ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

CONSTRUCTION RISK MANAGEMENT IN DEVELOPING COUNTRIES

M.Sc. THESIS

Tuna ERATA

Department of Architecture

Project and Construction Management Program

DECEMBER 2017

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Thesis Advisor: Prof. Dr. Fatma Heyecan GİRİTLİ

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

GELİŞMEKTE OLAN ÜLKELERDE İNŞAAT RİSK YÖNETİMİ

YÜKSEK LİSANS TEZİ

Tuna ERATA
(502141416)

Mimarlık Anabilim Dalı

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Tez Danışmanı: Prof. Dr. Fatma Heyecan GİRİTLİ

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Tuna Erata, a **M.Sc.** student of ITU Graduate School of Science Engineering and Technology with student ID: 502141416, successfully defended the **thesis/dissertation** entitled **"CONSTRUCTION RISK MANAGEMENT IN DEVELOPING COUNTRIES"**, which he prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor :	**Prof. Dr. Fatma Heyecan GİRİTLİ** Istanbul Technical University	.....
Jury Members :	**Prof. Dr. Hüsnü Murat GÜNAYDIN** Istanbul Technical University	.....
	Asst. Prof. Dr. Mehmet UĞURAL Istanbul Kultur University	.....

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FOREWORD

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December 2017

Tuna ERATA
(Architect)

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ABBREVIATIONS

AIC	**:** Advanced Industrialized Countries
APM	**:** Association of Project Management
CIC	**:** Construction Intelligence Center
EAP	**:** Economically Active Population
EPC	**:** Engineering Procurement Construction
EU	**:** European Union
GAAT	**:** General Agreement on Tariffs and Trade
GATS	**:** General Agreement of Trade and Services
GDP	**:** Gross Domestic Product
GNI	**:** Gross National Income
HDI	**:** Human Development Index
HDR	**:** Human Development Report
IBRD	**:** The International Bank for Reconstruction and Development
IMF	**:** International Monetary Fund
JRI	**:** Journal of Risk & Insurance
LDC	**:** Less Developed Countries
NIC	**:** Newly Industrialized Countries
OGC	**:** Office of Government Commerce
PCC	**:** Pearson Correlation Coefficient
RM	**:** Risk Management (Journal)
TCA	**:** Turkish Contractors Association
UN	**:** The United Nations
UNDP	**:** The United Nations Development Programme
USSR	**:** Union of Soviet Socialist Republics
WTO	**:** World Trade Organization

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CONSTRUCTION RISK MANAGEMENT IN DEVELOPING COUNTRIES

SUMMARY

Since the final products of construction industry are generally unmovable items such as buildings, facilities or infrastructures, the construction industry has been considered as a local industry in the past. However, through the benefits of globalization, which increased after 1950s, construction industry began to internationalize like many other industries and this internationalization increased rapidly by the help of international institutions and commercial agreements in the late 1990s.

Developing countries has a major role in international construction market. When the characteristics of developing countries are examined, it can be seen that they provide the development criteria in economy, social life, human rights or technology at a certain level, but not as much as the developed countries. Besides, when the economic structure of developing countries are examined, it can be seen that the construction industry has an important role in these countries, since its ability to provide a nationwide economic mobility through its various sub-industries. Due to increasing need of complex construction projects, which are beyond the capacity of local contractors, developing countries become an attractive market for international contractors. Financial aids provided for developing countries and increasing income from natural resources in the Middle East, are some of the other factors, which increase the importance of developing countries in the international construction market.

All these factors along with the great profit expectations, lead contractors to the international market. However, international construction market contains much more risk than local construction markets. In addition to regular construction risks, international projects are exposed to financial, technical and logistical risks in overseas construction market. Especially in developing countries, these risks exist alongside various local factors such as socio-political and economic stress, lack of resources or institutional inabilities. These facts make it necessary for international contractors to take special precautions against construction risks, especially when operating in developing countries.

Risk and uncertainty are inherent elements of construction business. Generally, these risks are gathered under six categories, which are technical, logistical, managerial, environmental, socio-political and economical risks. Construction risks can also be classified according to their sources, characteristics or the factors they are affected by.

Risk management is a concept, which became popular at corporate level after 1950s, also with the help of increasing academic studies on this subject. However, it became a popular topic in construction industry in 1990s. Generally, risk management refers to the process of identification and evaluation of potential risks, developing response plans and monitoring the results. Opportunities or positive risks are also identified

and evaluated in the risk management process. The response plans against the risks can be avoiding, mitigating or sharing the risk as well as accepting it.

As it is already stated, international construction projects are exposed to high amount of risk, since international projects are usually large scaled projects and directly affected by economic or socio-political status of the target country. There is a large number of studies in the literature regarding to international construction risks. However, many studies focus on these risks in a general categorization such as market, country or project level risks. In addition, some of the studies collect data from various projects and from various countries, which may mislead the researcher, since every country and every project have their own dynamics. In this sense, this study presents a detailed case study based on a specific international construction project, which is located in a developing country. The selected project for this case study is "Turkmenbashi International Seaport", which is located in Turkmenbashi, Turkmenistan and under construction by the year 2017. The project value is approximately 1.5 billion US dollars and was undertaken by a single Turkish construction company. It is a complex project consisting of terminals, shipyards, railroads, highways and administration facilities.

In the scope of the case study, 50 risk factors are identified, which are common in large-scale international projects according to literature review. In the first part of the study, background information was collected from the participants, which are 20 employees from head office in Turkey and site office in Turkmenbashi. In the second part, participants were asked to evaluate the identified risks in terms of their risk impact level (scale of 1 to 5) and probability of occurrence (percentage) according to their experience and insight. In the final part of the survey, 15 top rated risks were identified through the data collected from the second part of the survey. Afterwards, in order to collect information about the mitigation and response techniques used in the company against these risks, open-ended interviews were carried out with the executives of the related departments.

According to the results of the study, highest and lowest rated risks were analyzed. Generally, risks related to delayed payments from employer, budget overruns, missing the project deadline, late submittal of projects and logistics were rated as the highest risks. On the other hand, risks related to force majeure, intercountry relations or company's adaptation to the country were considered as the lowest level risks. The probable reasons for these risk ratings were also explained in the study.

Among the responses, the standard deviation values were calculated and it was observed that the results were generally consistent; however, there are some different opinions about certain risks due to the characteristics of the participants. In this context, the risk rankings made by respondents according to their characteristics such as managerial level, gender, profession, working location (headquarters or site) were analyzed using Pearson and Kendall's W correlation tests. The results and correlations are presented in the appendices and fourth chapter of the study.

According to the results received in the second part of the case study, 15 top rated risks were identified. After that, interviews were carried out with the executives in the company in order to gather information about risk response and mitigation techniques used at the company and details are presented in the fourth chapter of the study. In general terms, these measures consist of a number of risk avoidance and mitigation methods developed on financial, technical, managerial and logistical risks

by taking into account the fact that these risks are directly influenced by the dynamics of the country and geography.

Within the scope of this thesis, developing countries, international construction industry, risks in construction and risk management issues are examined. In order to support the findings and obtain new information regarding to the subject, a case study is carried out, of which the details are summarized above. As a result of this thesis, the statements presented in the introductory part of the study are verified and a number of suggestions are provided for the future studies.

GELİŞMEKTE OLAN ÜLKELERDE İNŞAAT RİSK YÖNETİMİ

ÖZET

İnşaat sektörü, son ürünlerinin genelde taşınmaz tesisler olmasının da etkisiyle, geçmişte çoğunlukla yerel bir sektör olarak görülmüştür. Tarihte birkaç örneği olsa da, gerçek anlamda uluslararası inşaat projeleri 1950'lerden sonra yaygınlaşmaya başlamıştır. Özellikle 2. Dünya Savaşı sonrası hızlanan endüstrileşme ve yapılaşma sürecinde, ülkeler arası teknoloji, bilgi ve iş gücü aktarımı zorunlu hale gelmiştir. Bu globalleşme süreci 1990'ların sonuna doğru, birtakım uluslararası kuruluşlar ve ticaret anlaşmalarının da yardımıyla ciddi anlamda hız kazanmış ve inşaat sektörü de bu gelişmelerden fayda sağlamıştır. Ayrıca, gelişmekte olan ülkelere yapılan finansal yardımlar ve Ortadoğu bölgesinde petrol, doğalgaz gibi doğal kaynaklardan elde edilen gelirler uluslarlarası inşaat işlerinin artışında önemli bir rol oynamıştır. Bu bağlamda, gelişmekte olan ülkelerde, büyük ölçekli liman, havaalanı, otoyol, fabrika gibi yerel müteahhitlerin kapasitelerini aşan kompleks inşaat projelerine gereksinim artmıştır. Bu durum da inşaat hizmetlerinin "ithal" edilmesine zemin hazırlamıştır. Uluslararası sektörlerde genel olarak gelişmiş ülkeler, gelişmekte olan ve az gelişmiş ülkelere teknoloji ve uzmanlık hizmeti sağlamaktadır. Öte yandan, gelişmekte olan ülkeler piyasaya hazır üretim mallar, az gelişmiş ülkeler ise işgücü sunmaktadır. Dolayısıyla gelişmekte olan bir ülkede yürütülen büyük ölçekli kompleks projeler, hem gelişmiş hem de gelişmekte olan diğer ülkelerin katkısıyla gerçekleşmektedir.

Gelişmekte olan ülkelerin karakteristik özelliklerine bakıldığında, ekonomi, sosyal hayat, insan hakları ve teknoloijk gelişmeler gibi bazı alanlarda, gelişmişlik kriteri olarak kabul edilen değerleri belli bir düzeyde sağladıkları, ancak gelişmiş ülkelere kıyasla biraz daha geride oldukları görülmektedir. Ayrıca gelişmekte olan ülkelerin ekonomik yapıları incelendiğinde, inşaat sektörünün önemli bir rolü olduğu anlaşılmaktadır. Birçok alt sektör ve yan sanayi içeren inşaat sektörü, ülke çapında ekonomik hareketlilik sağlayabilmesi nedeniyle gelişmekte olan ülkelerde genellikle ön planda olan ve yüksek yatırımlar yapılan bir sektördür.

Tüm bu gelişmelerle birlikte, dünya genelinde birçok müteahhit firma uluslararası inşaat sektörüne giriş yapmaya başlamıştır. Yerel piyasaların daralması, ekonomik problemler, şirket büyütme hedefleri ve yüksek kar beklentileri, inşaat firmalarını uluslararası piyasalara yönlendiren diğer faktörlerdir. Ancak yabancı bir ülkede, uluslararası bir inşaat projesi yürütmek, yerel piyasada proje gerçekleştirmeye göre çok daha yüksek oranda risk içermektedir. Bu tip projeler, inşaat sektöründeki genel risklere ilave olarak, uluslararası alanda karşılaşılan diğer ekonomik, teknik ve lojistik risklere de maruz kalmaktadır. Özellikle gelişmekte olan ülkelerdeki inşaat projelerinde karşılaşılan riskler, ülkenin sosyo-politik ve ekonomik koşullarından direkt olarak etkilenmektedir. Bu durum da uluslararası pazarda iş yapan müteaahitlerin özel önlemler almalarını ve detaylı bir risk yönetim süreci yürütmelerini zorunlu kılmaktadır.

