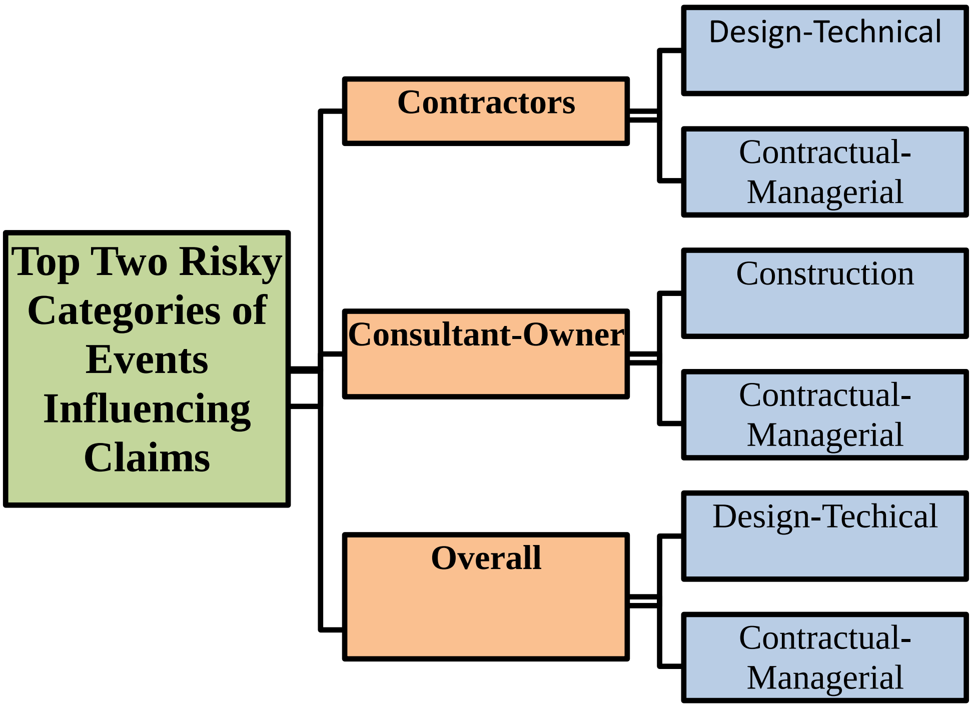

Figure 9.2: Top "two" risky categories of claim events according to the types of the organization.

The following sections present research findings and discussions based on the analysis of control measures in preventing contractors' claims on construction projects (Second Part). The following section presents the research findings and discussions on Phase: 3 (B) which related to benefit status of control measures.

9.4 Key Control (Mitigation) Measures in Preventing Contractors' Claims

In the following section, the quantitative research findings regarding the claim control measures and, discussions about the key effective claim control measures are presented, on the basis of organizational classifications.

9.4.1 Benefit Index of Claim Control Measures (Preventive Measure)

This section presents the results obtained through the quantitative analysis method described in Section 5.7.3.8 (Benefit Index of Claim Control Measures). The values of the parameters in the Benefit index calculations are given in section Appendix (please see Appendix-L). The Benefit Index (B.I.) of the claim control measures, by organization types is presented in Table 9.3 below.

Table 9.3: Benefit index (B.I.) for claim prevention factors by organization types

	No	Control (Preventive) Measure Factors	Contractor	Consultant - Owner	Overall
Technical	1	Standard form of Drawings	0.55	0.32	0.42
	2	Detailed Drawing/Specification	0.63	0.50	0.59
	3	Advanced Design Software (BIM)	0.42	0.37	0.41
	4	Front-End Planning (Feasibility)	0.51	0.40	0.48
	5	Qualified Architect-Engineer	0.59	0.55	0.58
	6	Easy Constructability Design	0.59	0.45	0.53
Managerial	7	Effective Communication	0.49	0.35	0.45
	8	Sharing Historical Data	0.50	0.31	0.45
	9	Qualified Project Manager	0.55	0.42	0.51
	10	Detailed Contract	0.57	0.50	0.55
	11	Staff training	0.50	0.47	0.49
	12	Contractors well-bidding organization	0.51	0.57	0.52
	13	Risk-sharing philosophy	0.56	0.33	0.49
	14	Awarding Right Contractor	0.50	0.54	0.51
construction	15	Effective Site Management	0.52	0.57	0.53
	16	Pre investigation of the site	0.49	0.53	0.50
	17	Effective Quality Control	0.46	0.51	0.49
Average Score			**0,52**	**0,45**	**0,50**

9.4.2 Discussions on Most Effective (Beneficial) Claim Control Measures

Based on the results in the Table 9.3 presented above, the following views were reached:

A) According to the Responses of Contractors: Based on the results obtained by the contractors, Contractors emphasized that the most effective methods that can reduce the claim risks in construction projects are "detailed design and specifications", "qualified architect / engineer" and "easy to build design".

B) According to the Responses of Consultant-Owner: Based on the results obtained by the consultant-owner, The “effective site management”, “Contractors well-bidding organization” “qualified architect/engineer” and “awarding of the right contractor” process were determined as the most effective preventive measures according to consultants and owners.

C) The Bottom Line: According to contractors, claims can be controlled most effectively by preventive methods applied to problems related to the improvement of design process and design documentation. However, according to consultants and owners, it was stated that by improving the construction process work, as well as well the good organization of the contractors, especially during the tender process, the claims can be strongly controlled. At this point, the responsibilities of contractors have been highlighted in the perceptions of consultants.

On the other hand, the highest average of the benefit index scores was observed in contactor’s evaluation (See in Table 9.3). This result revealed that, compared to the consultant-owners, there is a greater need for preventive measures in the contractors’ perceptions.

Figure 9.4 shows the top three key control measures according to the organizational types.

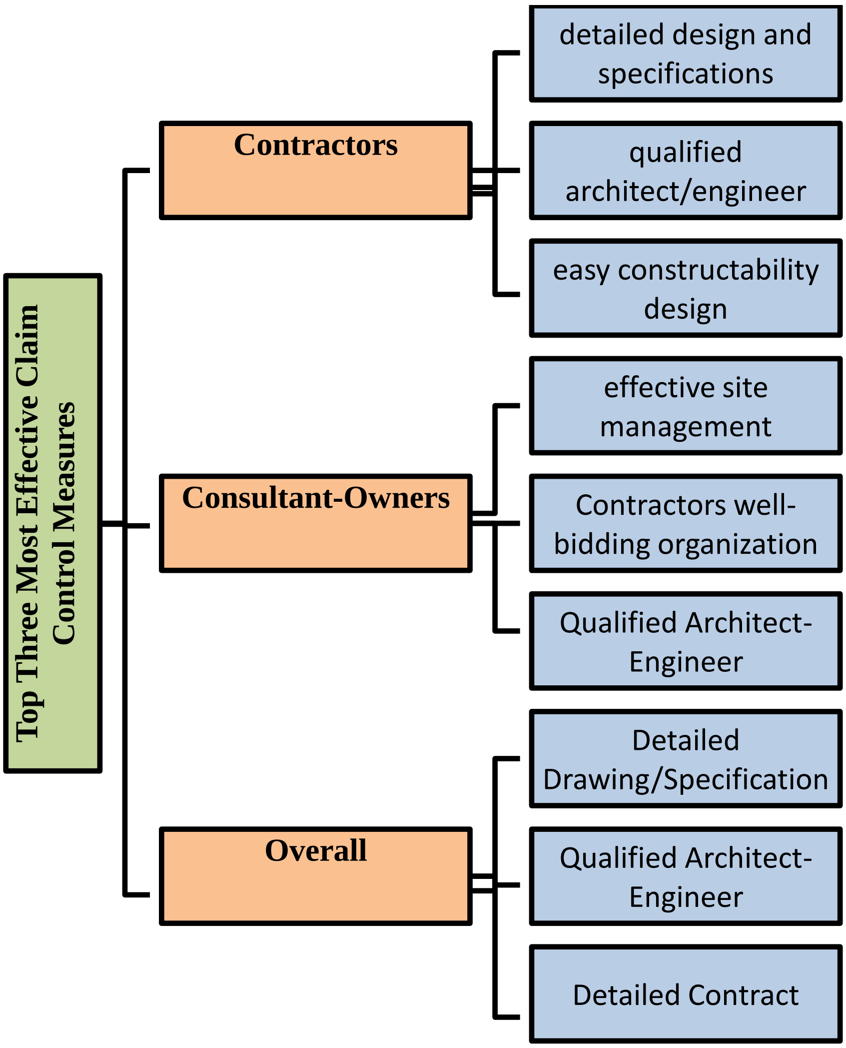

Figure 9.4: Top “three” beneficial claim control measures according to the opinions of organizations.

As explaine in Section 5.7.3.4 (please see Chapter 5 for details), "control measures" are categorized by type to achieve more focused results. The following section presents the research findings and discussions regarding the key beneficial categories of control measures, by organizational types.

9.5 Key Effective Control (Mitigation) Measure Categories, in Preventing Contractors' Claims

In the following section, the quantitative research findings regarding the categories of claim control measures and, discussions about the key effective claim control measures categories are presented, on the basis of organizational classifications.

9.5.1 Benefit Index of Claim Control (Mitigation) Measures Categories

This section presents the results obtained through the quantitative analysis method described in Section 5.7.3.9 (Benefit Index of Categories of Claim Control Measures). The Benefit Index (AV.B.I.) of the claim control measures, by organization types is presented in Table 9.4 below.

Table 9.4: Benefit index (AV. B.I.) of categories of claim control measures according to the organizations.

Control Measure Caregories	**Contractors**	**Rank**	**Consultants-Owners**	**Rank**	**Overall**	**Rank**
Technical	0,55	1	0,43	3	0,505	2
Contractual-Managerial	0,52	2	0,44	2	0,50	3
Construction	0,49	3	0,54	1	0,51	1
Average	**0,52**		**0,47**		**0,50**	

9.5.2 Discussions on Most Effective (Beneficial) Categories of Claim Control Measures

Based on the results in the Table 9.4 presented above, the following views were reached:

A) **According to the Responses of Contractors:** Based on the results obtained by the contractors, "Technical" measures have been identified as the most beneficial mitigation category, according to contractors. “Technical” based mitigation measures represent the development of work in the design phase and pre-construction process. This finding suggests that the most beneficial mitigation measures, according to contractors, are related to the improvement of technical documentation. In this context, according to the opinions of the contractor, the processes and works undertaken by the project owners and consultants should be improved. It was stated that the mitigation measures aimed at improving technical associated activities are the most useful category of the mitigation measures.

B) **According to the Responses of Consultant-Owner:** However, the “Construction” category expressed as the top beneficial category of mitigation measures according to consultants and owners (See in Table 9.4). In this context, the consultants and owners stressed that the most beneficial mitigation measures are relative to the improvement of the works carried out in the execution process. Consultants and owners have stated that the processes and work undertaken by contractors need to be improved, as activities in the execution process are carried out by contractors. It was concluded that actions aimed at "Improving Construction Implementation Activities" are the most beneficial mitigation measures that can minimize the claims on the construction project. It has observed that organizations strive to emphasize that the work undertaken by the other party in construction projects should be improved.

C) **The Bottom Line:** In the perception of contractors, the category representing control measures aimed at improving the technical, design, planning activities is the most effective in controlling claims in construction projects. However, in the consultant-owners perceptions, actions aimed at the improving the construction execution based activities concerning basically the contractors’ organizations and capabilities, is the most beneficial mitigation measures that can minimize the claims on the construction project.

On the other hand, the “Contractual-Managerial” category emerged as the second beneficial mitigation category for all organizations, hence it was pointed out that administrative issues had to be improved to reduce claims. However, this disclosure is emphasized by contractors more strongly than consultants and clients, as the highest benefit index results by the contractors.

Besides, the highest benefit index average was obtained in the evaluation of contractors (please See Table 9.4). Contractors expressed the need to implement mitigation measures in the strongest terms. It was observed that contractors are the most stressed for the need to implement mitigation measures. Problems encountered during the execution process are linked to the scope and quality of the works done before execution. For this reason, the contractors stated that most of the problems to be experienced in the construction project are caused by the defects in the design and tender process. In this context, contractors emphasized that measures are highly needed in the design and tender process.

Figure 9.5 shows the top two effective categories of claim mitigation measures, by types of organizations.

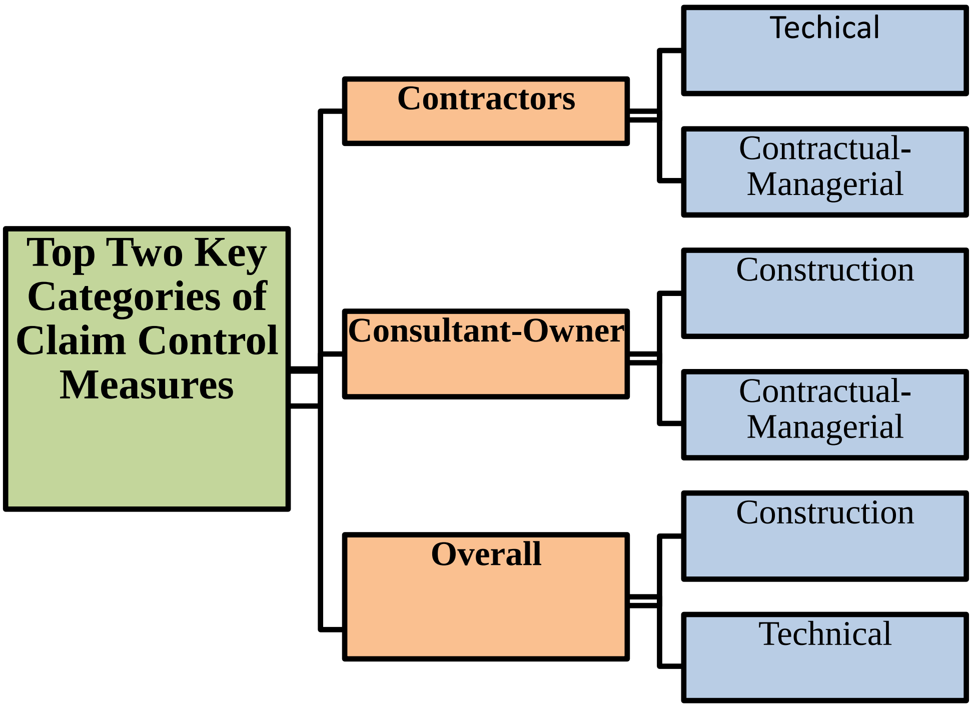

Figure 9.5: Top "two" beneficial categories of claim mitigation measures according to the organization's opinions.

As stated in the beginning of the chapter (please see Section 9.1 in this chapter), as the third part of research Phase: 3, the research findings and discussions were presented based on the findings obtained through the integrated analysis of claim events (Research Phase: 3-A) and control measures (Research Phase: 3- B). The following section presents the research findings and discussions based integrated analysis of claim events and control measures, in perceptions of organizations.

9.6 Key Control (Mitigation) Measures in Respect of Claim Event

In the following section, the quantitative research findings regarding the mutual (integrated) analysis of claim events and control measures and, discussions about the key effective claim control measures in respect of claim events are presented, on the basis of organizational classifications.

9.6.1 Crosswise Assessment of Claim Events and Claim Control (Mitigation) Measures

This section presents the results obtained through the quantitative analysis method described in Section 5.7.3.10 (Crosswise Comparison of Claim and Measure Factors). In respect of type of claim event, the most preferred claim control measures selected with the highest number were presented in Table 9.5 below.

Table 9.5: Top selected control (mitigation) measures (factor no) towards claim factors

	Factor No of Claim Control (Mitigation) Measure (See Table 9.3)		
Factors Affecting Claims	Contractor	Consultants - Owners	Overall
Inadequacies in Contract Drawings	1	2	1
Low Constructability Design	6	2	1
Inadequacies in Specification	2	2	2
Inconsistencies between different designs	1	5	3
Changes in Scope	7	4	2
Inadequacies in Contract	10	10	10
Inadequate knowledge of client	5	7	7
Inadequate Experience of Consultants	5	11	5
Low contract price	13	12, 14	12
Inadequate time in tendering	2	12	15
Inadequacies in Organizations	9	7	7
Lack of communication between parties	7	7	7
Changes in Construction Method	6	16	6
Errors of subcontractors	15	17	15
Inclusion of Shop Drawings	2	5	2
Inadequate Experience of contractor	5	14	14
Inflation in Resources Cost	13	12	13
Natural Disasters	13	10	13
Subsurface Problems	16	16	16
Shortages of Materials	6	12	6
Changes in Law and Standards	13	10	13
Top Selected Mitigation Measure Factors (Factor Numbers)	**13,5,2**	**12,2,10,**	**7,2,13**

As explained in section 5.7.3.10 (please see Chapter 5 for details), cross-evaluation method applied to select the most appropriate mitigation measures for claim factors. The most chosen preventive factor was deemed the most appropriate measure to control factors affecting the claim. According to the opinions of the organizations, the most preferred claim control measures for the factors affecting the claims are explained below.

9.6.2 Discussions on Most Preferred Control Measures in Spite of Claim Event

Based on the results in the Table 9.5 presented above, the following views were reached:

A) **According to the Responses of Contractors:** According to the contractors, the Risk-sharing method is the most preferred method to control claims. Following this, “qualified engineers / architects” and “detailed drawing and specification preparation” have become the most chosen measures by contractors.

B) **According to the Responses of Consultant-Owner:** Instead, by the consultant-owner, “Contractor well bidding organization” followed by “detailed drawing and specification preparation” and “clear contract” have become the most preferred preventive measures.

C) **The Bottom Line:** In the perception of contractors, the main principle of "partnering", which is a win-win philosophy, has been the most preferred measure to be applied in projects related to demand problems. On the other hand, in the perception of consultants, the most appropriate measure in respect of claim issues was associated with the initiatives and planning of the contractors during the tender process. In this regard, it has been observed that consultants-owners perceive the tender organizations of the contractors as the main cause of the claim based problems to be experienced in the future of the project.

Figure 9.6 illustrate the three most preferred claim preventive measures for claim events, by types of organizations.

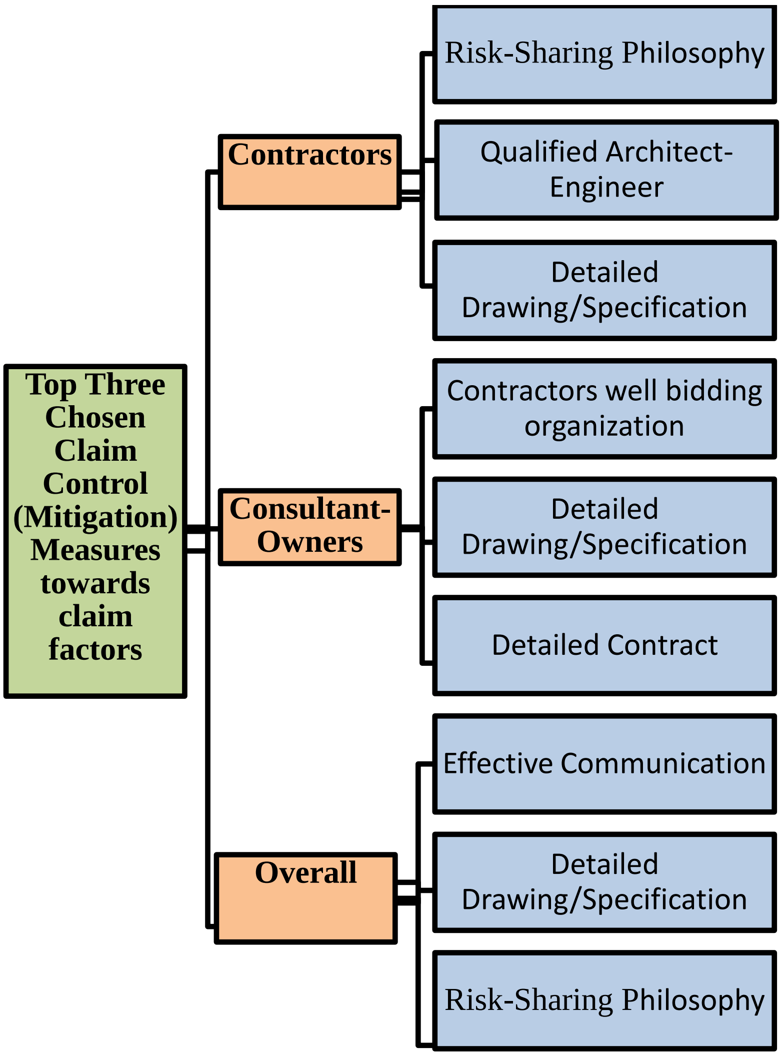

Figure 9.6: Top "three" chosen control (mitigation) measures towards claim factors according to the organizations.

The following section presents the success rate in the project based on the the risk index of claim events (results in section 9.2.1.) and the benefit index of claim control measures (results in 9.4.1.) and, crosswise assessment (results in section 9.6.1).

9.7 The Least Risky Claim Events in Terms of Project Success

In the following section, the quantitative research findings based on the relationship between the riskiness of claim events, effectiveness of control measure and, discussions about the least risky claim events in terms of project success are presented, on the basis of organizational classifications.

9.7.1 Project Success Rate (P.S.S.) in Spite of Encountering of Claim Event

This section presents the results obtained through the quantitative analysis method described in Section 5.7.3.11 (Project Success Rate). The ratio referring to the rate of success in the project, based on factors influencing the contractors' claims, was presented in Table 9.6 below.

Table 9.6: Project success score (P.S.S.) relative to claim factors according to the organizations

	Factors Affecting Claims	**Contractor**	**Consultants - Owners**	**Overall**
Design-Technical	Inadequacies in Contract Drawings	1,18	1,17	1,12
	Low Constructability Design	1,66	2,71	2,00
	Inadequacies in Specification	1,12	1,89	1,19
	Inconsistencies between different designs	1,03	1,90	1,18
	Changes in Scope	1,17	1,50	1,42
Contractual-Managerial	Inadequacies in Contract	1,27	1,30	1,10
	Inadequate knowledge of client	1,23	1,56	1,33
	Inadequate Experience of Consultants	1,24	1,74	1,21
	Low contract price	1,57	1,55	1,36
	Inadequate time in tendering	1,71	1,37	1,55
	Inadequacies in Organizations	1,60	1,00	1,40
	Lack of Communication between parties	1,70	1,98	1,63
Construction	Changes in Construction Method	1,82	1,46	1,76
	Errors of subcontractors	1,96	1,19	1,67
	Inclusion of Shop Drawings	1,26	1,69	1,22
	Inadequate Experience of contractor	1,60	1,56	1,51
External	Inflation in Resources Cost	1,57	1,27	1,44
	Natural Disasters	1,68	1,26	1,63
	Subsurface Problems	1,36	1,50	1,34
	Shortages of Materials	1,61	1,59	1,44
	Changes in Law and Standards	1,32	1,26	1,3
Average Score		**1,46**	**1,59**	**1,42**

9.7.2 Discussions on the Least Risky Claim Events in Terms of Project Success

Based on the results in the Table 9.6 presented above, the following views were reached:

A) **According to the Responses of Contractors:** According to the contractors, it was emphasized that the project can be completed in the most successful way with the measures to be implemented by the contractors to prevent the faults of the subcontractors. In this respect, it was stated that construction projects can be managed in the most successful way with the measures taken in case of claims related to the construction process. In other words, it was stated that construction projects suffer less because of contractor-driven claims in construction projects.

B) **According to the Responses of Consultant-Owner:** However, according to consultants and owners, it is emphasized that construction projects can most successfully be completed with mitigation measures to overcome "Complex Design", "lack of communication between parties" and" Inconsistencies between different designs". These findings revealed that construction projects suffer less from consultant-owner claims in construction projects. In this context, the consultant-owner expressed that the projects can be managed in the most successful way with the measures taken to overcome the "technical" problems.

C) **The Bottom Line:** According to the contractors, the encountering of subcontractor errors is the least problematic event for the successful termination of the projects. Instead, in the perceptions of consultant-owner, the encountering of design concerning issues does cause the least problems in the successful completion of projects. Organizations stated that construction projects can be managed in the most successful way with the measures taken addressing the problems under their responsibility. In other words, it was stated that the project may fail because of the damage incidents related to the obligations of the counterparty.

These findings showed that organizations avoid taking responsibility for problems arising from claims in construction projects. One of the most serious problems of claim is that it creates additional costs. According to the opinions of the organizations, these findings can interpret that additional costs should be covered by other parties.

Figure 9.7 shows the top three least risky claim events, by types of organizations.