Risk ve belirsizlik, inşaat projelerinin doğasında yer alan faktörlerdir. Birbirine bağlı yüzlerce aktiviteden oluşan inşaat projelerinde, en ufak belirsizlikler dahi riske

dönüşmekte ve proje başarısını tehdit eden unsurlar haline gelmektedir. İnşaat projelerindeki riskler genel olarak teknik, lojistik, yönetimsel, çevresel, sosyo-politik ve finansal olmak üzere altı kategoride toplanmaktadır. Bu kategorilere ek olarak inşaat riskleri, kaynaklarına, karakteristik özelliklerine ve bağlı oldukları faktörlere göre de kategorize edilebilmektedir. Proje riskleri incelenirken göz önünde bulundurulması gereken bir diğer konu da pozitif risklerdir. Proje sürecindeki herhangi bir belirsizlik, tehdit anlamına gelmeyip, bünyesinde fırsatlar barındırıyor olabilir. Bu tip fırsatların da değerlendirilmesinde proje risk yönetim süreçleri önemli bir rol oynamaktadır.

Risk yönetimi, kurumsal anlamda 1950'lerden sonra yaygınlaşmaya başlamıştır. Öncelikle büyük şirketler tarafından, iş portföyünü belli başlı risklere karşı güvence altına almak amacıyla kullanılmıştır. 1950-60'lı yıllarda bu alanda akademik çalışmalar hız kazanmış ve elde edilen bulguları piyasa koşullarına uyarlamak için de ayrıca çalışmalar yapılmıştır. Risk yönetimi kavramının inşaat sektöründe yaygınlaşması ise 1990'lı yılları bulmuştur. Genel anlamda risk yönetimi, potansiyel tehditlerin ve risklerin belirlenmesi, analiz edilmesi ve bu risklere karşı eylem planları hazırlanması olarak ifade edilebilir. Uygulanan eylem planlarına dair süreç ve sonuçların gözlemlenmesi ve bunlara yönelik analizler yapılması da risk yönetim sürecinin bir parçasıdır. Aynı zamanda fırsatlar veya pozitif riskler de bu süreç kapsamında değerlendirilip, bu doğrultuda eylem planları hazırlanmaktadır. Bu eylem planları, riskin etkilerini azaltmak üzerine olabileceği gibi, riskten kaçınmak, riski paylaşmak, riski transfer etmek ve kimi zaman da riski kabullenmek gibi stratejilerden oluşabilmektedir. Bu risk yönetim süreçlerinin şirket düzeyinde yürütülmesi kurumsal firmalar için büyük önem arz etmektedir.

Daha önce de belirtildiği gibi, uluslararası inşaat piyasası yerel piyasalara göre çok daha yüksek oranda ve farklı tipte riskler içermektedir. Uluslararası inşaat projeleri genellikle büyük ölçekli karmaşık projeler olup, piyasaya ve ülke şartlarına bağlı ekonomik, sosyo-politik ve çevresel faktörlerden direkt olarak etkilenmektedir. Bu faktörler gelişmekte olan ülkelerde çok daha hassas ve değişken olduğundan dolayı, bu ülkelerde yürütülen projelerde sıradan inşaat riskleri çok daha güçlü bir etkiyle hissedilmektedir.

Uluslararası inşaat projelerinde risk yönetimiyle ilgili olarak, literatürde birçok araştırma bulunmasına karşın, bu çalışmaların genellikle piyasa, ülke ve proje seviyesinde riskler şeklinde, genel bir kategorizasyon kullanılarak gerçekleştirildiği görülmüştür. Ayrıca bazı çalışmalarda, araştırmacılar farklı ülkelerden ve farklı projelerden topladıkları verileri bir arada analiz etmişlerdir. Ancak her ülkenin, coğrafyanın ve projenin kendine özgü dinamikleri olduğundan dolayı, uluslararası bir inşaat projesine risk yaklaşımı proje özelinde gerçekleştirilmelidir. Özellikle gelişmekte olan ülkelerde yürütülen projelerde, risk yönetim planlaması yapılırken, her aşamada ülkenin sosyo-politik ve ekonomik atmosferi göz önünde bulundurulmalı, bu faktörlerin riskler üzerindeki etkileri daima hesaba katılmalıdır. Bu bağlamda, bu tez çalışması kapsamında, gelişmekte olan bir ülkede yürütülen, büyük ölçekli bir uluslararası inşaat projesi seçilmiş, anket ve görüşmeler yardımıyla, bu projeye dair bir risk değerlendirme çalışması yapılmıştır. Çıkan sonuçlar doğrultusunda, kritik öneme sahip riskler için müteahhit firmada alınan risk aksiyonları incelenmiştir. Bu vaka çalışması için seçilen proje, Türkmenistan'ın Türkmenbaşı şehrinde yer alan, 2017 yılı itibariyle inşaatı devam eden "Uluslararası Türkmenbaşı Liman Projesi"dir. Proje bedeli yaklaşık 1,5 milyar Amerikan Doları olup, yapımı mühendislik, tedarik ve inşaat sözleşmesi ile anahtar teslim olarak bir

Türk inşaat şirketi tarafından tek başına üstlenilmiştir. Proje büyük ölçekli bir liman kompleksi olup, içerisinde tersane, yolcu/feribot terminali, yük terminalleri, otoyol ve demiryolu gibi birçok inşaat kalemi bulunmaktadır. Proje katılımcıları arasında işveren temsilcisi olarak bir Alman firması ve 3. parti bağımsız denetim şirketi olarak da bir İtalyan firması yer almaktadır.

Vaka çalışması kapsamında, uluslararası inşaat projelerinde sıklıkla karşılaşılan 50 tip risk belirlenmiş ve 7 ana kategori altında toplanmıştır. Literatür araştırmasında belirlenen 6 risk kategorisine ek olarak, proje için önem arz eden, 3. parti ile alakalı riskler de ayrı bir kategoride toplanmıştır. Böylece belirlenen 50 adet risk, anket kapsamında, sosyo-politik, yönetimsel, finansal, teknik, lojistik, çevresel ve 3. parti ilişkili riskler olmak üzere kategorize edilmiştir. Ankete, liman projesinin, proje yönetim ekibinde görevli 20 çalışan katılmıştır. Çalışanların bir kısmı saha ofisinde, bir kısmı merkez ofiste görevli personeller olup, meslekleri ve sektördeki tecrübeleri çeşitlilik göstermektedir.

Vaka çalışmasının ilk bölümünde, katılımcıların meslek, yaş ve inşaat sektöründeki tecrübeleri ile ilgili birtakım kişisel ve mesleki bilgiler toplanmıştır. İkinci bölümde ise belirlenmiş 50 riske dair bir anket sunulmuştur. Anket kapsamında, katılımcılardan her bir risk için 1 ve 5 arasında bir risk etki değeri seçmeleri, ardından tecrübe ve kişisel görüşlerine göre, bu riskin proje sürecinde gerçekleşme ihtimalini yüzde olarak belirlemeleri istenmiştir. Buna göre her bir riskle ilgili risk puanı hesaplanmıştır. Çalışmanın üçüncü bölümünde ise, ikinci bölümden elde edilen veriler doğrultusunda belirlenen en kritik 15 risk için şirketin aldığı aksiyon planları incelenmiştir. Bu bilgilerin toplanması, risklerin kategorilerine göre, ilgili departmanların yöneticileriyle yapılan birebir görüşmeler yardımıyla gerçekleşmiştir.

Anket sonuçları doğrultusunda bu 50 risk faktörü, öncelikle puanlarına göre en yüksekten en düşüğe doğru sıralanmıştır. Genel sonuçlara göre en yüksek ve en düşük risk puanlarına sahip riskler incelenmiş ve bu sonuçlar, olası gerekçeleriyle birlikte yorumlanmıştır. Genel olarak, geciken hakediş ödemeleri, proje bitiş tarihinin sapması, bütçe aşımları, iş programındaki sapmalar, geciken proje teslimleri ve lojistik ile ilgili risklerin yüksek puanlara sahip oldukları görülmüştür. En düşük puanlara sahip riskler ise, doğal afet, savaş gibi mücbir sebepler, ikili ülke ilişkilerine dayalı politik riskler ve firmanın ülke koşullarına uyum sağlayamamasından kaynaklı riskler olarak görülmüştür. Çalışmada ayrıca, bu risklerin yüksek veya düşük olarak puanlanmasının olası nedenleri üzerinde de durulmuştur.

Çalışmada, sonuçlar arasındaki standart sapma değerleri de hesaplanmış ve sonuçların genel olarak paralellik gösterdiği ancak belli başlı riskler konusunda fikir ayrımları olduğu da görülmüştür. Örneğin merkez ofis çalışanları, en kritik risk olarak, "işveren'den gelen hakediş ödeme gecikmeleri"ni belirlemiş iken, saha ofisinden katılımcılar "proje tamamlanma tarihinin kaçırılması"nı en kritik risk olarak değerlendirmiştir. Bu riskler gerçekleştiğinde ortaya çıkan sonuçlar, şirketin çeşitli departmanlarında farklı etkilerle hissedilmesinden dolayı, bu tip görüş ayrılıkları ortaya çıkmıştır. Bunlara ek olarak, şirketteki poziyon, çalışma lokasyonu (saha veya merkez ofis), cinsiyet, meslek gibi katılımcıların karakteristik özelliklerine göre ortaya çıkan risk sıralamaları da hesaplanmıştır. Sonuçlar arasındaki oy birliği ve korelasyon, Pearson ve Kendall's W korelasyon testleri kullanılarak incelenmiştir. Aralarında pozitif veya negatif korelasyon görülen risk faktörleri ve katılımcıların özelliklerine göre ortaya çıkan risk sıralamalarına ilişkin

sonuçlar detayları ile birlikte tez çalışmasının 4. kısmında ve ekler bölümünde sunulmuştur.

Vaka çalışmasının ilk iki bölümünden elde edilen sonuçların analiz edilmesinin ardından, genel sonuçlara göre en yüksek risk puanlarına sahip 15 risk belirlenmiştir. Şirkette bu risklere karşı alınan önlemler, hafifletme ve eylem planlarıyla ilgili bilgi edinmek amacıyla, bu risklerin ilgili olduğu departmanların yöneticileriyle görüşmeler yapılmış ve ilgili detaylar tez çalışmasının 4. bölümünde sunulmuştur. Genel anlamda bu önlemler, risklerin ülkeye ve coğrafyaya ait dinamiklerin direkt olarak etkisinde olduğu da göz önünde bulundurularak, finansal, teknik ve lojistik alanda geliştirilen birtakım riskten kaçınma ve riski hafifletme yöntemlerinden oluşmaktadır.

Bu tez çalışması kapsamında, gelişmekte olan ülkeler, uluslararası inşaat sektörü, inşaat sektöründeki riskler ve risk yönetimi konuları incelenmiştir. Ardından, bulguların desteklenmesi ve yeni bilgiler elde edilmesi amacıyla, gelişmekte olan bir ülkede yürütülmekte olan büyük ölçekli bir inşaat projesi seçilmiş ve yukarıda detayları özetlenen vaka çalışması gerçekleştirilmiştir. Bu araştırmaların sonucunda, çalışmanın giriş bölümünde bahsedilen, uluslararası inşaat, gelişmekte olan ülkeler ve inşaat risk yönetimine dair ifadeler büyük ölçüde doğrulanmış olup, gelecekteki araştırmalar için de birtakım öneriler sunulmuştur.

1. INTRODUCTION

The construction industry has been considered as a local industry in the past, since the final products of construction industry are generally unmovable items such as buildings, facilities, infrastructures etc. However, through the benefits of globalization, which became popular after the period of World War II due to increasing need of exchanging technology, labour and skills between the countries, construction industry also started to internationalize rapidly. Especially, in the late 1990s, by the help of international institutions and agreements such as GAAT, GATS, EU, WTO internationalization of the construction industry increased strongly (Langford, 2000).