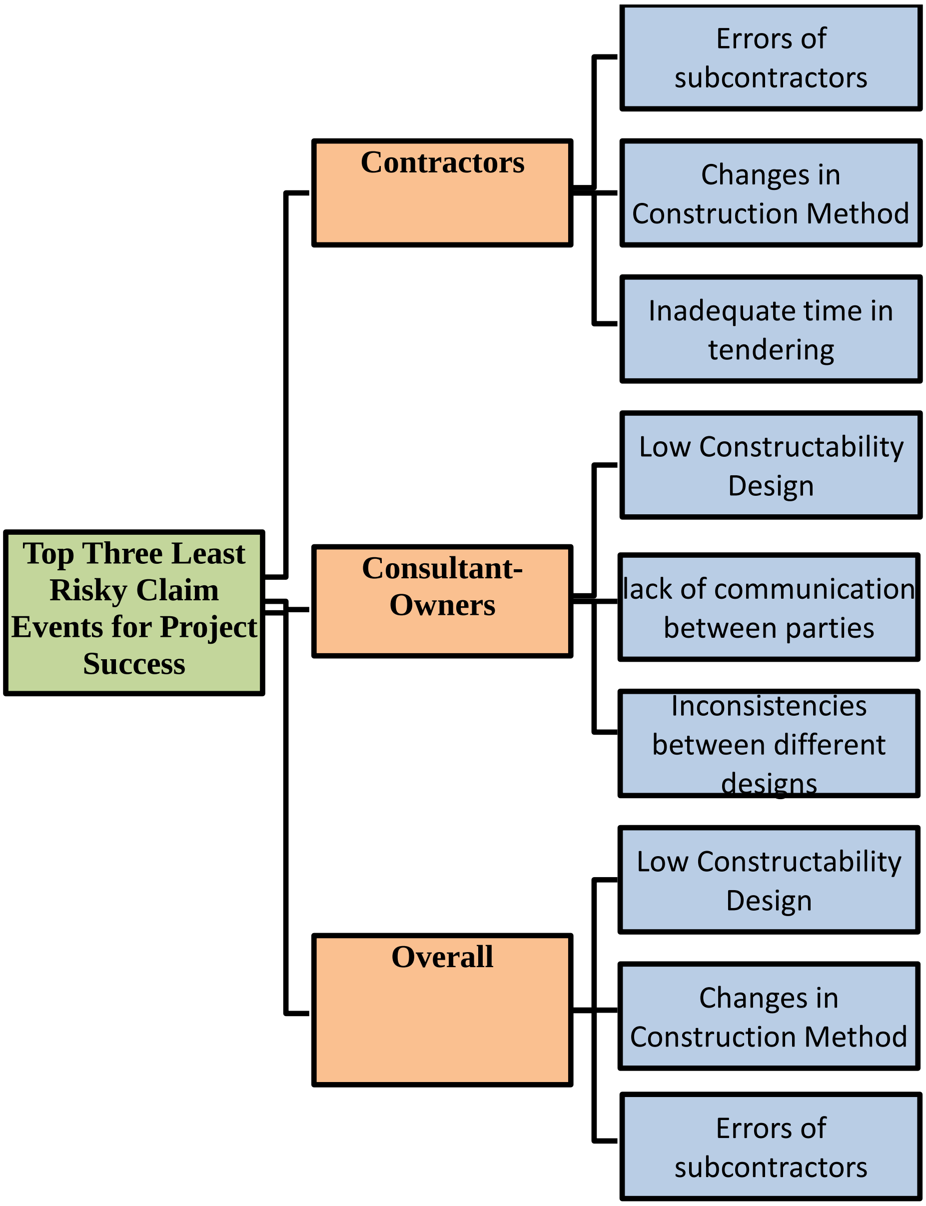

Figure 9.7: Top "three" least risky claim events with regard to project achievement, in perceptions of organizations

As explaine in Section 5.7.3.2 and 5.7.3.4 (please see Chapter 5 for details), "events of claims" and "control measures" are categorized by type to achieve more focused results. Within this context, the following section presents the research findings and discussions in respect of categories of least problematic claim events in terms of project success.

The following section presents the success rate in the project calculated based on the risk index of categories of claim events (results in section 9.3.1.) and the benefit index of categories of claim control measures (results in 9.5.1.) and, crosswise assessment (results in section 9.6.1).

9.8 The Least Risky Claim Event Categories in Terms of Project Success

In the following section, the quantitative research findings based on the relationship between the riskiness of claim events categories, effectiveness of control measure categories and, discussions about the least risky claim events categories in terms of project success are presented, on the basis of organizational classifications.

9.8.1 Project Success Rate Average (AV. P.S.S.)

This section presents the results obtained through the quantitative analysis method described in Section 5.7.3.12 (Project Success Rate Average). The ratio referring to the rate of success in the project, according to the claim event categories was presented in Table 9.7 below.

Table 9.7: Project success score of categories (AV. P.S.S.) of claim factors by organizations types

Categories of Claim Factors	**Contractors**	**Consultants-Owners**	**Overall**
Design-Technical	1.23	1.83	1.38
Contractual-Managerial	1.47	1.50	1.37
Construction	1.66	1.48	1.54
External	1.51	1.38	1.43
Average	**1.47**	**1.55**	**1.43**

9.8.2 Discussions on the Least Risky Categories of Claim Events in Terms of Project Success

Based on the results in the Table 9.7 presented above, the following views were reached:

A) **According to the Responses of Contractors:** According to contractors, the rate of success on the project is highest with measures to be implemented to prevent “construction” based damage factors. In this context, it was denoted that construction projects can be managed in the most successful way by the measures taken in case of claims due to the issues in the construction process.

B) **According to the Responses of Consultant-Owner:** According to the consultant-owner, the rate of success in the project is highest with the measures to be implemented to overcome the "Design-Technical" based claims. These findings revealed that construction projects suffer less from consultant-owner based claims. In this context, it was emphasized that according to the consultants-owners, projects can be managed in the most successful way with the preventive measures taken in case of claim due to malfunctions in the design process.

C) **The Bottom Line:** Contractors perceive that, construction projects suffer less from contractor-driven claims. On the other hand, consultant-owner implied that the project could be completed in the most successful way with the measures taken by the consultants because of the facts that the consultants and the owners are more responsible.

Here again, organizations emphasized that construction projects can be managed in the most successful way with the measures taken against the problems in their areas of responsibility.

Figure 9.8 shows the top two least risky claim events categories by types of organization.

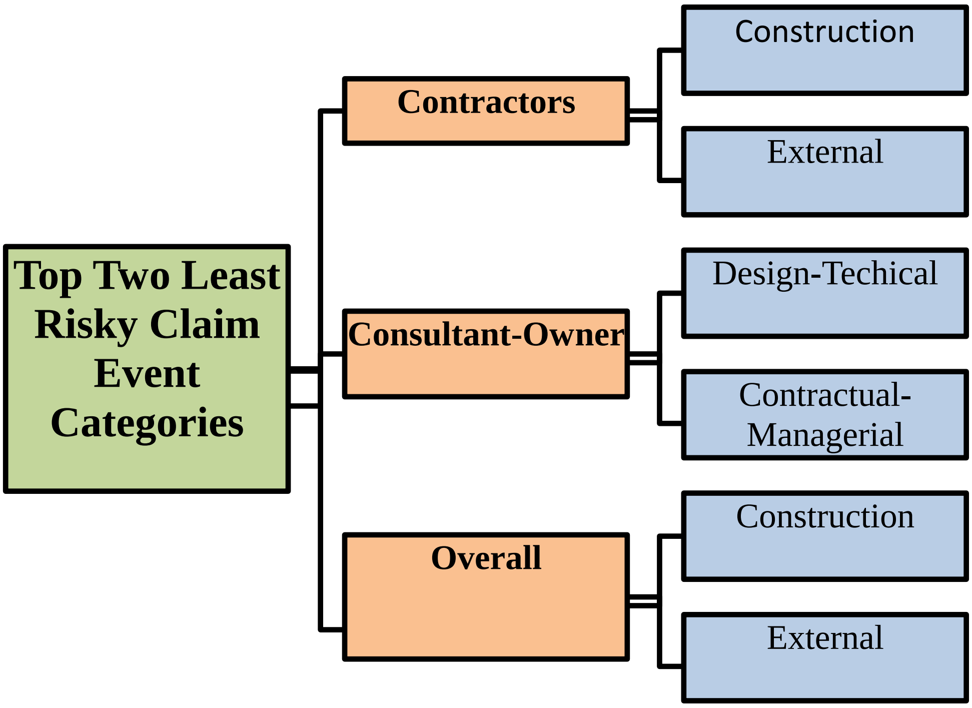

Figure 9.8: Top two least risky Claim Events Categories with regard to project achievement, in perceptions of organizations

Chapter 10

INTEGRATION AND THE DISCUSSIONS ON THE KEY EVENTS OF CHANGE ORDERS, SHOP DRAWING PRACTICES, CLAIMS, AND, KEY CONTROL MEASURES, ON PROPOSING FRAMEWORK AS AN INDICATOR MODEL

10.1 Introduction

In this section, based on the critical findings concerning contract clauses named change orders, shop drawing practices, claims and control measures, it is intended to propose a frameworks as an indicator system of the most risky events of contract clauses of change orders, shop drawing practices and claims and key control measures on preventing claims for the Turkish construction industry. This section presents the framework models prepared based on this qualify and discussions stated according to the organization types.

In this section, the most critical events of contract clauses named change orders, shop drawing practices, claims, and the most effective control measures were evaluated and discussed together. At the end of this process, framework models were developed aiming to draw attention to the most risky events and the most effective measures for the Turkish construction industry.

10.2 Integration and Discussions on Relationship Status of Key Events of Change Orders, Shop Drawing Practices, Contractors' Claims and, Key Control Measures

In the following section, a relationship has established with regard to key events that lead most risky change orders, shop drawing practices, and contractors' claims, in the perceptions of organizations. As the last component, key control measures integrated. Figure 10.1 presents the top two events leading most risky changes, claims, and most effective control measures, by organization types.

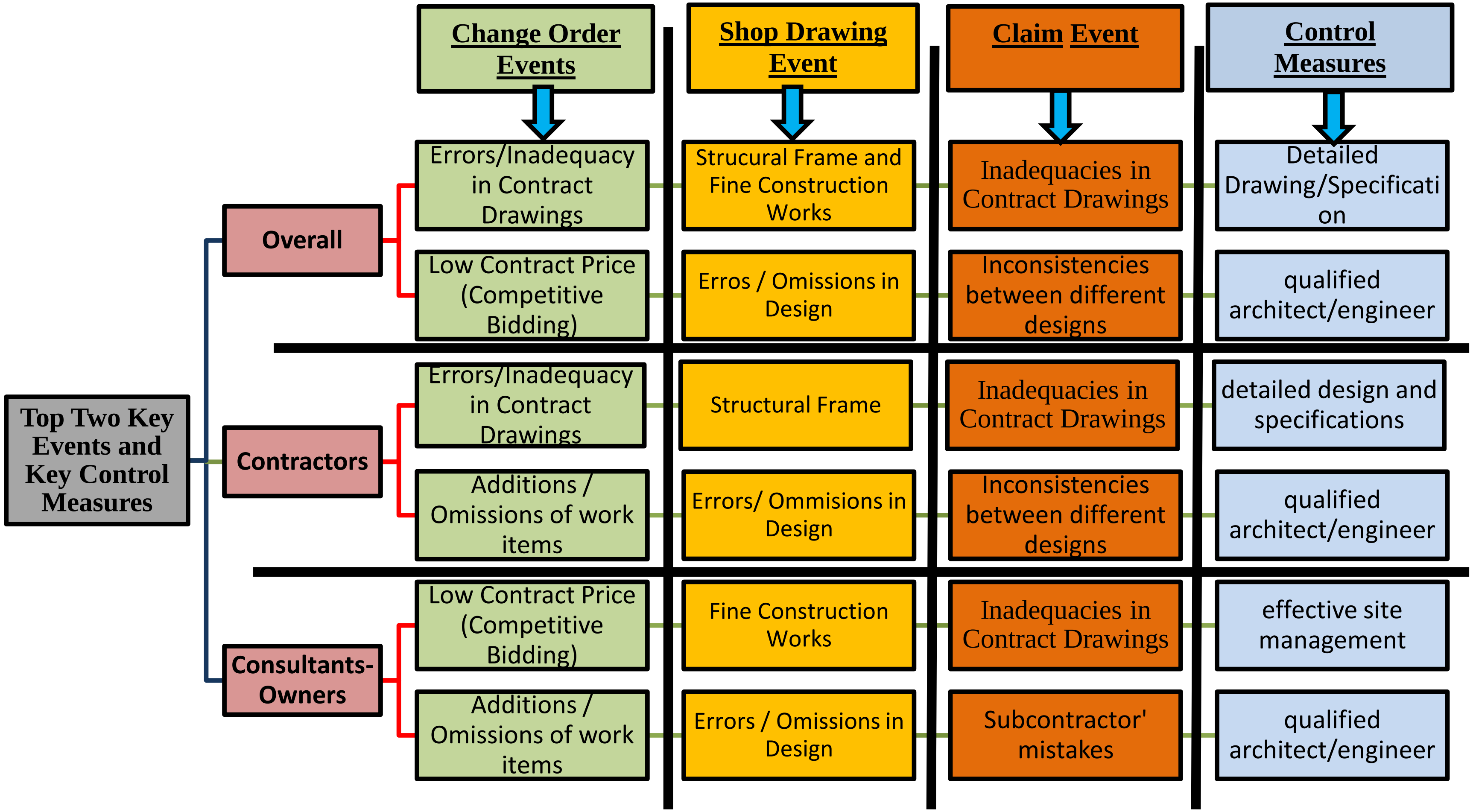

Figure 10.1: The top "two" most critical events of change orders, claims and the most effective measures

Based on the results in the Figure 10.1, the following views were reached:

10.2.1 Discussions Based on Contractors

According to the opinions of the contractors, it was emphasized that the top risky changes were caused by errors and deficiencies in the project drawings, while the same factor appeared in the top risky claims. However, it was also emphasized that the most effective measure to taken to prevent claims is to prepare detailed project drawings and specifications. According to these results, the project owner and project consultants have a great responsibility. It is implied that the project owner and project consultants have a great responsibility in meeting its costs and as well as preventing the claims.

One of the top risky changes was caused because of the additional work items. However, it was emphasized that one of the top risky claims caused by the inconsistencies between different design disciplines. It is stated that one of the most effective methods to taken to reduce the claims is to appointment of qualified architects and engineers. Based on these results, attention was drawn to the scope of the project regarding the reasons for the changes. The scope of the project should well planned. In this context, the importance of planning in the pre-construction phase was once again emphasized. In this context, well-organized and comprehensive project planning and organization must carry out. However, as the consistency and compatibility of the project drawings and appointment of architect and engineers are under the responsibilities of project owners and consultants, it is once again implied that the project owner and consultants have great responsibility for the top risky claims and the most effective measures that need to be implemented on construction projects.

10.2.2 Discussions Based on the Consultants-Owners

It was emphasized that the most risky changes were due to the low contract price, according to the consultant-owners' views. However, it was stated that errors and inadequacies in the project drawings were caused to the top risky claims. It was emphasized that the most effective measure taken to prevent claims is to implement an effective site management during the construction process. According to these results, attention was drawn to the contractor's bid price in the tender process, regarding the top risky changes. In addition, since the quality of the project drawing documents is under the responsibility of the owner-consultant, the responsibilities of the project owner and the consultants were pointed out. On the other hand, it is implied that both the contractor and the owner-consultants have great responsibility to avoid claims, as the construction work is organized, equipment and teams are the responsibility of the contractors, and supervising the works on the site is under the consultants' responsibilities.

One of the top risky changes was caused because of the additional work items. However, it was emphasized that one of the top risky claims caused by the subcontractor’s errors. It is stated that one of the most effective methods taken to reduce the claims is the appointment of qualified architects and engineers. Based on these results, attention was drawn to the scope of the project regarding the reasons for the changes. The project should well planned. In this context, the importance of planning in the pre-construction phase was once again emphasized. In this context, well-organized and comprehensive project planning and organization must be carried out. However, since subcontractors are appointed and organized by the contractors, it is implied that the contractors have a great responsibility regarding the top risky claims. However, it is implied that owners and consultants have great responsibility in implementing the most effective measures that can be taken to reduce the claims, as the appointment of architect and engineers is under the owners and consultants’ obligations.

10.2.3 Discussions Based on the Overall Respondents

According to the evaluations of all participants, it was emphasized that the most risky changes were caused by errors and deficiencies in the project drawings, while the same factor emerged in the most risky claims. However, it was also emphasized that the most effective measure to taken to prevent claims is the preparation of detailed project drawings and specifications. According to these results, the project owner and project consultants have a great responsibility. It is implied that the project owner and project consultants have a great responsibility in preventing the claims as well as meeting its cost.

One of the top risky changes was caused because of the low contract price (second top risky change cause). However, it was emphasized that one of the top risky claims caused by the inconsistencies between different design disciplines. It is stated that one of the most effective methods to taken to reduce the claims is the appointment of qualified architects and engineers. According to these results, regarding the reasons for the changes, attention has been drawn to the contractors not to give lower prices than required during the tender process. However, it is again implied that the project owner and consultants have a great responsibility regarding the top risky claims and the most effective measures that can be taken to reduce the claims.

10.3 Integration and Discussions on Relationship Status of Categories of Key Events of Change Orders, Shop Drawing Practices, Contractors' Claims and, Categories of Key Control Measures

As stated in previous of the thesis, events of contract clause components are categorized by type to achieve more focused determination. The following section presents the interaction and discussions with regard to the most critical categories of events of those four contract clause components. By organization types, the interaction statuses of categories of key contract clause components are discussed in the section below.

In the following section, a relationship has established with regard to categories of key events that lead most risky change orders, shop drawing practices, and contractors' claims, in the perceptions of organizations. As the last component, categories of key control measures integrated. Figure 10.2 presents the top two categories of most critical events of change order, shop drawing practices and contractors' claims, and most effective control measures, in the perceptions of organizations.

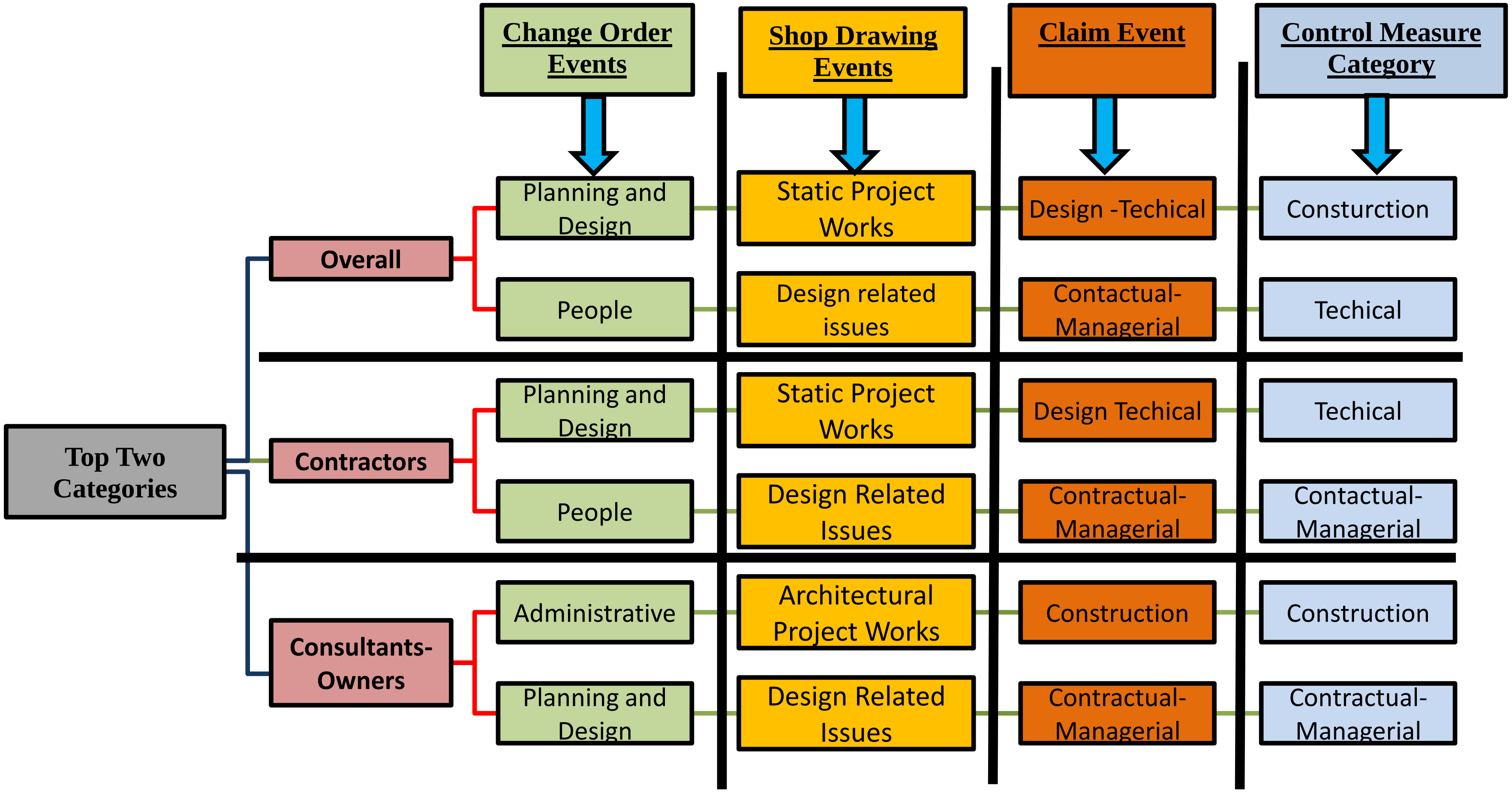

Figure 10.2: Top “two” risky categories for changes, shop drawing and, claims events and top two categorises of most beneficial mitigation measures

Based on the results in the Figure 10.2, the following views were reached:

10.3.1 Discussions Based on the Contractors

According to the opinions of the contractors, it was emphasized that the top risky changes caused due to the planning and design-related factors, while a similar type of factor, called "Design- Technical" was caused the top risky claims. However, it was also emphasized that the most effective measures to taken to prevent claims are related to increasing the quality of the technical origin works refers to the design and planning studies in the pre-construction phase. According to these results, it is implied that the project owner and project consultants have a great responsibility both in meeting the costs and preventing the claims since planning and design activities, as well as technical needs mainly referring the design documents and planning implemented in the pre-construction phase are responsibility of the owners and consultants.

10.3.2 Discussions Based on the Consultants and Owners

According to the views of the consultant-owners, it was emphasized that the most risky changes were mainly due to administrative factors referring to the contract, while factors related to construction activities caused the most risky claims. However, it was also emphasized that the most effective measures to taken to prevent claims are related to the increase in the quality of the works in the construction process. Project owners and consultants have a role and responsibility in determining the administrative structure of the project. It is at the discretion of the project owner to prepare the contract for the project and decide on the project procurement model. On the other hand, since activities in the construction process are under the responsibilities of the contractor, it has been implied that the greatest responsibility falls on the contractors both in meeting the costs and implementation of the measures to taken to decrease the claims.

10.3.3 Discussions Based on the Overall Respondents

According to the all participants, it was emphasized that the top risky changes caused due to the planning and design-related factors, while it was stated that design and technical related factors caused the top risky claims. However, it was also emphasized that the most effective measures taken to prevent claims are related to the increase in the quality of the works in the construction process According to these results, it is implied that the project owner and the project consultants have a great responsibility in meeting the claims, as the planning and design activities, and the technical requirements, which mainly refer to the design documentation and planning, are the responsibility of the owners and consultants. However, it was implied that since the construction works are carried out by contractors, the major responsibility falls on the contractors for the measures taken to reduce the claims.

10.4 Overview on the Top Critical Findings on Those Four Contract Clause Components

The following section highlights the most critical findings in proposing an indicator model concerning change orders, shop drawing practices, claims, and the most effective control measures, on the basis of organizational perceptions. These critical findings are illustrated in Figure 10.3 and Figure 10.4 below, based on the organizational classifications.