Developing countries are one of the most important factors of internationalization in the construction industry. Local contractors of developing countries may not always achieve in constructing special facilities and complex projects such as airports, seaports, factories and highways. At this point, as Drewer (1980) stated, for developing countries it is generally unavoidable to "import construction", since the local contractors may not be sufficient to achieve the requirements of advanced projects. This situation creates many opportunities for the contractors from all over the world to internationalize. As Langford and Male (2001) pointed out, contractors take their business to other countries due to many reasons such as declining demand, saturation and high levels of competition in domestic market or expecting greater profits from overseas projects.

As a course of its nature, construction business is exposed high amount of risk and uncertainty at almost every stage, since a construction project includes various dependent activities and a minor error may affect the whole process. Smith et al. (2006) indicated that time, cost and quality, the three main elements in a construction project, are subject to risk factors at the same time, during the whole construction process. However, risk or uncertainty do not always have to be threats for the project. Some unexpected benefits may be gained from uncertainties. Hillson (2001) described the risk as an umbrella term, which consists of "threats" and "opportunities". These opportunities, also known as positive risks, may also be

determined in the risks management steps along with the negative risks and threats. Therefore, an effective risk management policy is crucial for success of the project. The concept of risk management is usually defined as the process of identification and evaluation of the risks, subsequently developing response plans against them and monitoring the results. This kind of a systematic approach is suggested also for the construction projects in several studies in the literature. Especially for the large or international projects, it is important to establish a systematic risk management policy at company level.

Regular construction risks, which may occur in domestic construction business, have higher levels of impact in international arena. Furthermore, some other risk factors related to international dynamics such as intercountry relations or logistical, managerial and financial issues, appear in overseas construction projects. These factors should be taken into consideration alongside the regular construction risks. Hastak and Shaked (2000) pointed out that in order to analyze risks for a specific international project, it is critical to determine how the project may be affected by the country conditions and international construction market environment. In other words, specific threats and opportunities related to target countries should be identified and analyzed in detail.

Since the construction industry has a great number of supplier industries, large-scale projects are able to provide a wide-ranging economic mobility in a country. Therefore, developing countries frequently make investment in construction. Construction Intelligence Center (2016), which is a large data and analysis source for global construction industry, pointed out that between the years 2012 and 2016 the global construction output has increased from 7.9 trillion to 8.8 trillion US Dollars and it is also projected that it will reach 10.1 trillion US Dollars in the year 2021. Moreover, 46.7% of this global output came from emerging economies and it is projected that by the year 2021 this rate will reach 52.8%. In other words, the share of developing countries in the global construction business is generally higher than developed countries.

As it is stated previously, developing countries do not always have enough qualification to carry out large-scale complex projects such as major factories, airports, seaports, dams or highways. As a result, construction services and expertise are imported from other countries, so that many contractors from all over the world

decide to internationalize and undertake overseas projects. Foreign construction firms, foreign consultancy, professional personnel, imported equipment and material are the main resources for developing countries to carry out special projects (Ofori, 1990).

However, carrying out a large overseas construction project in a developing country also means exposing the company to higher levels of risk. In developing countries, regular risks related to construction activities and international business occur at a different level. As Ofori (2000) stated, in developing countries regular construction risks exist alongside some other local factors such as socio-economic stress, institutional inabilities and lack of resources. In the case of carrying out an international overseas construction project in a developing country, risks should be identified and evaluated by taking into account of all the critical factors together, which include global economy, socio-political and economic stability of target country or specific threats/opportunities for the market and project itself. Every country and every construction project have their own dynamics so that risk management process should be developed according to the project by also taking into consideration of the environmental factors mentioned above.

1.1 The Purpose of the Study

In the light of the mentioned issues above, the study aims to overview the general characteristics of developing countries, the role of construction in emerging economies, the concept of construction risk management, construction risks in developing countries and risk management approaches against them through a case study. The study also bears on three statements, which are studied further through literature review and case study in the research:

- Construction industry has a significant role in developing country economies and by this means creates a major opportunity for international contractors.
- International construction includes high amount of risk, which occurs with stronger impact in the construction market of developing countries.
- A detailed risk management approach should be developed for the construction risks in developing countries, since the socio-political, economical or cultural

features of developing countries are relatively more delicate so that a regular construction risk may have a stronger impact than expected.

Alongside these statements, the study presents a case study on a large-scale international construction project, which has been carrying out in Turkmenistan. Thus, it aims to provide an insight for international contractors doing business in developing countries and to be a preliminary step for future researches on the topic.

1.2 Research Objectives

The characteristics of international construction, developing countries and risk management are highlighted in several chapters of the study. The general objective of this study is to understand the risk management approaches for international construction projects in developing countries. The specific objectives of the study can be listed as following:

- Overview the definition, general characteristics and economic conditions in developing countries.
- Examine the role of the construction industry in developing country economies.
- Overview the concept of risk and risk management processes in detail.
- Overview the concept of international construction and construction risks in developing countries.
- Conduct a case study based on a large international construction project located in a developing country in order to explore risk assessment and risk response strategies.
- Present the outcomes of the case study in detail and provide an insight for international contractors and future researches.

1.3 The Content of the Study and Methodology

The study consists of five main chapters and starts an introduction part about developing countries, international contruction business and the concept of construction risk, followed by the purpose of thesis and the content of the study in Chapter 1.

Chapter 2 overviews the definition and general characteristics of developing countries. In this section, the importance of construction industry in developing countries and the role of construction in emerging economies are also examined.

In Chapter 3, risk management processes are described alongside the concept of risk, including uncertainty and positive risk. Details about international construction and construction risks in developing countries are also presented in this chapter.

Chapter 4 includes a case study based on a large-scale international project in a developing country. Findings of this study and analyses are also presented in this chapter.

Finally, Chapter 5 presents a conclusion, evaluation of the study and suggestions for future researches.

The definitions, concepts and details about developing countries, nature of international construction industry and risk management processes are formed through a literature review. Afterwards, a case study is developed including a questionnaire & open-ended interviews with project management team of a large-scale international construction project in a developing country. Rankings, analyses and correlations regarding to the survey results are presented in the study.

2. DEVELOPING COUNTRIES AND THE CONSTRUCTION INDUSTRY

2.1 Developing Countries

2.1.1 Definition of developing country

Although there are several definitions for the term “developing country” in the literature, there is not a generally accepted definition for developing countries or any strict criteria to categorize them as developing or developed. However, there are some reference points that are critical for the analyses related to developing countries. Development level of the countries is mainly defined by economic benchmarks as well as other criteria such as social standards, human rights, technological development etc. In a literature review, it is also possible to come across to term "newly industrialized country" instead of the term developing country.

Nielsen (2011) indicated that The United Nation’s Development Programme (UNDP) uses Human Development Index (HDI) with the Human Development Report (HDR) for country classification since 1990. The HDI describes three critical measures for a country, which are life expectancy, education level and income. In addition, some other criteria such as security and freedom are taken into account for HDI. The International Bank for Reconstruction and Development (IBRD) under World Bank classifies the countries by their GNI (Gross National Income) in order to analyze their credit worth. According to O’Sullivan and Sheffrin (2007), a developing country can be defined as a country, which has a relatively lower industrial basis and HDI (Human Development Index) than other countries in the world. Figure 2.1 illustrates the human development levels of the countries for the year 2016 according to the data of Human Development Report of United Nations Development Programme (UNDP, 2016).

In the year 2013, the World Bank specified that the countries with a GNI (Gross National Income) per capita per year of 11,905 US dollars or less are categorized as “developing countries”. However, in 2016 the World Bank decided to remove the distinction between developing and developed countries since there is not a certain definition in the literature (World Bank, 2017).

As it is seen, although there are some various descriptions for the term "developing country" in the literature, there is not a commonly agreed, specific definition for it.

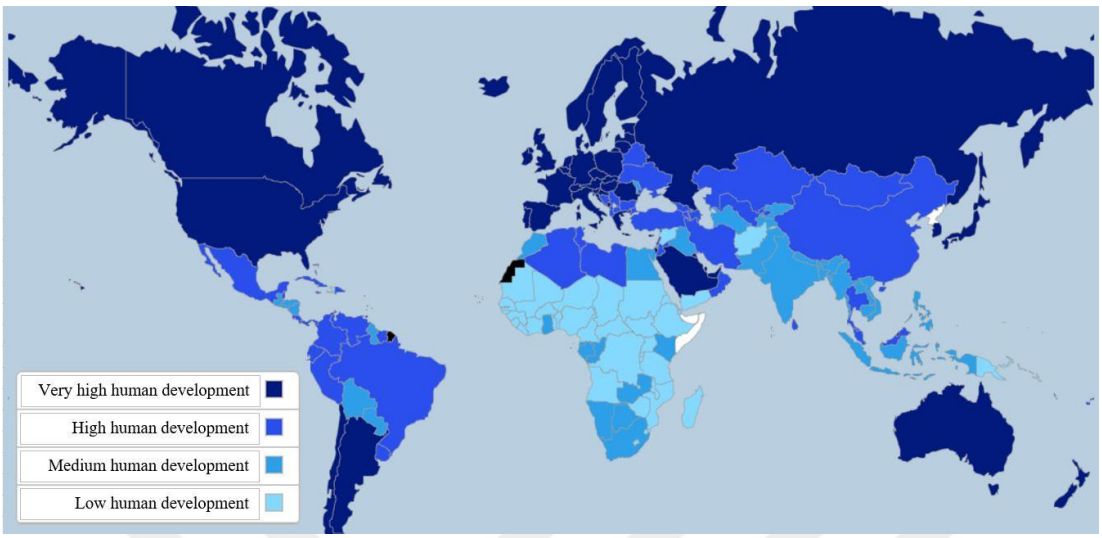

Figure 2.1 : Human development levels of the countries, UNDP (2016).

However, two points are standing out in almost every definition or analysis about developing countries, which are the economic situation and human development index of the country.

2.1.2 General characteristics of developing countries

As discussed in the previous section, the two most common criteria used to define a developing country are economy and human development level. However, in detail, there are some structural features of developing countries, which come forward a lot in the literature.

Todaro and Smith (2015) indicated that it is a common acceptation that developing countries have relatively lower living standards according to developed countries. These living standards are generally described in terms of level of income, housing standards, health service and education opportunities, birth and mortality rates and general well-being of the society.

Other common characteristics of developing countries are their high levels of population growth and unemployment rates arising from that. Birth rates, which refer to the amount of births per 1000 person in a population, are relatively higher in developing countries than the developed ones. According to the statistics of the World Bank (2015), it is a fact that while European Countries has one-digit birth rate

numbers, Middle Asian or South American Countries have higher values and in Africa birth rates reach up to 49 per 1000 people. This high level of population growth has some serious effects on employment rates. One of the greatest obstacles to achieve a successful employment system is the high levels of population growth (United Nations, 2015). However in order to analyze the effects of population growth on the economic situation of a country, along with the high levels of population growth, another important criteria which should be considered is the demography of the population. Todaro and Smith (2015) pointed out that the economic growth potential of a country depends on both its natural and human resources. Regarding to human resources the important thing is not just the amount of population but also their skills and level of education. In developing countries, the amount of dependency burden, which is a term refers to the people who are under age 15 or above age 65 and not active contributors to work, is also relatively higher than the developed countries. While in developed countries 1/3 of the population consists of dependency burden, this ratio is around 45% in developing countries. (Todaro & Smith, 2015)

2.1.3 Globalization and the economies of developing countries

Globalization usually describes expediting of internationalization, which means enlarging the markets and spreading products, services and technology for the countries. Through globalization, market dependency and uniformity increase which enable the countries to conduct international business (United Nations, 2010).