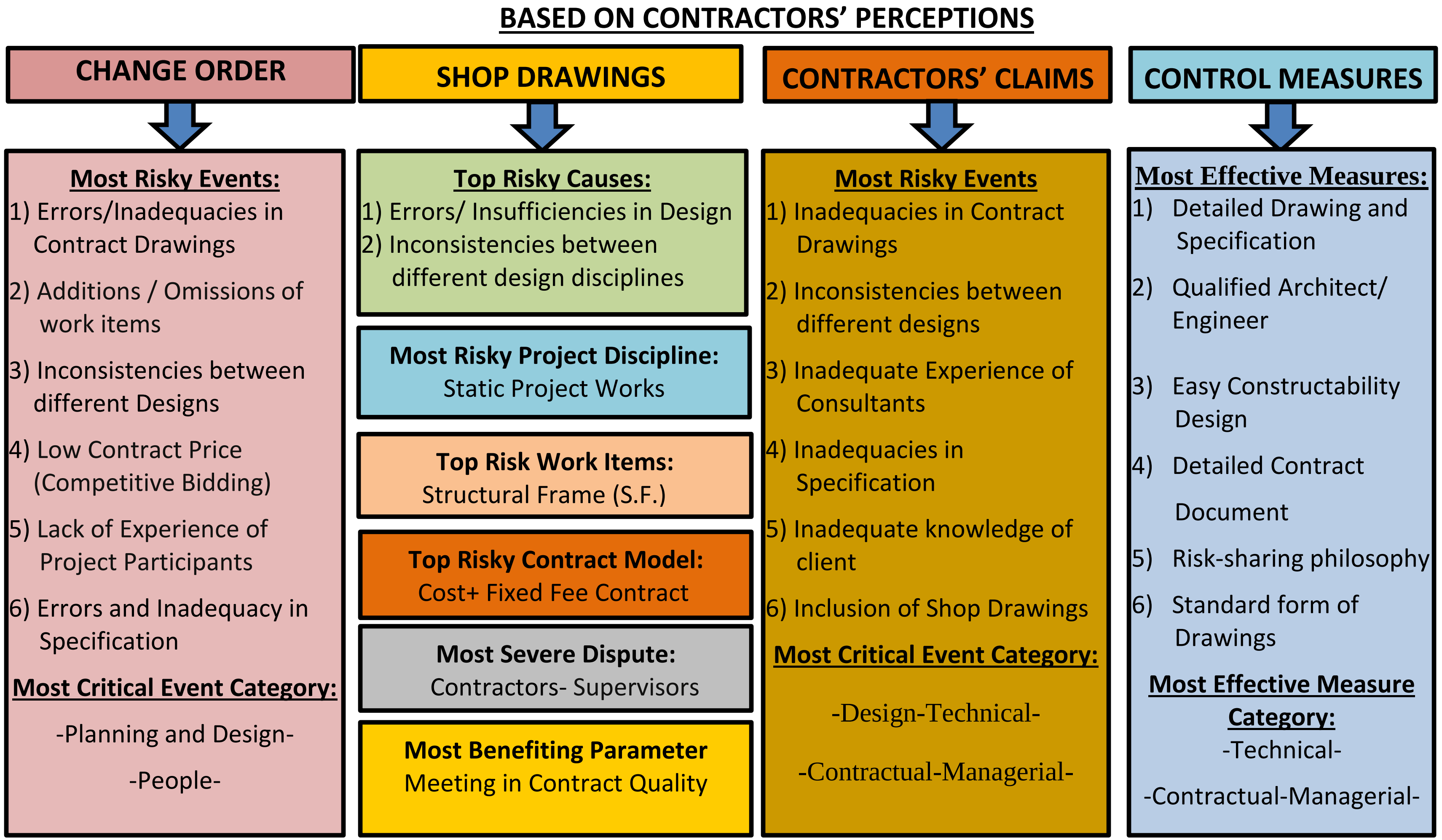

Figure 10.3: A framework of critical events of contract clauses according to the contractors' perceptions

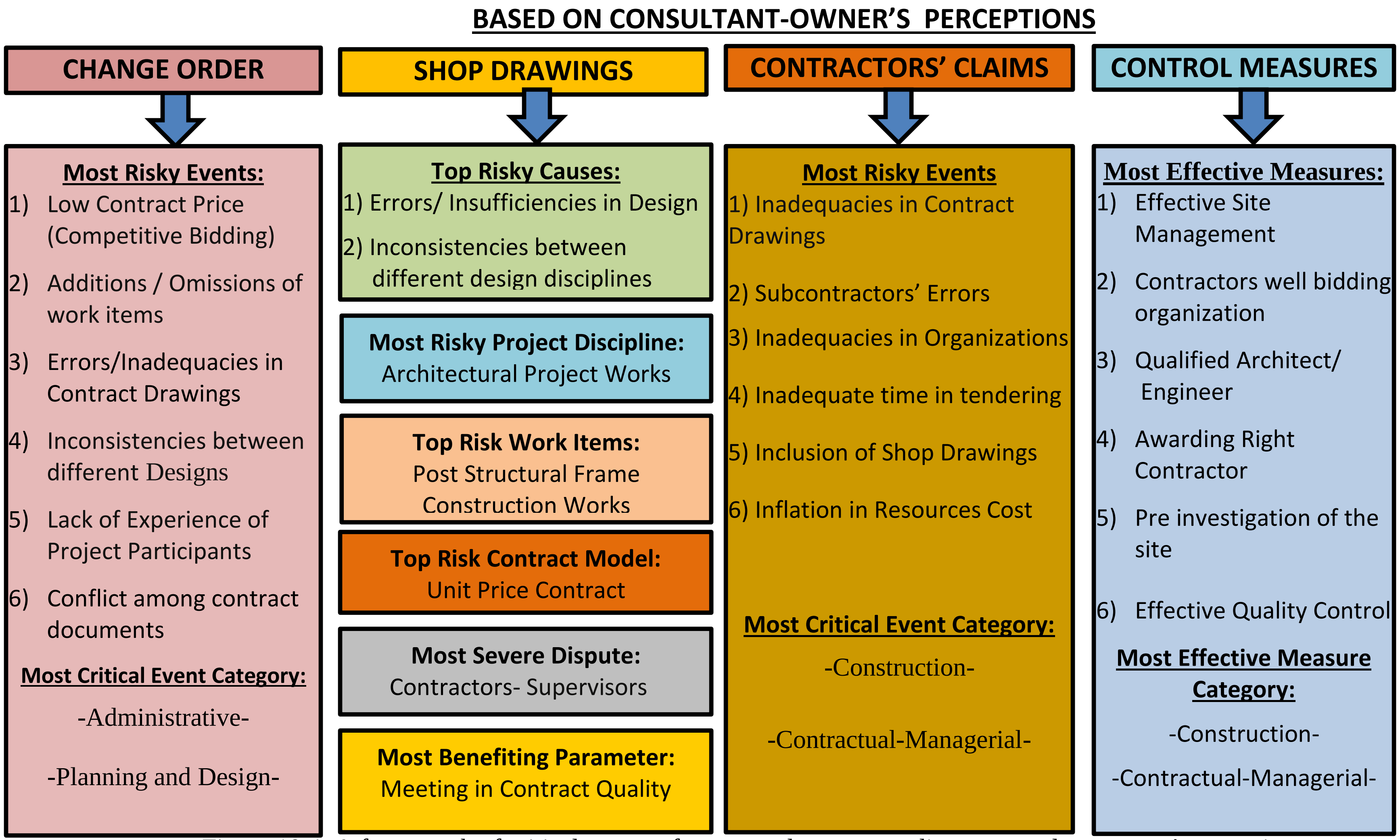

Figure 10.4: A framework of critical events of contract clauses according to consultant-owner' perceptions

Figures 10.3 and 10.4 show the overall perceptions of organizations based on the most critical events and the most effective control measures. According to the results in Figure 10.3 and Figure 10.4, the following views were reached concerning the contract clauses named change orders, shop drawings, claims and control measures.

10.4.1 On Change Order Event

According to the contractors, top risky change orders have emphasized to being composed due to "design based issues", however, according to the consultants and owners, the top risky changes have emphasized to be due to the "low contact price" which raised from administrative based issues in which associated with the contract management and tendering process.

Contractors stressed that the top risky changes are due to weaknesses and defects in project drawings. Contractors stressed that the top risky changes are due to weaknesses and defects in project drawings. The project owners have a great responsibility in preparing drawing documents, as in design-bid-build model projects, preparing project drawings is undertaken by consultants under the owner's responsibility. Contractors struggled to express that they had no obligations and responsibilities regarding the project design, as the contractors not involved in the design phase in design-bid-build model projects (Xia et al., 2017) (Arain & Pheng, 2005a) (Arain, Assaf & Low, 2004). In this context, contractors concluded that other major organizations such as owners and consultants are in charge for design-related issues. Contractors strived to point out they have a right to claim additional payment and time because of changes arising from design issues since they express themselves as a victim in such cases.

However, consultants and owners interpreted that the most risky changes occurred because of the lower bid price associated with the contractor selection method. This finding pointed out that the low bidding price could seriously intense that precipitating change cases in construction projects. This type of problem in construction projects has also been highlighted in research studies conducted by, Verweij, Meerkerk & Korthagen (2015), Khan& Khan, (2015) and, Arain & Pheng's (2005a) research studies. In their research, the authors emphasized that, the changes can be a great opportunity for contractors to claim extra payments to reduce the distress of low bid prices.

10.4.2 On Shop Drawing Practices

According to the findings, organizations referred that the severity of shop drawing practices on construction projects can be changeable depending on the technical and administrative features of building projects. According to the contractors, top risky shop drawing practices were those implemented for “superstructure construction works”, while according to the consultant-owners, top risky shop drawing practices were associated with the “construction works after superstructure” in construction projects. According to the contractors, the shop drawing practices in the rough construction process constitute higher risk, while the shop drawing practices for the fine construction work after the rough construction phase constitute maximum risk, according to the consultants-owners. On the other hand, all organizations expressed that, “design errors and deficiencies” is the most common reason leading the shop drawing practices in building projects.

In point of administrative feature of the construction projects, the “Cost + Fixed Fee” contract model was emphasized as the top risky administrative model in the perception of contractors, while the “Unit Price” contract model was emphasized to be a top risky administrative model according to the consultant and owners. "Cost + fixed fee" has a stricter feature in terms of additional payments. This result can be interpreted as the intention of contractors to express their concern about receiving additional payments. In "unit price" contracted construction projects, contractors may claim high amounts of payments because of changes. At this point, this result can be interpreted as the intention of "consultant-owners” to express their concern for the "unit price contract" model in terms of additional payment during construction process.

10.4.3 On Claim Event

The findings referred that, all organizations have acknowledged that the top risky claims in construction projects are caused by "Errors and Inadequacies in Design". However, while contractors put more emphasis on design issues such as “inconsistencies between different design documents”. However, consultants and owners have mostly stressed to the issues associated with the activities during construction execution process principally “subcontractor-based issues” and “poor organization” instead. At this point, these results can be interpreted as the intention of contractors to drawing attention to the obligations of consultants and owners, while consultant-owners highlight the factors associated with the contractor's responsibilities, conversely.

10.4.4 On Control Measures

The findings indicated that, according to the contractors, “detailed design and specifications”, “qualified architect/engineer” and “easy constructability design” have emphasized as the most effective methods to prevent changes in construction projects. While, according to the consultant and owners, “effective site management”, “Contractors well bidding organization” “qualified architect/engineer” and “awarding of the right contractor” in the tender process have determined as the most effective mitigation measures to prevent changes in construction projects, instead.

This findings point out that, the most beneficial mitigation measures, according to contractors, are related to the improvement of technical documentation. In this context, according to the opinions of the contractor, the processes and works undertaken by the project owners and consultants should be improved. Instead, consultant-owner emphasized that, actions aimed at "Improving Construction Implementation Activities" are the most beneficial mitigation measures that can minimize the claims on the construction project. At this point, it was emphasized that, according to the contractors, the measures focused on improving the activities under the responsibility of the consultants and owners were the most effective measures, while the consultants-owners emphasized the importance of activities during the “construction”, together with the capabilities, experiences, and qualification status of the contractors, which basically associated with the effective tendering process organization for the accurate awarding decisions. At this point, since the activities in the construction process are carried out by contractors, consultants and owners were in a struggle to express that, the work undertaken by contractors need to be improved which is a function of contactors’ quality and capabilities in which could be achieved by the awarding of accurate contractors in the tendering process. These findings revealed that, organizations strive to emphasize that the work undertaken by the other party in construction projects should be improved. This result can also be basically interpreted as organizations trying to avoid taking responsibility.

10.4.5 The Bottom Line

In overview, consistency has been observed between the characteristics of factors that cause the most risky changes and claims and the most effective preventive measures in the perceptions of the organizations. In the perceptions of contractors, "poor design" is the top risky factor for "change order", "shop drawing practices", and, "contractors' claims". On the other hand, the preparation of "Detailed Drawing and Specification" has been the most effective mitigation measure in preventing claims in the perceptions of the contractors. However, one of the principal striking results in the consultant-owner perceptions is that, “subcontractors’ errors” were emphasized as one of the top risky factors affecting contractors’ claims. Principally, by the consultant-owners, attention was drawn to the activities during the construction process and performance of the contractors which is a function of the quality status of the contactors.

This result highlights the importance of the planning process in construction projects. It appears that other most effective measures are related to actions in design and tendering process which both are in pre-construction stage. It has been understood that the time and budget spent in the pre-construction process are of great importance to avoid larger problems that may arise during the construction phase. The widespread use of BIM technologies for both design and management requirements in today's construction industry can make a significant contribution to the goal of achieving projects. On a global scale, it is increasingly understood how important integration and integrity are significant in projects, both in technical and managerial aspects. Today, the difficulty of competition and economic conditions is increasing. In particular, the findings also refer to how competition and economic conditions can be risky for construction projects today, as one of the striking findings have represented the impact of “low contract price due to the competition” in which associated with the contractors awarding method in the Turkish construction industry.