Driscoll and Clark (2003) indicated that developing countries rapidly get involved in globalization for several reasons. The most important ones are opportunities arising through foreign investment as new jobs, products or technology and disappearing trade barriers. It is a known fact that developing countries suffer from unemployment rates for many years since their population growth and fewer job opportunities through industrial inadequacy. The unemployment rates in many developing countries remain 10% or above for several years and it can be concluded that developing countries have a chronic and constant problem in employment (Turnham and Eröcal, 1990). Opportunities arising through globalization also function as a solution for continual unemployment problem in developing countries.

In her speech at Maryland University in 2016, IMF (International Monetary Fund) President Lagarde pointed out the fact that developed countries should cooperate with developing countries in order to achieve economic growth in global arena (as cited in Özsümer, 2016). She also stated that developing countries contain 85% of the world's population and create 60% of the global economy and consequently the center of the economy starts to move towards to developing countries. Since the year 2008, developing countries have 80% contribution to the world's economy and have an active role to decrease global unemployment and poverty (as cited in Özsümer, 2016). Figure 2.2 shows the GDP growth data of the countries for the year 2016 according to IMF (2016).

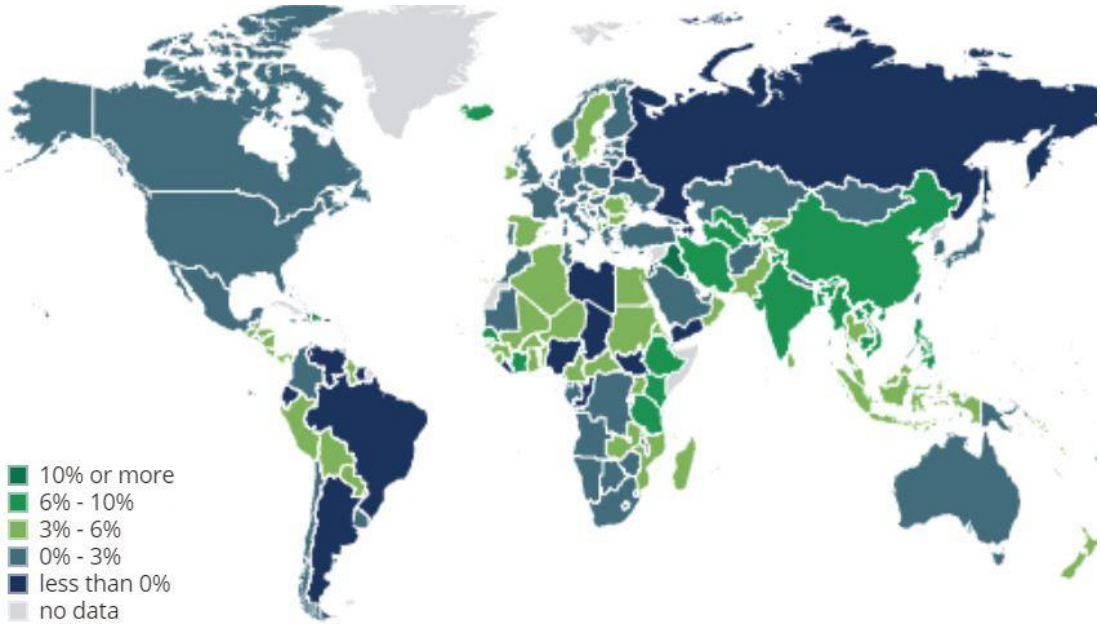

Figure 2.2 : GDP growth rates of the countries, IMF (2016).

As it is seen on this figure, in the recent years, developing countries experienced a rapid growth in GDP and played an important role in the global economy.

2.2 Construction Industry in Developing Countries

2.2.1 The role of the construction industry in emerging economies

It is generally considered that total investment in construction industry is in a close relationship with the economic growth. Likewise, economic growth has a direct influence on construction industry investments. Especially in developing countries, the construction industry is capable of boosting the whole economy of the country since its wide and intensive connections to other industries. That is why in many

sources the construction industry is described as a “locomotive” in developing country economies. There are several reasons why construction industry has such an importance for economy of developing countries. Construction industry increases the employment due to high demand of labor, enhances economic growth via contribution to GDP (Gross Domestics Product) and improves the socio economic level of the society.

The construction industry has many primary participants like architects, engineers, workers, contractors, owners or even the end users, also some ancillary participants such as material suppliers, real estate developers, insurance agencies, banks etc. (Moavenzadeh, 1978). The final products of this industry, such as roads, ports, factories, hospitals, schools etc. are considered as “investment goods”, which not just exist for their own functions but also help the other business industries to produce, grow and make contribution to the economy (Düzyol, 1997). Owing to all of its impacts to economy, countries going through economic shrinkage, prioritize investments in construction as a way of exit from economic depression. Construction industry is also considered as “locomotive industry” since there are over 200 sub-industries, which depends on construction industry in order to supply their products or provide their services (Kılıç and Demirbaş, 2012).

This relationship between construction industry and economic growth makes the industry vulnerable to economic fluctuations. It is one of the industries, which shows rapid development during an economic growth. However, in case of an economic stagnation or crises the construction industry is also one of first industries, which is affected negatively. These unavoidable fluctuations are often tried to be taken under control by some government policies including some interventions to construction industry. Governments reduce the amount of investment to construction or block the funding in order to slow down an uncontrolled growth in economy. Quite the contrary, in economic situations, where there is a high amount of unemployment and lack of demand in the market, governments can follow some policies to accelerate the growth in construction industry. In other words, governments in developing countries often use the construction industry to shape their economy (Ball and Wood, 1995).

2.2.2 Investing in construction for economic development

Developing countries often make investment in construction industry in order to trigger economic development. Since construction industry has several supplier industries, large projects can provide a nation-wide economic mobility. Ofori (1990) indicated that construction industry's contribution to the economy consists of direct and indirect contributions as well as backward linkages. Indirect contributions include building facilities, which will be used for the improvement of other industries like manufacturing, agriculture, transportation, education, health services etc. Through the backward linkages with other sectors, construction industry provides high amount of employment, which is also critical for the economy.

In the literature, there were several attempts to indicate the correlation between construction and economic development. In late 1960s and early 1970s, Turin and Strassmann indicated a positive interaction between "per capita GDP" and "value added in construction as a % GDP" by using cross-country comparisons (as cited in Wells, 1985). In light of these findings, Wells (1985) also studied the relationship between construction activities and economic growth and decided that there is a clear association between them. By collecting data for more than 100 countries, Wells (1985) found out a clear positive correlation between GDP per capita and measures of construction activity, which he divided into three:

(i) Value-added by construction as a percentage of GDP.

(ii) Capital information in construction as a percentage of GDP.

(iii) Employment in construction as a percentage of the total EAP (economically active population).

Figure 2.3, Figure 2.4 and Figure 2.5 illustrate the relationship between GDP per capita and these three construction activity measures. Wells (1985) also analyzes the collected 20 years-data to determine the relationship between the amount of construction activities and level of development of the countries. According to the results, highest growth in construction output is observed in developing countries, especially in the region of Africa and Middle East. Furthermore, the construction output seemed to grow faster than GDP in all of the economic regions in which there was a majority of developing countries.

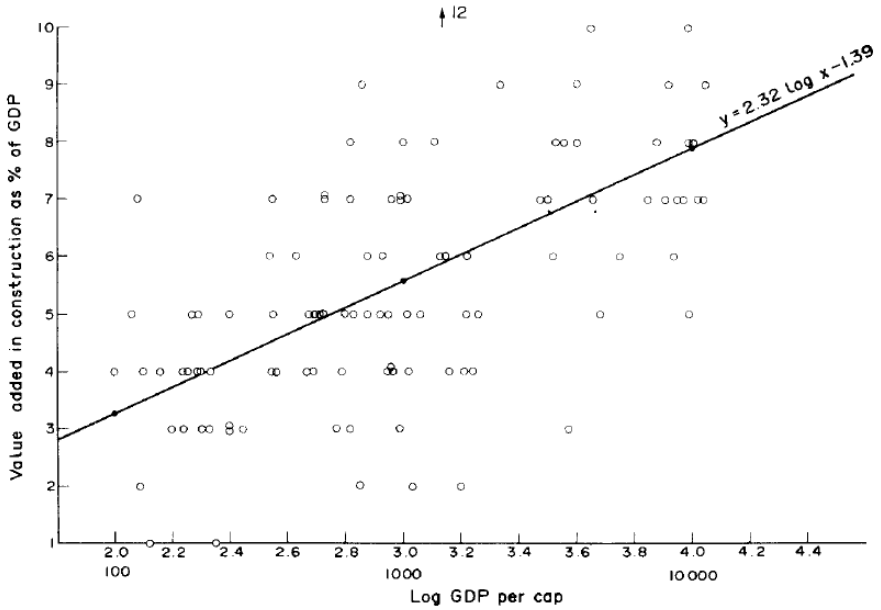

Figure 2.3 : Correlation between "value-added in construction as % of GDP" and GDP per capita, Wells (1985).

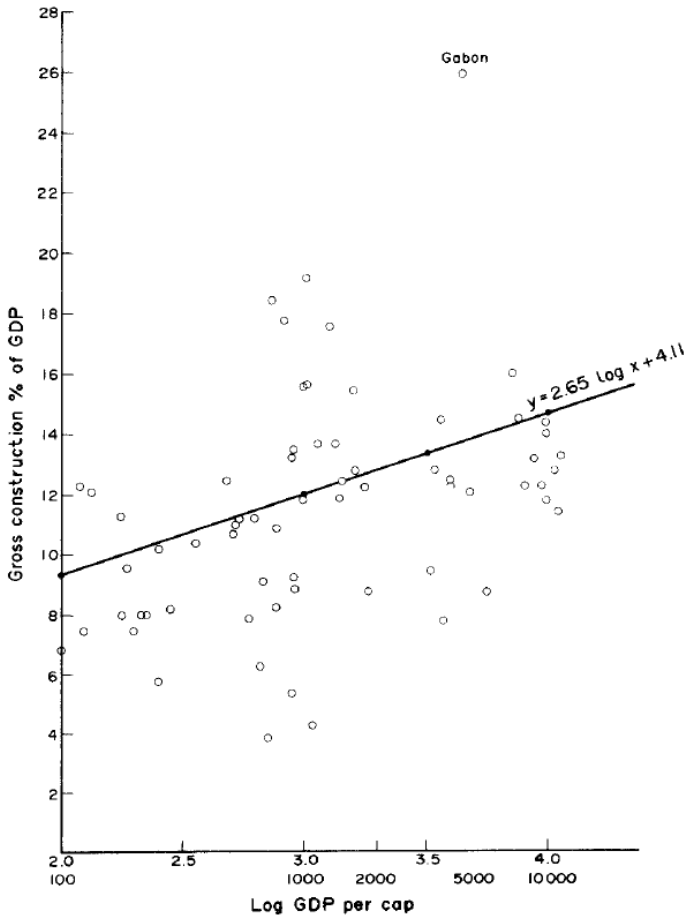

Figure 2.4 : Correlation between "gross construction % of GDP" and GDP per capita, Wells (1985).

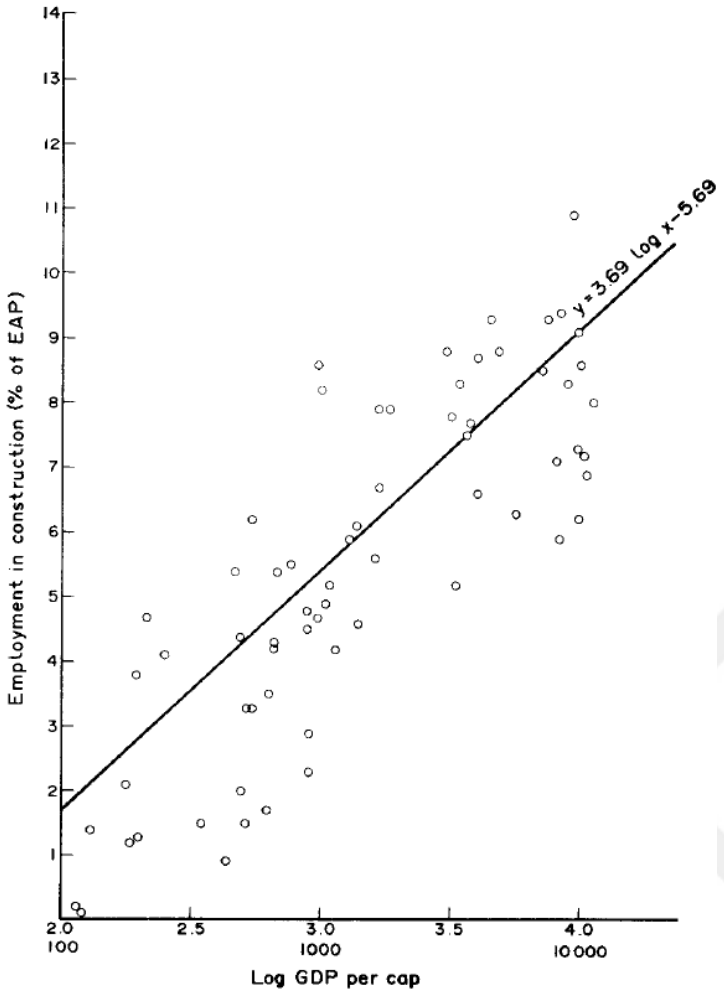

Figure 2.5 : Correlation between "employment in construction (% of EAP)" and GDP per capita, Wells (1985).

Construction activities stimulate the economy through its sub-industries and services. Through many analyses in literature, researchers generally agree on the existence of a positive correlation between construction industry and economic development in developing countries/emerging economies. Recent data also confirms these findings. Construction Intelligence Center (CIC), which is a large data and analysis source for global construction industry, indicated that the global construction output reached 8.8 trillion US dollars in 2016 from 7.9 trillion US dollars in 2012 and it is projected that it will increase to 10.1 trillion US dollars in 2021. Furthermore, in 2012 46.7% of this global output consisted of the contributions of emerging economies, which is projected to reach 52.8% in 2021. Figure 2.6 shows the distribution of this projected percentage increase according to regions on the world (CIC, 2017).

According to the data of CIC (2017), during the period of 2012-2016, construction markets in Africa and Middle East achieved a significant growth and it is also

foreseen that this growth will continue with a smaller pace towards the year 2021. Figure 2.7 describes the share of advanced economies and emerging markets in global construction output growth.

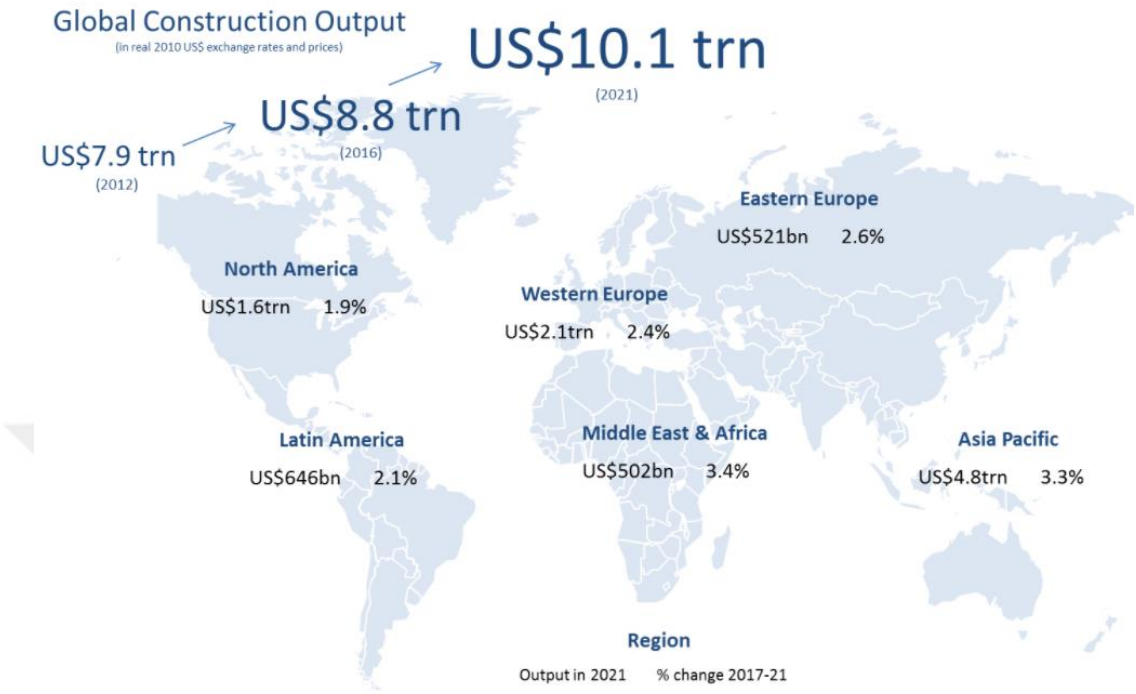

Figure 2.6 : Projected increase of global construction output according to the regions between the years 2017 and 2021, CIC (2017).

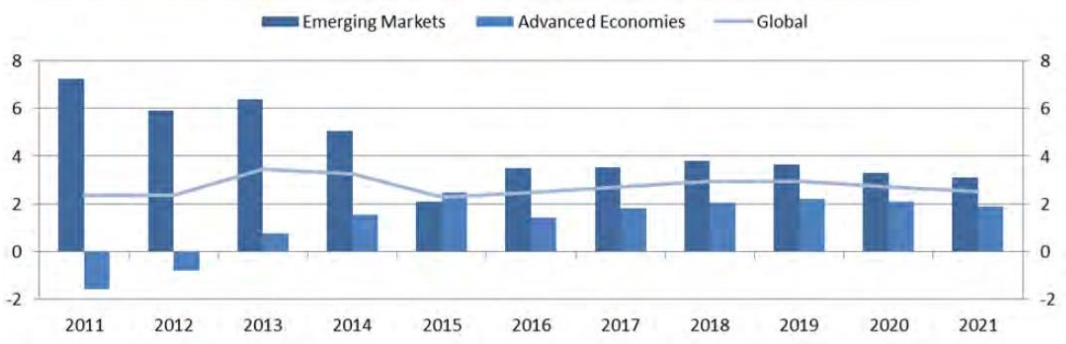

Figure 2.7 : Contribution of emerging markets and advanced economies in the global construction output growth, CIC (2017).

The share of emerging economies in this growth was generally larger than the growth in advanced economies. It is projected that the average global construction output growth will be at 2.8% per year during the period 2017-2021 and the share of emerging economies will remain larger.

3. RISK MANAGEMENT IN INTERNATIONAL CONSTRUCTION

3.1 The Concept of Risk

3.1.1 Risk and uncertainty

Risk basically means exposure to a situation, which has an uncertain outcome. Holton (2004) stated that risk has two crucial elements, which are "exposure" and "uncertainty", and described risk as a vulnerability to the results of a proposition. Some of the lexical meanings of the term risk are:

- *"Possibility of loss, chance of danger, something that creates a hazard etc."* (Merriam-Webster Dictionary, 2017).
- *"A situation involving exposure to danger"* (Oxford Dictionary, 2017).

Even though the term risk generally refers to a negative outcome, according to many views in the literature, risk can also have positive outcome and is seen as an opportunity. Gupta et al. (2015) describe risk as an ambiguity of the result of an action, which can be both negative and positive. The risk assessment should be done by considering the occurrence probability of an event and also the impact of this event if it actually becomes real (Gupta et al., 2015). Risk also has various components and the potential of risk should be analyzed. Loosemore et al. (2006) define the risk as a complicated event with environmental, financial and sociocultural aspects so that the impact of a risk depends both on the potential damage and on the approach to analysis of that potential.

Considering the various definitions of the term risk, it seems like the agreed common points in most of the definitions are "exposure" and "uncertainty".

Risk = f (Probability, Impact)

Risk refers to a vulnerable situation in which the results of the events are not fully predictable. In this context, it is logical that construction projects include many risk events since they consist of various interdependent activities, which have uncertain outcomes. According to Smith et al. (2006), a risk event indicates the fact that there

are several possible results of the event, which are more or less desired than the expected outcome and the project risk is defined as the consolidation of these risks.

Uncertainty on the other hand is a slightly different concept than risk. According to Aven (2012), the most important distinction between risk and uncertainty is the amount of available information about an event. In uncertain situations, the existing information is not sufficient to assess the situation and estimate the probability. Winch (2003) summarized the sources of uncertainty as "complexity" and "predictability". Complexity refers to the high amount of money or time required to gather information about the situation and analyze it. Predictability means the available data from the past is not dependable for the future analysis. Taroun (2012) indicated that uncertainty refers to the undiscovered events, which may affect the project goals both positive and negative. Uncertainty may also expose new opportunities for the project.

As Hillson (2004) stated, the relationship between risk and uncertainty can be summarized as following: *"Risk is measurable uncertainty; uncertainty is unmeasurable risk".*

3.1.2 Positive risk

Although the concept of risk generally refers to negative events and their results, a risk does not necessarily have to be a threat to the objectives of a project. Positive risk basically describes the result of an event, which might have positive impact on project goals. Hillson (2004) indicated that every project is exposed to uncertain events, which may have a range of impacts on project objectives. While some of these uncertainties may be damaging, which are "threats", some of them may be positive and helpful to achieve project goals, which may be referred as "opportunities". Hillson (2002) also described risk as an umbrella term, which has two components:

- "Threat" which refers to a risk with negative impacts
- "Opportunity" which refers a the risk with positive impacts

Figure 3.1 illustrates a "double probability-impact matrix" in terms of threats and opportunities. The matrix is modified by rotating the opportunities part as shown in the figure. This way the critical threats and opportunities can be gathered together under "the arrow of attention". This area describes the most important risks &

opportunities, which should be taken into consideration. The size of this area depends on the organization's risk approach. If the organization more risk-averse the size of the arrow of attention area becomes larger.