The findings have been revealed that organizations' perceptions differ in accordance to serve their own interests aiming not to responsible for the negative consequences of the changes, claims and the control measures. Additionally, it was also noticed that there is a direct harmony between the most serious problems concerning those contract clauses, and the key effective measure in construction projects in Turkish construction industry. It was noticed that the perceptions of the parties could be in a way to serve their own interests. In this research, it was revealed that organizations take a stance in line with their interests on the causes of change and claims as well as on the preventive measures in the Turkish construction industry.

10.5 Overview on the Top Critical Findings, Based on the Regional Classification

As stated in previous, on the "change order" research process (Research Phase: 1), results were obtained according to two different regional characteristics as in developing (Northern Cyprus- Turkey) and developed (The U.S.A.). Within this context, the following section highlights the most critical findings, based on regional classification. Figure 10.5 below presents the most critical findings on “change order events” in the perception of regional characteristics.

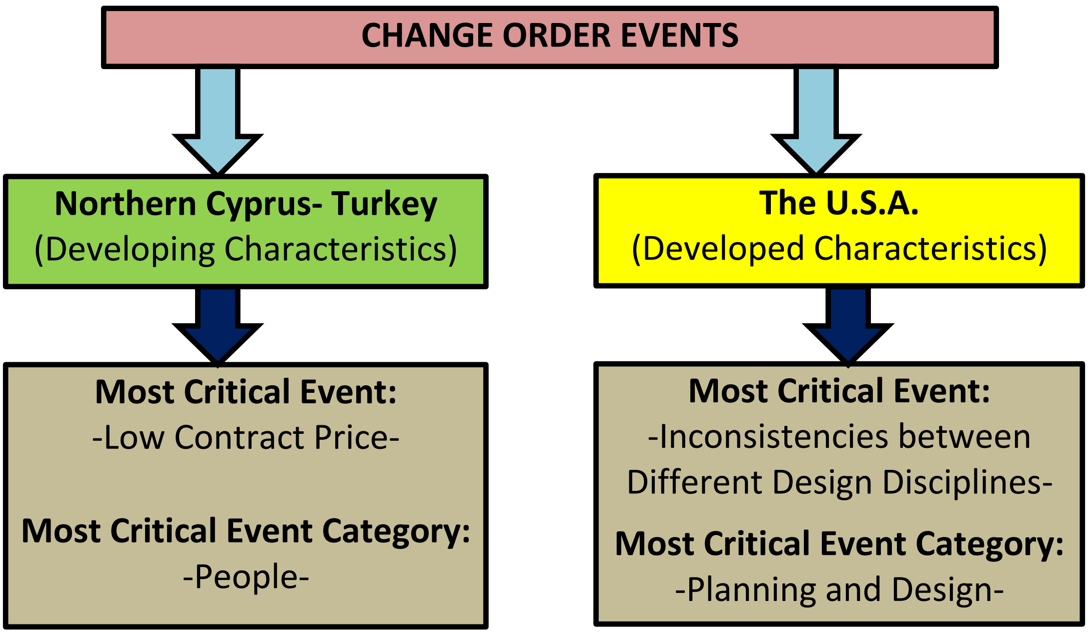

Figure 10.5: Top critical events of change orders according to the regions

10.5.1 Northern Cyprus-Turkey

Based on the results in the Figure 10.5, the following views were reached:

It has been observed that the characteristics of the regions have an important effect on interpreting the top risky change factors. The findings have showed that the top risky change factor was identified as coherent by the regional characteristics. In Northern Cyprus and Turkey, "Low contract price" were designated as to be top risky change factor, whereas "Inconsistency between different design" were identified in the US. Organizations in Northern Cyprus and Turkey have preferred to implement the project by achieving the lowest cost rather than higher quality (İlter & Çelik, 2014, 2018), (Kocaman, Kuru & Çalış, 2020). This finding could be interpreted that short-term success is more attractive than long-term for organizations in North Cyprus and Turkey.

Today, competitive and economic conditions are becoming more challenging in the global sense. Contractors may in tend to offer a low bid price due to high competition to get the contract and continue their activities (Ahmed et al., 2016) (Mohamad, Nekooie & Al-Harthy, 2012). Lower prices may be more attractive to project owners in the short term. However, in the long run, project owners may experience difficulties because of the tendency of contractors to increase their income through additional work. Shrestha & Shrestha (2017), Assbeihat & Sweis (2015) and Tan et al. (2008) noted that contractors would offer a lower bid price than those other competitors in a sacrifice of the profit margin and hence financial damage may compensate by change orders during the execution process to claim extra financial resources from the owner.

Contractors in this region are basically awarded based on prices (Akcay & Manisali, 2018). For this reason, evaluation based on quantity (price) rather than qualification is often preferred, and therefore owners may in tend to award the lowest bidder contractors.

On the other hand, it was seen that, the problem due to profile and performance of people involved in the project and project administrative status were shown as the source of a very high risks. Within this context, it is perceived that, in North Cyprus and Turkey, the fundamental defects were mostly related to human and administrative defects.

On the other hand, in the light of the findings, suggestions were proposed based on regional characteristics, in purpose of preventing the top risky change factors and presented in the following section.

It has realized and experienced that "low contract price because of competition" is highly risky for contractors, due to the reality that every change order of the contractor may not be awarded by owners. This issue can being neutralized by setting the base price offer as the tender threshold value in order not to accept any bid below the base price (Palguta & Pertold, 2017) (Assaf & Al-Hejji, 2006) (Odeh & Battaineh, 2002). The base price to be determined should also provide financial conditions to contractors so that the project can being completed smoothly. In addition, it will be beneficial to evaluate the offers by applying qualitative based evaluation rather than quantitative based evaluation for the tender process, giving less weight to quantitative criterions and more weights on qualitative criterions.

Bidding becomes an important process to prevent potential problems. For this reason, quality consultancy services are needed to carry out the tender process in the most accurate way and to award the most accurate contractor for execution. This finding can be interpreted as construction projects are subject to low quality consultancy services. It will be beneficial for the project owners to realize their projects by experienced consultancy firms.

Potential forthcoming problems can be mitigated by choosing the most accurate contractor through a qualitative based evaluation method. It is required to make legal arrangements to make mandatory to use the qualification based method in the tender process. Besides, within the context of the findings in Northern Cyprus-Turkey, the findings can be considered as an indicator for countries with similar characteristics.

10.5.2 The U.S.A.

Based on the results in the Figure 10.5, the following views were reached:

The U.S.A. is one of the predominant indicators of developing countries. Thus, by including the U.S.A. in the research, it was possible to make clear comparisons between developed and developing countries.

According to the results, unlike "Northern Cyprus-Turkey", people origin events pose a relatively low risk in the U.S.A. In the U.S.A., problems arise from the design and construction execution phase has observed as the source of the greatest risks.

In the U.S.A, the biggest difficulties encountered are related to inconsistency between different design disciplines. Today, the most common technical challenge encountered in construction projects is the incompatibility between project disciplines because of the need for large-scale, multi-functional, and complex projects in the global construction sector.Such problems are more common, especially in large-scale projects. Today, the scale and scope of projects is in a growing trend. Multifunctional buildings are being built with an increasingly global competitive environment trend. The compatibility and integrity between different designs becomes more difficult because of the increase in project complexity. Today, with the increasing trend of complex designs, the quality and function of contract drawings are becoming more important. On the other hand, based on this finding, in the following section, suggestions are presented aiming to prevent inconsistency problems between designs in construction projects.

It is necessary to strengthen and develop harmony and integrity in a project to overcome conflicts between different designs. Unique designs need to be combined in a single holistic design to ensure integrity. In addition, it is necessary to create an environment where different design units can work together. For this, it is necessary to establish an integrated project design unit during the design phase of the construction project. In this context, different design units will better managed through a holistic project design unit. It is possible to reduce such problems with BIM technology (Oyewobi et al., 2016). Today, the use of BIM in the United States is widely applied for construction projects to ensure compatibility between different project disciplines (Bryde et al., 2013). Unique designs can integrate easily and effectively with BIM tools. Also, the BIM tool enables the integration of managerial information into project design, so BIM is a powerful and effective method to increase integrity in different design disciplines to tackle such problems in the construction industry. In this context, legal regulations need to be made to ensure that the BIM tool is used in construction projects.

Globally standardized contract forms (i.e.: FIDIC) used in construction projects (Chen et al., 2018) (İlter & Çelik, 2016). However, there is no standard form and content for the drawings in the global sense. At this point, contract drawings should be prepared according to certain standards that can be globally validated in terms of structure, requirement, scope and format. With this structure and philosophy, the suffering and weakness caused by the drawings can minimized (Chen et al., 2018) (Ijaola & Iyagba, 2012) (İlter & Çelik, 2016). Thus, drawing standard certification would be requested from design firms. On the other hand, it would be beneficial to involve contractors in the design process so that contractors can take the initiative in the design process to ensure the legalization of all parties' responsibilities regarding design documentation. Design-Build procurement models can be effective in overcoming this issue (Lohne et al., 2017) (Sha'ar et al., 2017) (Assaf & Al-Hejji, 2006). Integrating similar obligations in the Design-Build procurement method into the contracts can be effective to minimize design-related problems. In addition, the high quality, broad participatory and comprehensive design process can contribute to reducing the need for project change.

Chapter 11

CONCLUSION AND RECOMMENDATIONS

11.1 The Main Theme of the Research

Due to uncertainties and deficiencies-errors in construction projects, changes are made in the project during the construction phase. Besides, as construction projects are multidisciplinary projects and are carried out with the contribution of many industries and involvement of the parties, construction projects are exposed to the influence of many factors. Changes made in the project during the construction process affect the price and duration of the construction project. Recently, the requirements of shop drawing practices are in increasing trend because of the large-scale and complex design of construction projects. In this respect, shop drawing practices are needed for the execution of the construction work items. It is well accepted by the construction industry that shop drawings are one of the most significant factors causing changes in construction projects. Since the activities in different project disciplines are interconnected, shop drawings in this context can create a domino effect on the project. The main expectations of the project parties in the construction project are to complete the project on time with the targeted price. As such, changes in the project have serious impacts and consequences for the parties involved in the project.

The contractors claim extra cost and time to cover the costs caused by changes in the project. The parties involved in the project can act in line with their interests in terms of the reason for changes and in meeting the costs arising from the changes. To complete the project smoothly and successfully, it is essential to complete the project within the targeted budget and time. In this context, it is essential to control and eliminate the factors that cause extra cost and time claims.

The Turkish construction industry is facing a lot of changes. Serious costs are paid because of changes in construction projects. In this research, through investigating the status of the potential contributors of change and claim events, and also the potential control measures, it is aimed to point out to the top risky events and top effective control measures and aimed to propose a strategy to manage change and claims for the Turkish construction industry.

The next section highlights the main inferences and conclusions from the research findings.

11.2 The Main Conclusions and Achievements of the Research

11.2.1 Main Implications on Top Risky Events of Change Orders

In the first phase of the research, the perception of organization and regions regarding the risk of change order events was investigated in the perceptions of the different organizational and regional characteristics. It has been observed that the factors affecting the most risky change were variable depending on organizational and regional characteristics.

It is known that such changes cause both cost and time overruns and this leads to serious disputes among the parties involved in construction projects. In this regard, organizations may take a stance towards their interests while stating the reason for changes. Organizations insisted that counter organizations are responsible for the changes. The results obtained in the study confirm this idea. According to results, it has been observed that contractors, consultants, and project owners tend to point out to those change factors where they subject to less responsibility.

In general, according to the opinions of the contractors, the factors affecting the top risky changes were due to design based issues, however according to the consultants and owners, top risky changes were due to "construction execution based issues" and "contractors capabilities". Commonly, consultants and owners have great responsibility on drawing documents while; the bid price is more relevant to the responsibilities of the contractor's organizations.

On the other hand, it has been observed that the characteristics of the regions have an important effect when interpreting the top risky change factors. In Northern Cyprus and Turkey, it was revealed that, the problem due to profile and performance of people involved in the project and project administrative status were shown as the source of a very high risk. Unlike "Northern Cyprus-Turkey", people origin events pose a relatively low risk in the U.S.A. In the U.S.A., problems arising from the design and construction execution phase have observed as the source of the greatest risks. The findings showed that the top risky change factor was identified as coherent by regional characteristics. In Northern Cyprus and Turkey, "Low contract price" were determined as the top risky change factor, whereas in the U.S.A., "Inconsistency between different design" were designated as to be the top risky change factor. In general, organizations in Northern Cyprus and Turkey are preferred to carry out the project by achieving the lowest cost rather than high quality. This is because; more importance being given to the cost, not being quality when selecting contractors in Northern Cyprus and Turkey. This finding can be interpreted that short-term success is more attractive than long-term for organizations in Northern Cyprus and Turkey. On the other hand, the biggest difficulties encountered in the U.S.A. are related to inconsistency between different design disciplines. Today, the most common technical challenge in construction projects is to be the incompatibility between project disciplines due to the need for large-scale, multi-functional, and complex projects in the global construction sector.