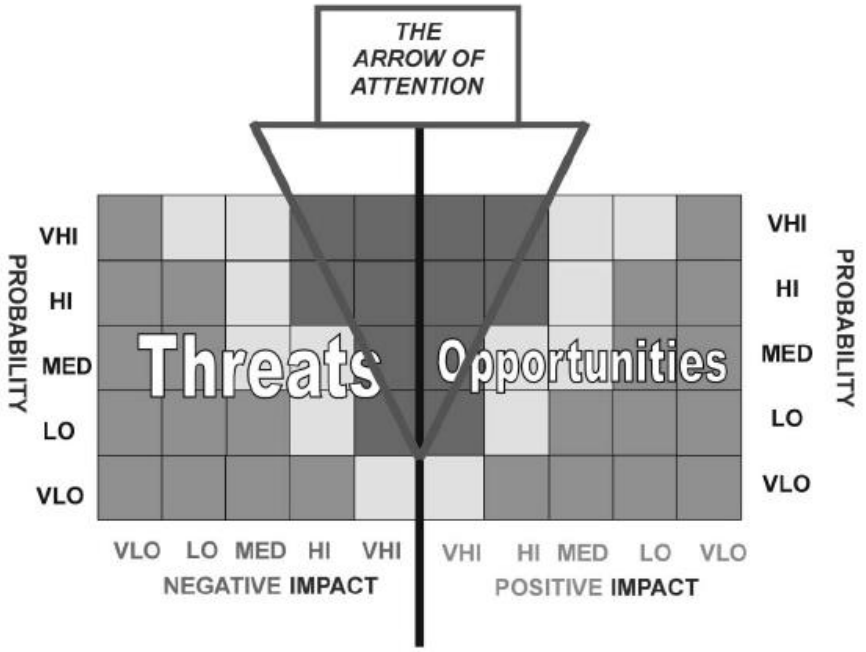

Figure 3.1: Double probability-impact matrix, Hillson (2001).

PMI (2013) also defines the risk as an uncertain event, which may have positive or negative impacts on project goals. The primary objective of project risk management is to reduce the probability and impact of negative risk events and increase the probability and impact of positive risk events.

3.2 Risk Management

3.2.1 Brief history of risk management

The concept of risk management is evolved from "insurance management" which generally refers to methods used after World War II by large companies to cover their portfolio and assets against small risks. In this sense risk management is a relatively new term in corporate management, which mostly became subject to the studies after 1950s. Various sources from literature indicate the origin date of the first risk management studies between 1955 and 1964. Crockford (1982) described the years between 1963 and 1967 as the time period, in which the academic interest on the risk management subject reached its maximum and states that in 1963 the

largest amount (nine) of research papers about risk management published in "The Journal of Risk & Insurance (JRI)". In fact, the first academic book on the subject of risk management was also published in the year 1963 by Mehr and Hedges. Figure 3.2 indicates the number of published risk management related articles in the JRI through the years. The academic studies reach at maximum level between the years 1963 and 1967. After the year 1967, there is a distinct decline in the graphic, which is described as a "documentation period" by Crockford. (Crockford, 1982)

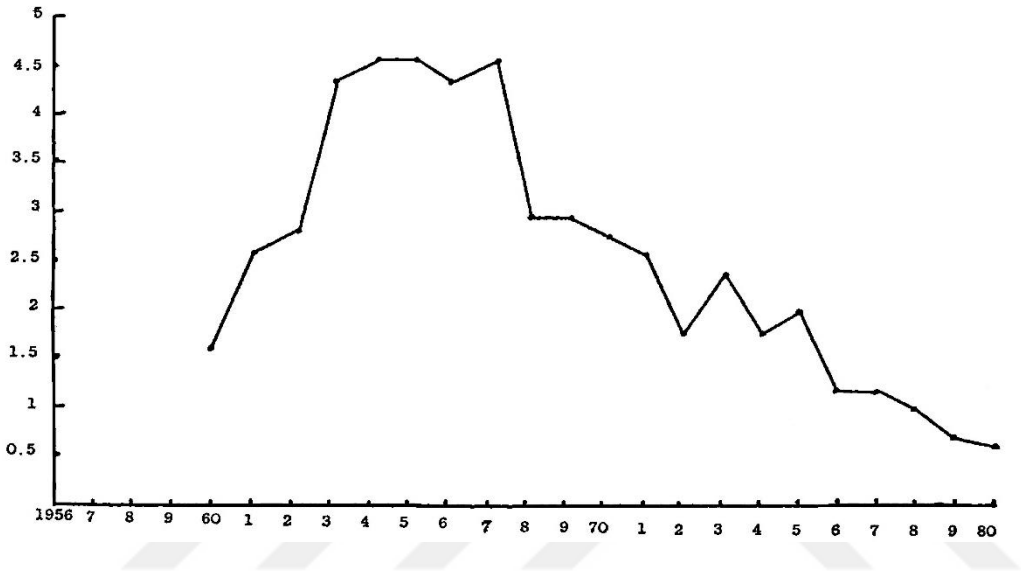

Figure 3.2 : Amount of risk management articles published in JRI, Crockford (1982).

On the other hand, Figure 3.3 shows the amount of published risk management articles in the journal "Risk Management (RM)" which concentrates more on the practical aspects of risk and targets practitioners more than JRI. After the year 1967, as the decline in the number of published articles in JRI continues, the article numbers in the RM kept rising exponentially until 1980s. In fact, this comparison puts forward an important result in the history of risk management. According to Crockford (1982), the articles, which were written in the time period of "academic interest" and focused on theoretical aspects of risk, were became guidelines for the studies which are focused on the "practical aspects" of risk and change the perspective of practitioners on the concept of risk management.

In 1970s, awareness of risk management began to increase in the world especially in the financial sector. In 1990s, risk identification and assessment techniques have gained popularity also in the construction industry. Topics such as Probability-

Impact assessment, Monte Carlo Simulation and Fuzzy Set Theory were studied by the researchers like (Tah et al., 1993), (Dawood, 1998), (Wirba et al., 1996).

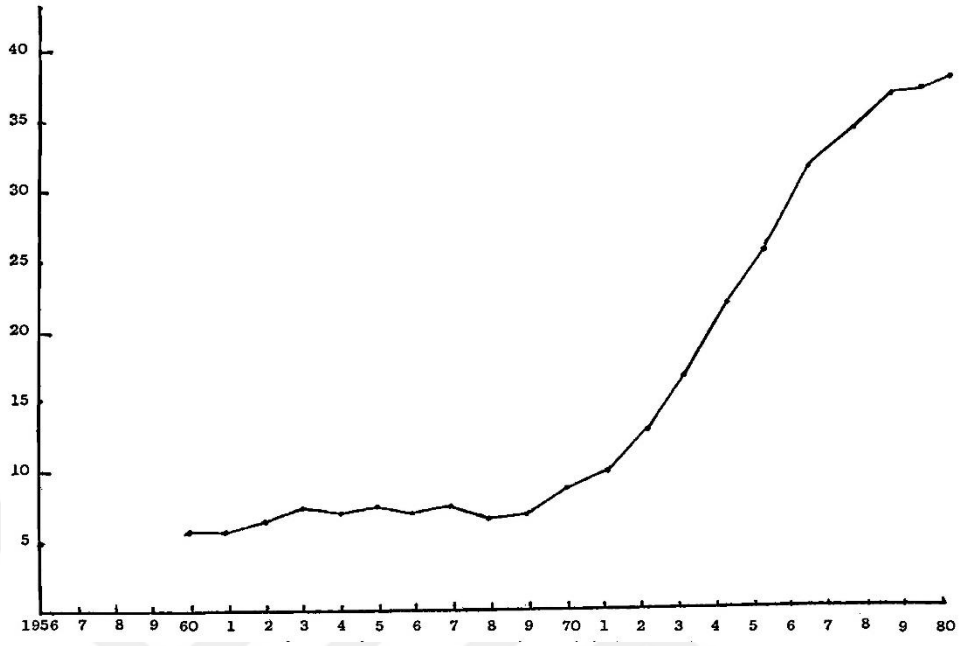

Figure 3.3 : Amount of risk management articles published in RM, Crockford (1982).

Before 2000s, only a small number of studies were performed about identification and assessment of the risks in construction projects and that resulted as an absence of "systematic approach" in risk management (Renuka et al., 2014). Later researchers started to develop more systematic approaches to risk management in their studies and in the post 2000s some studies about classification and analyze of risk factors in systematical ways by researchers such as (Dikmen et al., 2007) or (Zeng et al., 2007).

After the year 2010, there was a high increase in the number of studies about risk management, especially about identification and assessment of risk. Renuka et al. (2014) reported after the year 2010 some "sophisticated models" were studied in order to combine risk assessment with decision-making framework by various researchers such as Rezakhani (2012) or Goh et al (2013).

Apparently, risk management is a relatively new concept in management, which evolved from "insurance management" and was began to be studied mostly after the year 1950. Although the history of risk management goes back to 1950s, it took several decades for this concept to become popular in construction industry. Starting from 1990s to nowadays, risk management in construction became a popular topic for both academicians and practitioners.

3.2.2 Risk management processes

Risk management is generally defined as the process of identifying, assessing and controlling the potential threats for the goals of the organization by using various avoidance and mitigation techniques.

Smith et al. (2006) indicated that every primary goals of a construction project such as time, cost and quality are quite likely to expose uncertainty and risk. The important point is to consider risks not as random events and determine the main causes of them. It is generally possible to avoid risk if their main causes are determined, analyzed and controlled before the risk event becomes real. After determining a management strategy for main risks, the organization should also secure itself by transferring the remaining risks to their partners or subcontractors in order to insure project goals and increase the performance. To accomplish these processes, it is advised to use a systematic approach, which basically consists of risk identification, risk assessment (analysis), developing response plans and monitoring the results. According to Smith et al. (2006), following benefits are gained by developing a strong risk management strategy:

- Analyzing the details and major points of the project from the beginning
- Analysis based project decisions
- Clarification of special risks related with the Project
- Monitoring the whole construction process
- Generating helpful data for future projects of the company

As the risk management definitions in the literature are reviewed, it can be seen that the largest authorities and organizations related to Project Management define the concept in similar ways. For instance, according to the British Standards Institute's definition, risk management is a *"systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risk"* (BS-IEC-62198 2001, p.7). On the other hand, the Association of Project Management (APM) defines the risk management as a build-up process, in which the risk events and project risks are analyzed, minimized and managed to optimize the project goals (APM, 2006). The Project Management Institute (PMI), the largest professional

institute devoted for PM in the world, described risk management as a process of steps, which aims to maximize the positive impacts and minimize the negative impacts of the events in the project life cycle (PMI, 2013). According to all of these descriptions, risk management is a continual process in the project life cycle, which consist of specific steps to analyze and manage all types of risks to optimize the project objectives. In this context, the steps of risk management can be listed as following:

- Risk Management Planning
- Risk Identification
- Risk Assessment
- Risk Response Planning
- Risk Control and Monitoring

3.2.2.1 Risk management planning

Risk management planning is the process of determining risk management ways and activities for potential project risks. PMI (2013) indicated that the communication is one of the most important key steps of this process since a risk management plan should be supported by all of the parties. This planning process begins with the early stages of the project and ends with the project planning phase. This process also includes the potential positive risks. Barron and Barron (2011) stated that some incidents or conditions (discovering an easier method for activities or decrease of the material prices etc.) can provide benefit for the project and these are also managed as risks. Risk management planning is also critical for revealing the potential of these positive risks.

PMI (2013) indicated that risk management planning process consist of three main steps named as Inputs, Tools & Techniques and Outputs, which are also illustrated in the Figure 3.4. The output of this process is a risk management plan, which is a part of project management plan and consist of several components:

- Methodology, roles and responsibilities
- Budgeting and timing
- Risk categories

- Probability and impact definitions
- Probability-impact matrix
- Stakeholders' tolerances
- Reporting formats and tracking

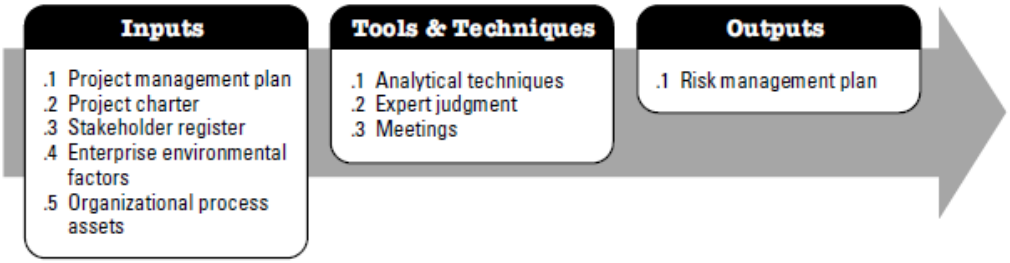

Figure 3.4 : Risk management planning stages, PMI (2013).

3.2.2.2 Risk identification

Risk identification, the second step of risk management, is the process of determining project risks and analyze their characteristics. To achieve that several methods can be used with the participation of various project members such as project managers, project team, stakeholders, customers or risk management experts outside of the project/company. As it is indicated in the PMI (2013), risk identification is a continual process since the project risks may change or evolve during the project life cycle. Figure 3.5 describes the stages of risk identification process in terms of inputs, tools & techniques and outputs.

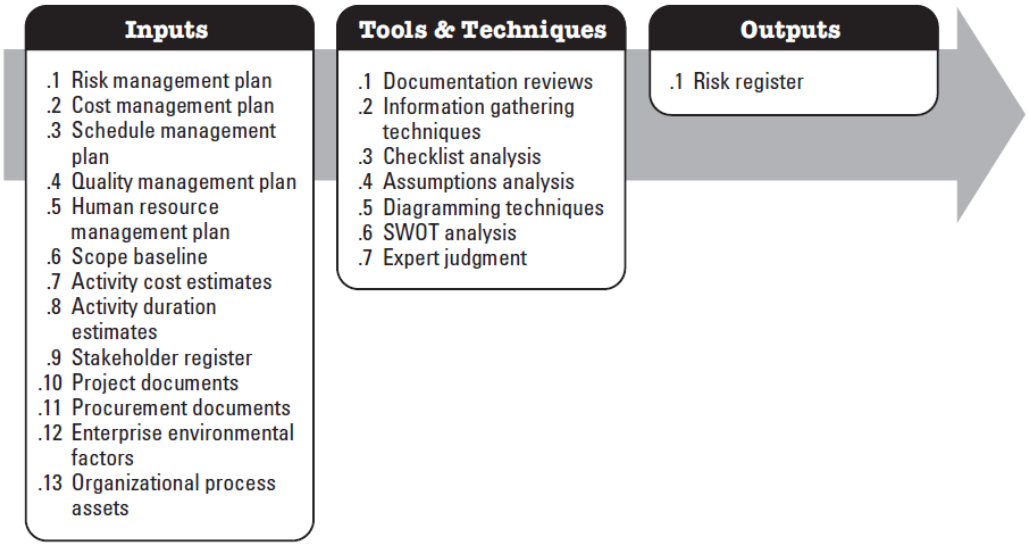

Figure 3.5 : Risk identification stages, PMI (2013).

According to Kerzner (2009), risks in the project should be analyzed in a detailed way, which makes it possible to see both the importance of the risk and also their origins including root causes. That is one of the practical ways to identify the potential risks in large-scale projects. Although there are various methods for risk identification, the most commonly used method is to group project risks according to their sources, which are divided as objective and subjective sources. Objective sources generally refer to the data from both previous and ongoing projects. Subjective sources on the other hand refer to expert opinions and experiences. Kerzner (2009) also indicated that another approach to risk identification is to determine risks according to project life cycle phases. Total risk is relatively high at the early stages of the projects due to lack of information for adequate risk identification. On the later stages of the project, financial risks become quite large due to investments (cost) and missed options (opportunity cost). Figure 3.6 shows the relation between total project risk and typical risk events during project life cycle (Kerzner, 2009).

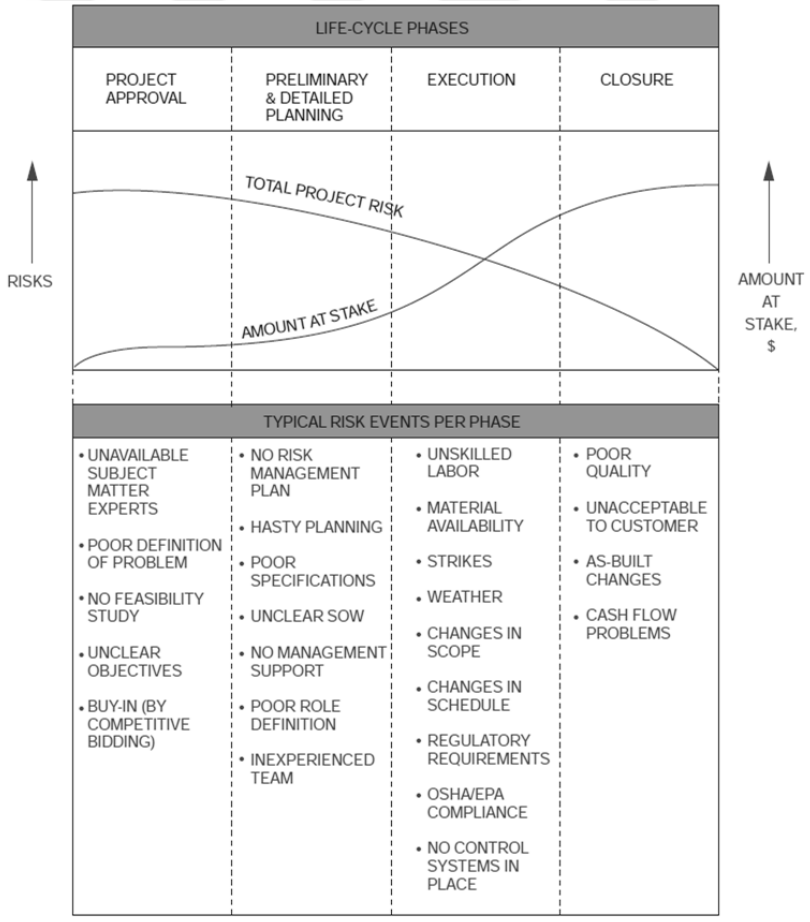

Figure 3.6 : Total project risk and typical risk events, Kerzner (2009).

In general terms, all of the sources and methods, which contain information about potential risk and hazards, can be used to identify project risks. These risk identification methods can be summarized as following which are also indicated by the PMI (2013):

Documentation reviews: A systematic review of the project documents such as plans, analyses, contracts, agreements and previous project data. This review can be a basis for identification of project risk.

Information gathering: Techniques to collect information from participants of the project. Brainstorming, Delphi Technique, Interviewing and Root Cause Analysis can be listed as the most common techniques for information gathering. Brainstorming can be carried out under the direction either of a coordinator, typical free-form session or with the help of extensive interviews. On the other hand, the Delphi technique is used to collect information with questionnaire and share the results with the participants for further comments or revised responses. That the deviations in the results can be minimized and more accurate data can be collected. Interviewing professionals and using root cause analysis techniques are further ways to collect information for project risk identification process.

Checklists: Data and experience gained from previous projects (especially from similar projects) provide basis for risk identification checklists. The possible risks which are not included in checklists should also explored by the team members. It is also critical to review the checklists regularly during project life cycle.

Assumptions analysis: Hypotheses or assumptions are part of every project development process. Assumption analysis is the process of exploring the assumptions in terms of their validity as the project goes on. That way it becomes possible to foresee the risks, which rise from the wrong assumptions at the earlier stages of the project.

Diagramming: Diagramming techniques are used to identify project risk. The most common ones are following:

Cause and Effect Diagrams: Practical diagrams which also referred as Ishikawa of Fishbone Diagrams, which are practical to identify causes of project risk.

System/Process Flow Charts: The charts are useful to illustrate the relation of project elements with each other. That way the causes of risks can be seen clearly.

Influence Diagrams: These diagrams are graphical presentation of the relationship between the variables in a project. They illustrate how these variables and their outcomes influence each other.

SWOT analysis: By using SWOT Analysis the project is explored by its Strengths, Weakness, Opportunities and Threats perspective. That way the internal risks are also taken into consideration and the range of identified risks become larger.

Expert judgment: Expert opinions may be used to identify project risks. These experts have experience with similar projects and are asked for advice about possible risks based on their experience.

Risk identification produces the first outputs of the risk management process. Risk register (a documentation of potential risks, risk analysis and action plans) starts to take form at the end of risk identification.

"List of identified risks" is created, which defines the risks by using a structure like the one illustrated in the Figure 3.7.

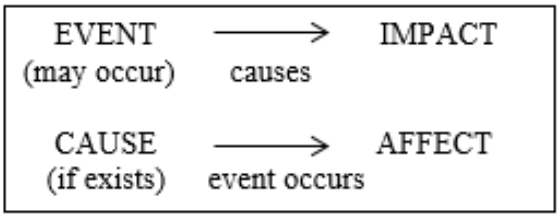

Figure 3.7 : Risk identification structure.

"List of potential responses" may be also produced at the end of risk identification process in order to determine some of the potential response methods, which may be used in the further stages of risk management. (PMI, 2013)

3.2.2.3 Risk assessment

Risk assessment process starts after risk management planning and risk identification steps are completed. OGC (2007) indicated that the primary objective of risk assessment is to understand and evaluate the potential impacts of the identified risks along with their probability of occurrence. Although there are several risk assessment techniques, they are classified under two main categories according to the common practice:

- Qualitative Risk Analysis
- Quantitative Risk Analysis

Qualitative Risk Analysis

According to OGC (2007), qualitative risk analysis aims to define and explain every identified risk and determine the significance of the risks. The outputs of this process are follows:

- Project stages when a risk could occur
- Project components which could be affected
- Factors which could cause a risk to occur
- Relationship between the risks
- Probability of occurrence of a risk

PMI (2013) described the qualitative risk analysis process under five analysis techniques:

Risk Probability and Impact Assessment

This technique is used to determine the probability of occurrence and impact of each identified risk through interviews/meetings with project team members and experts. Impact analysis describes the potential effect of the risks on the primary project objectives such as time, cost, quality etc. These analyses could also include opportunities and positive risks.

Probability and Impact Matrix

This matrix aims to prioritize risks according to their rating based on probability of occurrence and impact on projects objectives. Ratings are located in a matrix in which the degree of risk is determined as low, moderate or high. Figure 3.8 shows a typical matrix for prioritizing the project risks and opportunities according to organization's thresholds.

Risk Data Quality Assessment

This method is used to evaluate the collected data, which will be used in risk management process. When the existing data has low quality and is not trustable, it may be required to collect new data.

Probability and Impact Matrix

Probability	Threats					Opportunities				
0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05
0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04
0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03
0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02
0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01
	0.05/ Very Low	0.10/ Low	0.20/ Moderate	0.40/ High	0.80/ Very High	0.80/ Very High	0.40/ High	0.20/ Moderate	0.10/ Low	0.05/ Very Low

Impact (numerical scale) on an objective (e.g., cost, time, scope or quality)

Each risk is rated on its probability of occurring and impact on an objective if it does occur. The organization's thresholds for low, moderate or high risks are shown in the matrix and determine whether the risk is scored as high, moderate or low for that objective.

Figure 3.8 : Probability and impact matrix, PMI (2013).

Risk Urgency Assessment

This technique determines the urgency level of risks along with their risk ratings based on probability of occurrence and impact. Some of the risks may be more urgent than others are and require taking extra measures.

Expert Judgment

Expert judgment helps to categorize the risks in the probability-impact matrix according to their significance level. Experts are usually chosen from the people who have experience with similar projects. All tables and figures must be horizontally centered on the page.