All sectors in North Cyprus suffer from weaknesses in terms of institutionalization and inclusiveness. This is because of the lack of global integrity of sectors in North Cyprus as a result of implementing global isolation by the international community. The isolation of North Cyprus from a global trend could be attributed to this fact. Lack of integrate into global standards leads to differences in tender laws in Northern Cyprus. The way of execution of projects in Northern Cyprus is different; this is because the administrative and technical obligations of the projects differ according to global standards. This creates differences in perception and qualities in North Cyprus organizations compared to international organizations. In this respect, great importance should be given to the concept of institutionalization and this structure needs to developed and implemented throughout all project phases.

11.2.2 Main Implications on Factors Affecting the Shop Drawing Practices

In the second phase of the research, the primary purpose was to observe the risk status of shop drawings practices, according to various technical and administrative features of construction projects. One of the principal aims of this thesis is to draw attention to the most influential technical and administrative variables regarding the severity of shop drawings practices. Thus, it was aimed to assist the various parties of the contract by pointing out to the top risky technical and administrative features of the construction projects where shop drawings fall under contract terms.

It has been observed that the most risky technical and administrative project variables that cause the most severe shop drawing practices in construction projects vary depending on the organizational characteristics. At this point, according to the organizational characteristics, the main implications of this research phase are as follows:

It has been observed that contractors are more concerned and more complaining about the risk perception of shop drawing practices, as higher indexes resulted in contractors' evaluation. According to the contractors, top risky shop drawing practices were those implemented for “superstructure construction works”, while according to the consultant-owners, top risky shop drawing practices were associated with the “construction works after superstructure” in construction projects.

In administrative feature aspects, the “Cost + Fixed Fee” contract model was emphasized as the top risky administrative model in the perceptions of contractors, while the “Unit Price” contract model was emphasized to be a top risky administrative model according to the consultant and owners.

All organizations have acknowledged that the top risky claims in construction projects are caused by "Errors and Inadequacies in Design". However, while contractors put more emphasis on design issues such as “inconsistencies between different design documents”, consultants and owners have drawn attention to “subcontractor-based issues”, instead.

11.2.3 Main Implications on Factors Affecting the Top Risky Claims

In this research stage, the perception of risk with respect to the contractors' claims was examined. Factors affecting the top risky claims have been observed to be changeable depending on the organizational characteristics.

According to the findings, it was revealed that, Contractors put more emphasis on design issues such as "inconsistencies between different design documents". However, consultants and owners have mostly stressed to the issues associated with the activities during construction execution process principally "subcontractor-based issues" and "poor organization" instead.

Project performance parameters can be significantly affected due to contractor claims. Any organization involved in the project may have to cover the cost incurred from claims. It has been observed that organizations exhibit different approaches by their organizational characteristics towards claim factors. At this point, as observed in other research stages, the findings emphasizes that organizations take a stance according to their interest regarding factors influencing claims in construction projects.

Construction projects in Turkey are extremely susceptible to the claims of the contractors. Many factors allow contractors to ask claim, construction projects can be subject to a lot of contractors' claims. One of the most important factors affecting the claims are called "insufficient project documents" and "lack of organizations during the pre-construction phase of the projects". In common, such activities are carried out in the design and tender processes. Consultants and project owners play a more active role than contractors in establishing the technical and administrative structure of the project.

11.2.4 Main Implications on Control (Mitigation) Measures (Claim Preventive Measures)

At the last research phases of the thesis study, the perception of the organization to the effectiveness of claims mitigation factors was examined. As in previous research findings, at this phase, it has been observed that the factors that can prevent the claims in the construction projects may vary depending on the organizational characteristics.

This findings point out that, the most beneficial mitigation measures, according to contractors, are related to the improvement of technical documentation. Instead, consultant-owner emphasized that, actions aimed at "Contractors' evaluation during tendering" and "Improving Construction Implementation Activities" are the most beneficial mitigation measures that can minimize the claims on the construction project

In other words, organizations have taken different approaches according to their organizational characteristics regarding preventive measures. This study has shown that organizations take a stance based on their interest concerning mitigation measures. The findings obtained in this thesis have been revealed that in the pre-execution process, more importance should be given to detailed project scope and comprehensive project preparation, and to effective site management during the execution phase of construction projects in Turkey.

The results obtained show that contractors need to conduct resource management to organize their resources effectively. Contractors should be well organized with all construction crew and suppliers prior to the construction implementation process. In this context, contractors need to organize their resources, teams, and suppliers in the pre-construction stage. Overall, the research findings highlighted that the finer the preparation of project documents and well-organized in terms of technical and managerial aspects prior to the construction process can significantly help to reduce the necessity of claims in construction projects.

This study has revealed that construction projects may be subject to lesser claims if all organizations fulfil their responsibilities during the project stages. In this context, additional budget and time will not be required due to fewer claims in construction projects. Projects will be able to complete at the planned budget and time, this result will be counted as a success for all parties involved in construction projects. By this study, it was intended to raise awareness about the claims of the contractors in Turkish construction industry.

11.3 Final Remarks and Recommendations

A lot of changes are experienced in construction projects carried out in Northern Cyprus and Turkey. The reason for so many changes in construction projects is often the lack of quality consultancy services. The quantity-based selection method is often applied in Northern Cyprus and Turkey and, therefore, poor quality of consultancy services are provided, as consultants to be selected based on bid price (Quantity based) rather than quality based. This fact is very effective in this regard as the quality of the project outcomes (from design to execution) depends on the efforts of the consultancy services. Today, the U.S.A. as a developed country is in trend to select consultants by applying a quality-based selection method. In this context, the project owners in Northern Cyprus and Turkey, should assign consultants through the quality based evaluation rather than quantity.

Another important contribution of change and claim events is that design-related problems are frequently encountered in construction projects. Especially in order to avoid design document based problems, at this point, it was thought that it would be beneficial to create and adopt standard form documents in a global sense to overcome design document based problems. Globally standardized contract forms (i.e.: FIDIC) used in construction projects (İlter & Çelik, 2016). However, there is no standard form and content for the drawings in the global sense. At this point, contract drawings should be prepared according to certain standards that can be globally validated in terms of structure, requirement, scope and format. With this structure and philosophy, the suffering and weakness caused by the drawings can minimized (Ijaola & Iyagba, 2012) (İlter & Çelik, 2016). Thus, drawing standard certification would be requested from design firms. On the other hand, it would be beneficial to involve contractors in the design process so that contractors can take the initiative in the design process to ensure the legalization of all parties' responsibilities regarding design documentation. Design-Build procurement models can be effective in overcoming this issue (Sha'ar et al., 2017) (Assaf & Al-Hejji, 2006). Integrating similar obligations in the Design-Build procurement method into the contracts can be effective to minimize design-related problems. In addition, the high quality, broad participatory and comprehensive design process can contribute to reducing the need for project change.

Shop drawings may have a beneficial effect in improving the quality and consistency of the works, and cause an increase in the project price. Construction projects may face difficulties in completing the project within the contract price and duration, where the shop drawings are the contractual requirement. The bid price of the works may vary because of the detailed content of the shop drawings. As a consequence of shop drawing practices, depending on the site condition, the costs agreed in the tender may vary due to the revision of construction works. In this context, it will be beneficial for contractors and project owners to be cautious about cost control in construction projects where shop drawings are applied. It will be beneficial for contractors to prepare bids during the tender process, as taking into account the impact of shop drawings practices on increasing the cost of the project.

This research in overall revealed the importance that, in Turkish construction industry, construction projects may experience less problems if:

- All organizations fulfil their responsibilities during the project stages.
- Quality - Based Evaluation to award the contractors and consultants.
- The finer the preparation of project documents and well-organized in terms of technical and managerial aspects in pre-construction process.
- Continues and integrated planning, monitoring and performance controlling in all project phases (From Planning to Closure) both for techical and managerial aspects (i.e. BIM).
- Creating an integrated environenment for organizations and techical units.

Particularly, for the purpose of achieving integrated and compatible environment in construction projects for technical and managerial aspects, using a standard design tool can make it possible to achieve this goal. BIM technologies is becoming a potential tool for construction project managers in enhancing collaboration between stakeholders, reducing the changes, errors and misunderstanding in projects as well as reducing time required for project documentation, and therefore can be an effective in achieving successful project outputs (Nascimento et al., 2018) (Succar, 2009).

Because of project changes and claims, project performances are significantly affected and therefore any organization involved in the project could be condemned to pay the cost of the changes. As general terms, the findings were pointed out that, the better preparation of project documents and comprehensive organization in terms of both technical and managerial aspects prior to the construction execution could significantly help to reduce the need for change, and certainly the more successful project would being terminated. This thesis intended to create regional awareness on the risk of changes and claims as well as the effectiveness of preventive measures in construction projects.

In this study, the findings on the factors influencing changes have only proven according to the ideas of the construction organizations in Northern Cyprus, Turkey and the U.S.A. for lump sum contracted design bid build procured model building projects because of the chosen region and project characteristics. Therefore, researchers are encouraged to examine the risk level of causes of change and to examine the effectiveness of change preventive measures based on different regional and project characteristics.

The findings about the shop drawing practices, and findings on factors of claims and the preventive measures have only proven by the ideas of the construction organizations in Turkey, for a lump sum and design-bid-build contracted building projects because of the chosen region and project characteristics. Therefore, researchers are encouraged to examine the risk status of shop drawing practices as well as factors of contractors' claims and effectiveness of preventive measure for different regions and project characteristics.

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APPENDICES

Appendix A: The Relative Importance Index (R.I.I.) of Change Factors by Organization Types

Causes of Change	Contractor			Consultant-Owner			Overall		
	Frequency (F.I.)	Cost (C.I.)	Time (T.I.)	Frequency (F.I.)	Cost (C.I.)	Time (T.I.)	Frequency (F.I.)	Cost (C.I.)	Time (T.I.)
Errors/Inadequacies in Contract Drawings	71.7	71.7	63.9	64.7	57.5	57.5	68.0	61.9	58.3
Inconsistencies between different Designs	63.3	58.7	50.9	61.3	54.7	58.6	62.2	57.0	55.5
Errors and Inadequacy in Specification	59.4	58.3	48.3	56.4	50.9	49.5	58.0	53.0	47.3
Conflict among contract documents	54.4	61.0	52.1	61.8	54.3	53.8	58.4	56.5	52.1
Un-use of advanced design software	53.3	45.1	45.7	51.5	37.1	35.6	52.8	34.8	34.2
Constructability Ignored	50.0	53.5	59.7	55.9	54.4	57.4	53.4	53.2	57.5
Error in Cost Estimating and budgeting	48.9	57.8	48.9	45.1	55.5	45.2	47.0	55.7	46.5
Unrealistic imposed contract duration	41.7	41.1	56.7	59.3	45.9	63.0	51.3	42.9	58.7
Inadequate site investigation in pre-construction	50.0	61.9	58.9	56.4	54.8	57.3	53.8	58.1	58.0
Uncertainties / problems of Subsurface	41.7	53.9	55.0	50.0	51.4	51.8	46.3	52.3	53.1
Provision of additional shop drawings	55.0	55.6	57.2	58.8	46.8	54.2	57.2	49.6	54.2

Errors in execution	41.7	37.1	41.6	45.1	51.2	60.5	44.0	42.5	49.4
Material / Equipment / Manpower shortage	40.8	43.3	45.6	41.2	40.0	48.5	41.0	38.6	43.9
Additions / Omissions of work items	65.6	65.8	61.4	65.7	60.1	57.1	65.9	59.7	56.0
Lack of Experience of Project Participants	48.3	63.8	69.9	51.0	59.8	71.6	49.8	65.5	74.3
Poor communication between Parties	53.9	50.6	53.3	62.3	50.3	56.7	58.4	50.7	55.2
Owners Level of Construction Sophistication	52.2	46.7	46.1	49.5	44.7	46.2	50.8	43.5	43.9
Poor Contract Management	51.1	58.9	51.7	60.3	51.2	51.2	56.1	54.9	51.6
Inappropriate choice of project delivery system	50.0	47.8	41.1	51.0	49.4	39.6	50.2	47.5	39.3
Inappropriate choice of contract type	50.0	49.4	47.8	51.5	48.1	43.6	50.6	46.0	42.8
Low Contract Price (Competitive Bidding)	54.4	63.9	62.2	73.0	61.2	58.2	64.5	62.8	60.6
Unforeseeable Natural Conditions	42.2	46.7	55.6	42.2	35.4	46.7	42.3	40.2	50.1
Fluctuation in Tax / Interest Rate / Material and Labor Cost	43.3	48.9	39.2	42.4	44.0	38.6	43.4	48.0	41.2
Change in government laws/ regulations	32.2	33.3	33.3	30.9	32.5	33.5	31.5	34.1	34.4
Shortening / Compression in Project Schedule	39.4	46.7	56.1	41.7	49.0	57.8	41.2	45.8	54.7

Appendix B: The Relative Importance Index (R.I.I.) of Change Factors by Region Types

Causes of Change	Northern Cyprus-Turkey			The U.S.A.			Overall		
	Frequency (F.I.)	Cost (C.I.)	Time (T.I.)	Frequency (F.I.)	Cost (C.I.)	Time (T.I.)	Frequency (F.I.)	Cost (C.I.)	Time (T.I.)
Errors/Inadequacies in Contract Drawings	67.0	66.1	62.6	70.8	51.8	47.6	68.0	61.9	58.3
Inconsistencies between different Designs	62.2	52.2	51.5	62.5	71.7	67.5	62.2	57.0	55.5
Errors and Inadequacy in Specification	56.3	56.1	52.3	62.5	47.9	37.5	58.0	53.0	47.3
Conflict among contract documents	58.7	60.9	57.1	57.3	50.0	43.8	58.4	56.5	52.1
Un-use of advanced design software	51.7	30.0	31.4	56.3	42.7	38.5	52.8	34.8	34.2
Constructability Ignored	51.7	55.2	60.1	57.3	49.0	52.1	53.4	53.2	57.5
Error in Cost Estimating and budgeting	45.8	58.2	46.1	50.0	50.0	47.9	47.0	55.7	46.5
Unrealistic imposed contract duration	50.7	43.8	63.9	52.1	42.7	47.9	51.3	42.9	58.7
Inadequate site investigation in pre-construction	51.6	61.6	61.8	58.9	52.1	51.0	53.8	58.1	58.0
Uncertainties / problems of Subsurface	45.5	57.9	58.6	47.9	42.7	43.8	46.3	52.3	53.1
Provision of additional shop drawings	56.3	47.7	53.6	59.4	54.2	55.2	57.2	49.6	54.2

Errors in execution	41.0	41.5	49.8	51.0	42.7	45.8	44.0	42.5	49.4
Material / Equipment / Manpower shortage	41.1	36.9	44.7	40.6	42.7	41.7	41.0	38.6	43.9
Additions / Omissions of work items	63.9	57.8	54.6	70.8	62.5	57.3	65.9	59.7	56.0
Lack of Experience of Project Participants	49.7	76.2	87.7	50.0	50.0	52.1	49.8	65.5	74.3
Poor communication between Parties	58.7	51.7	58.0	57.3	49.0	49.0	58.4	50.7	55.2
Owners Level of Construction Sophistication	50.3	45.0	46.0	52.1	39.6	38.5	50.8	43.5	43.9
Poor Contract Management	55.9	59.2	56.0	56.3	49.0	44.8	56.1	54.9	51.6
Inappropriate choice of project delivery system	52.4	52.0	42.6	44.8	38.5	33.3	50.2	47.5	39.3
Inappropriate choice of contract type	51.7	50.1	47.0	47.9	39.6	36.5	50.6	46.0	42.8
Low Contract Price (Competitive Bidding)	64.9	69.3	66.2	62.5	53.4	53.4	64.5	62.8	60.6
Unforeseeable Natural Conditions	41.3	39.1	50.9	44.8	42.7	47.9	42.3	40.2	50.1
Fluctuation in Tax / Interest Rate / Material and Labor Cost	39.2	45.9	35.1	53.6	49.5	52.1	43.4	48.0	41.2
Change in government laws/ regulations	31.3	34.2	36.2	32.3	33.3	29.2	31.5	34.1	34.4
Shortening / Compression in Project Schedule	37.2	43.0	53.4	51.0	46.9	52.1	41.2	45.8	54.7

Appendix C: Frequency Index (F.I.) of Shop Drawing Practices according to the Work Items

	Frequency Index (F.I.)		
Work Items	Contractors	Consultant-Owner	Overall
Excavation and Foundation	0,685	0,692	0,689
Structural Frame	0,704	0,615	0,660
Electrical	0,565	0,519	0,542
Waste Water	0,528	0,462	0,495
Domestic Water	0,519	0,500	0,509
Construction works after structural frame	0,713	0,673	0,693
Doors, Windows and other fine works	0,722	0,673	0,698

Appendix D: Cost Overrun Index (C.I.) of Shop Drawing Practices according to the Work Items

	Cost Overrun Index (C.I.)		
Work Items	Contractors	Consultant-Owner	Overall
Excavation and Foundation	0,731	0,625	0,679
Structural Frame	0,704	0,625	0,665
Electrical	0,556	0,567	0,561
Waste Water	0,463	0,394	0,429
Domestic Water	0,435	0,365	0,401
Construction works after structural frame	0,667	0,654	0,660
Doors, Windows and other fine works	0,565	0,596	0,580

Appendix E: Time Overrun Index (T.I.) of Shop Drawing Practices according to the Work Items

	Time Overrun Index (T.I.)		
Work Items	Contractors	Consultant-Owner	Overall
Excavation and Foundation	0,565	0,567	0,566
Structural Frame	0,741	0,673	0,708
Electrical	0,565	0,423	0,495
Waste Water	0,454	0,356	0,406
Domestic Water	0,491	0,356	0,425
Construction works after structural frame	0,667	0,625	0,646
Doors, Windows and other fine works	0,593	0,577	0,585

Appendix F: Frequency Index (F.I.) of Shop Drawing Practices according to Project Disciplines

	Frequency Index of Shop Drawings (F.I.)		
Project Disciplines	Contractors	Consultant-Owner	Overall
Static Project Works	0,806	0,817	0,811
Architectural Project Works	0,815	0,856	0,835
Mechanical Project Works	0,583	0,635	0,608
Electrical Project Works	0,593	0,644	0,618

Appendix G: Frequency Index (F.I.) of Shop Drawing Practices by Contract Types

	Frequency Index of Shop Drawings (F.I.)		
Contract Types	Contractors	Consultant-Owner	Overall
Lump Sum	0,574	0,596	0,585
Unit Price	0,556	0,606	0,580
Cost+ Fixed Fee	0,565	0,548	0,557
Cost+ Percentage of Cost	0,630	0,538	0,585

Appendix H: Cost Overrun Index (C.I.) of Shop Drawing Practices by Contract Types

	Cost Overrun Index of Shop Drawings (F.I.)		
Contract Types	Contractors	Consultant-Owner	Overall
Lump Sum	0,435	0,490	0,462
Unit Price	0,583	0,596	0,590
Cost+ Fixed Fee	0,657	0,548	0,604
Cost+ Percentage of Cost	0,444	0,490	0,467

Appendix I: Frequency Index (F.I.) of Shop Drawing Practices by Procurement Model

	Frequency Index of Shop Drawings (F.I.)		
Procurement Model	Contractors	Consultant-Owner	Overall
Design-Bid-Build	0,611	0,500	0,557
Design-Build	0,602	0,577	0,590
Partnering	0,528	0,462	0,495

Appendix J: Cost Overrun Index (C.I.) of Shop Drawing Practices by Procurement Model

	Cost Overrun Index of Shop Drawings (F.I.)		
Procurement Model	Contractors	Consultant-Owner	Overall
Design-Bid-Build	0,509	0,548	0,528
Design-Build	0,556	0,500	0,528
Partnering	0,509	0,471	0,491

Appendix K: The Relative Importance Index (R.I.I.) of Claim Factors by Organization Types

	Contractor			Consultant -Owner			Overall		
Factors Affecting Claims	**Frequency (F.I.)**	**Cost-Time (C.T.I.)**	**Dispute (D.I.)**	**Frequency (F.I.)**	**Cost-Time (C.T.I.)**	**Dispute (D.I.)**	**Frequency (F.I.)**	**Cost-Time (C.T.I)**	**Dispute (D.I.)**
Inadequacies in Contract Drawings	0.787	0.760	0.720	0.731	0.610	0.588	0.769	0.723	0.687
Low Constructability Design	0.593	0.660	0.593	0.478	0.546	0.568	0.544	0.626	0.579
Inadequacies in Specification	0.684	0.782	0.698	0.489	0.511	0.533	0.631	0.722	0.652
Inconsistencies between different designs	0.723	0.803	0.683	0.511	0.600	0.511	0.666	0.749	0.635
Changes in Scope	0.727	0.653	0.640	0.622	0.578	0.533	0.641	0.636	0.615
Inadequacies in Contract	0.707	0.640	0.653	0.667	0.533	0.533	0.697	0.615	0.626
Inadequate knowledge of client	0.703	0.763	0.693	0.554	0.543	0.514	0.655	0.695	0.624
Inadequate Experience of Consultants	0.763	0.714	0.663	0.537	0.581	0.563	0.704	0.675	0.641
Low contract price	0.593	0.653	0.560	0.622	0.622	0.556	0.600	0.646	0.559
Inadequate time in tendering	0.620	0.640	0.607	0.647	0.616	0.593	0.641	0.625	0.604
Inadequacies in Organizations	0.593	0.647	0.587	0.656	0.596	0.628	0.632	0.615	0.602
Lack of Communication between parties	0.600	0.647	0.580	0.444	0.444	0.489	0.564	0.600	0.559
Changes in Construction Method	0.547	0.647	0.587	0.533	0.533	0.511	0.544	0.621	0.569
Errors of subcontractors	0.580	0.633	0.593	0.631	0.651	0.656	0.610	0.629	0.632
Inclusion of Shop Drawings	0.746	0.677	0.640	0.671	0.542	0.577	0.721	0.641	0.621

Inadequate Experience of contractor	0.627	0.627	0.600	0.621	0.658	0.511	0.616	0.641	0.572
Inflation in Resources Cost	0.620	0.600	0.627	0.622	0.600	0.622	0.621	0.600	0.626
Natural Disasters	0.593	0.647	0.567	0.422	0.556	0.400	0.554	0.626	0.528
Subsurface Problems	0.667	0.673	0.660	0.578	0.489	0.533	0.646	0.631	0.631
Shortages of Materials	0.653	0.700	0.620	0.594	0.618	0.656	0.631	0.674	0.640
Changes in Law and Standards	0.560	0.593	0.587	0.422	0.489	0.467	0.528	0.569	0.559

Appendix L: The Relative Importance Index (R.I.I.) of Claim Mitigation Measures by Organization Types

		Contractor			Consultant-Owner			Overall		
No	**Mitigation Measure Factors**	**E.I.**	**C.P.I.**	**T.P.I.**	**E.I.**	**C.P.I.**	**T.P.I**	**E.I.**	**C.P.I.**	**T.P.I.**
1	A standard form of Drawings	0.733	0.700	0.800	0.556	0.600	0.556	0.692	0.579	0.646
2	Detailed Drawing/Specification	0.753	0.784	0.884	0.722	0.742	0.630	0.746	0.772	0.821
3	Advanced Design Software (BIM)	0.700	0.640	0.553	0.600	0.622	0.622	0.677	0.636	0.569
4	Front-End Planning (Feasibility)	0.707	0.700	0.733	0.660	0.652	0.566	0.696	0.690	0.696
5	Qualified Architect-Engineer	0.797	0.690	0.780	0.758	0.723	0.733	0.788	0.716	0.768
6	Easy Constructability Design	0.783	0.750	0.747	0.711	0.622	0.644	0.750	0.708	0.717
7	Effective Communication	0.740	0.627	0.687	0.622	0.533	0.578	0.713	0.605	0.662
8	Sharing Historical Data	0.747	0.653	0.693	0.556	0.533	0.578	0.703	0.626	0.667
9	Qualified Project Manager	0.763	0.737	0.713	0.611	0.706	0.683	0.725	0.720	0.697
10	Detailed Contract	0.743	0.747	0.793	0.689	0.689	0.756	0.731	0.724	0.785
11	Staff training	0.733	0.627	0.727	0.711	0.644	0.667	0.728	0.631	0.713
12	Contractors well-bidding organization	0.700	0.713	0.733	0.751	0.729	0.796	0.716	0.705	0.749
13	Risk-sharing philosophy	0.757	0.683	0.790	0.578	0.578	0.578	0.697	0.660	0.743
14	Awarding Right Contractor	0.700	0.707	0.713	0.800	0.689	0.667	0.723	0.703	0.703
15	Effective Site Management	0.710	0.703	0.757	0.777	0.715	0.766	0.732	0.706	0.754
16	Pre investigation of the site	0.707	0.633	0.740	0.701	0.746	0.778	0.708	0.662	0.749
17	Effective Quality Control	0.687	0.667	0.677	0.756	0.689	0.667	0.730	0.674	0.674