Quantitative Risk Analysis

Quantitative risk analysis technique generally aims to evaluate the significance of identified risks in numeral values. OGC (2007) indicated that this method assesses the project risks in terms of:

- Cost
- Time
- Performance
- Health and safety implications

- Political risks
- Reputational risks

The techniques and methods for quantitative risk analysis are summarized by PMI (2013) as following:

Data Gathering and Representation Techniques

Interviews may be carried out with the experienced project team members in order to evaluate the risks according to impact and probability of occurrence.

Probability Distributions are used to show the uncertainty in probability values. For instance, the duration and cost of the activities in a construction project are changeable according to the project stages. Probability of occurrence for these risks is also changeable and can be represented in graphic distributions.

Quantitative Risk Analysis and Modeling Techniques

Sensitivity analysis aims to specify the most impactful project risks and present the impact levels of these risks in a graphical method comparing to each other.

Expected monetary value analysis helps to calculate the future outcome based on the risk and uncertainty scenarios. For these outcomes, opportunities are given positive values and threats are given negative values. After that, these outcome values are multiplied by the probability of occurrence (of the scenarios) and added together. That way expected monetary values are obtained.

Modeling and Simulation techniques may be used to transform the risk or uncertainty data into potential impact on project goals. Monte Carlo technique is the most common practice.

Expert Judgment

Experts who have experience with relevant and recent projects may help to determine potential impacts of risks on cost, schedule or to define tools to assess identified risks. For a successful jugdement, experts should have knowledge about the tools & techniques used for risk assessment. They should also suggest the most suitable tools for risk analysis according to the project's objectives and company's culture.

As Kerzner (2009) indicated, it is required to covert and group the results as "risk levels" once the risk analysis processes are over. The results of a qualitative risk analysis can be classified according to the existing risk boundaries of the project. (In terms of cost, time, technical risks etc.) On the other hand, the risk ratings that are collected from qualitative risk analysis can be useful for the identification of risk importance levels. Although it is possible to group risk levels in several degrees, they are generally grouped in three levels as following:

High Risk: Significant impact on primary project objectives such as cost, time, quality. Top management attention is necessary and serious measures should be taken.

Medium Risk: Some possible impact on primary project objectives, which can be avoided if proper precautions are taken. Supervision of top management may be necessary.

Low Risk: Small impact on primary project objectives. These risks may be avoided or the results can be easily compensated if they are not undervalued (Kerzner, 2009).

3.2.2.4 Risk response planning

Risk management process includes the step risk response planning which follows risk assessment. PMI (2013) defined risk response planning as a process in which action plans and responses are designed to manage the project risks by reducing the impacts of threats and seizing the opportunities. The most important advantage of this process is that it makes it possible to plan actions according to the risk importance levels and insert the cost of these activities into project budget at early stages of the project. The action plans, which are created in the risk response planning process, should be convenient for the importance level of the risk, cost effective and rational. All of the participants in the project who are involved in related risks also should agree upon the risk response plans. That means an optimum risk response plan should be created.

Figure 3.9 shows the general process of risk response planning. To develop risk response plans various strategies could be used which are briefly categorized under four sections by PMI (2013):

- Strategies for negative risks or threats

- Strategies for positive risks or opportunities
- Contingent response strategies
- Expert judgment

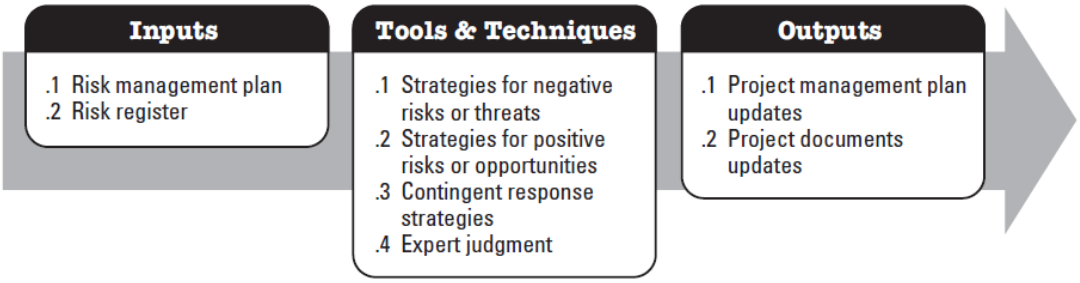

Figure 3.9 : Risk response planning stages, PMI (2013).

Strategies for Negative Risks or Threats

The typical response strategies for threats are “avoid”, “transfer” and “mitigate”. However, a forth response strategy which is “accept” could also be used against negative risks. PMI (2013) indicated that while “avoid” or “mitigate” strategies are useful for the critical risks with high level of impact, “transfer” or “accept” strategies are effective against less important risks with lower level of impact. Hillson (2002) summarizes the details of these four strategies as following:

Avoid: Trying to wipe out the uncertainty by preventing the risk to occur (Decreasing the possibility of occurrence to zero). Also carrying out the project activities in different ways might be another avoidance method. This makes it possible to achieve the project goals and isolates the project from the risk impacts. (Decreasing the impact level of risk to zero).

Transfer: Choosing a different stakeholder or subcontractor, which may manage the risk better and take the action responsibility.

Mitigate: Making the risk smaller by decreasing the risk impact and/or possibility of occurrence and making it tolerable for the organization.

Accept: Deciding that a risk should be taken and developing an active or passive risk response strategy. An active response may be a contingency plan, which will be executed when the risk occurs. On the other hand, a passive risk response means not taking any action, only observing the risk status.

Barron (2011) illustrates some these risk response strategies as following in the Figure 3.10:

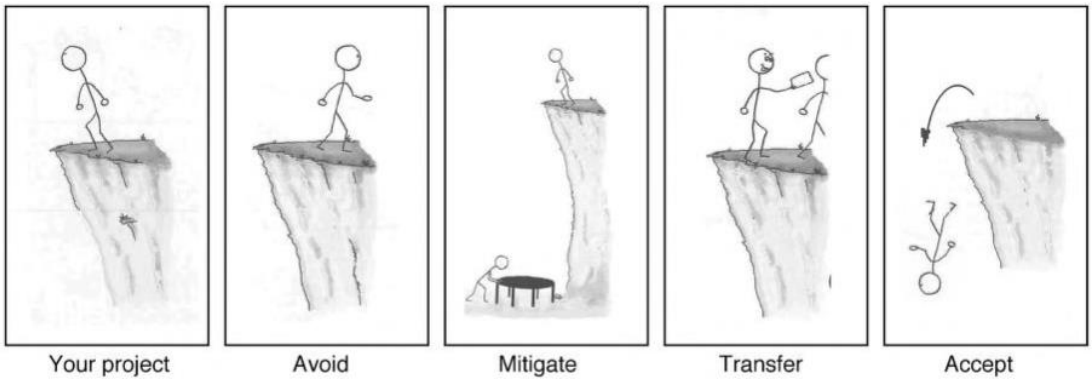

Figure 3.10 : Potential ways to handle project risk, Barron (2011).

Strategies for Positive Risks or Opportunities

The common strategies for developing response plans for positive risks and opportunities are *"exploit", "share", "enhance"* and *"accept (ignore)".* Hillson (2002) summarizes the details of these strategies as follows:

Exploit: Similar to avoid strategy in negative risks, "exploit" strategy tries to make sure that the positive risks or opportunity becomes real. In other words, it aims to increase the probability of occurrence to 100%.

Share: Similar to transfer strategy in negative risks, "share" strategy aims to choose a stakeholder, partner or subcontractor who may deal with the opportunity better and maximize the probability of occurrence and benefit.

Enhance: Similar to mitigate strategy in negative risks, "enhance" strategy seeks to increase the probability of occurrence and benefit of the positive risk or opportunity.

Accept: This strategy means not taking any specific action for an opportunity. In this sense, "accept" strategy can also be seen as "ignore" strategy. Some positive risks or opportunities are so minor that developing no response is more reasonable.

Contingent Response Strategies

Contingent responses are developed for certain risk events and only executed if the event occurs. PMI (2013) indicated that these plans are generally called contingency or fallback plans and include a "triggering event", a specific incident that must occur to put the plan into effect.

Expert Judgment

Similar to previous processes of risk management expert judgment and opinions are also useful for the risk response planning. PMI (2013) stated that these contributions may be provided by a professional with special knowledge, experience, education or training in developing risk responses.

Hillson (2002) emphasizes the importance of risk response planning by indicating that the decisions, which have direct influence on project's risk exposure, are made in this step of risk management. In this sense, it is also especially important to develop response plans for positive risks and opportunities as well. The outputs of risk response planning process, which are listed in the PMI (2013), can be summarized as Schedule, Cost, Quality, Procurement and Human Resources Management Plans and Scope, Schedule and Cost Baselines.

3.2.2.5 Risk control and monitoring

Risk control and monitoring is the final phase of risk management process. The risks, which are identified in the earlier phases, are tracked in risk control phase. The risk response plans are implemented in this phase and the status of the risks is monitored continuously. That way the efficiency of the risk management process is controlled and optimized constantly. PMI (2013) indicated that defining alternative methods, implementing a contingency plan or even updating project management plan might be a part of the risk control process. Hillson (2002) emphasized that risk control process has critical importance since many organizations break down at this phase by not correctly implementing the risk responses and monitoring the results.

Several techniques may be used in risk control phase, which are listed as following by the PMI (2013):

Risk Reassessment: Identifying new risks, reassessing existing risks and removing the outdated risks.

Risk Audits: Evaluating the efficiency of risk response plans and risk management process.

Variance and Trend Analysis: Comparing the projected results to actual results, analyzing the performance of the project, which may help to see the deviation in the project goals in terms of schedule or cost.

Technical Performance Measurement: Comparing the technical objectives to the actual technical achievements, which helps to see the success in sticking to the project schedule.

Reverse Analysis: Analyzing the risks, which occur during project execution to check if the contingency reverses of the project are enough for these newly emerging risks.

Meetings: Regular project management meetings should be held which includes topics about risk responses and status. Frequently discussed risk details may help the team improve the process.

Work performance analysis, updates about risk response plans, actions and project management plan are the most critical outputs of risk control process. Kerzner (2009) expressed that risk control is an active process, which aims to collect objective data about project life cycle and helps to decrease the risk to manageable levels.

Since being the final phase of risk management, risk monitoring and control processes have significant importance in the risk management process. Even if the risk identification, assessment and response planning phases are completed successfully, the risk management plan may easily fail if risk control phase is not correctly managed.

3.2.3 Risk management at company level

Managing the risks in different projects, especially large scale & international projects, requires also a risk management strategy at the company level. It is important for a company to have a specified risk management strategy in order to respond common risks in ongoing and upcoming projects. Smith et al. (2006) indicated that managers who are in charge of developing management guidelines are responsible for making risk management also a part of company's management culture. Accordingly, most of the companies gain advantage from innovative managers who support and pay attention to risk management. Since risk may be both positive and negative, Smith et al. (2006) indicated that a successful risk management is about trying not to miss any opportunities while avoiding from taking wrong risks. The balance between these two points is crucial. Smith et al. (2006) also divided risk management in a corporate organization in three levels: Corporate, strategic business and project levels as shown in the Figure 3.11.

Chapman and Ward (2003) on the other hand, described six questions in order to establish a risk management culture in corporate level and specified that this six question framework points out the critical aspects, which should be considered to develop a project risk management culture for a company:

- Who are parties ultimately involved?
- What do the parties want to achieve?
- What is it the parties are interested in?
- How is it to be done?
- What resources are required?
- When does it have to be done?

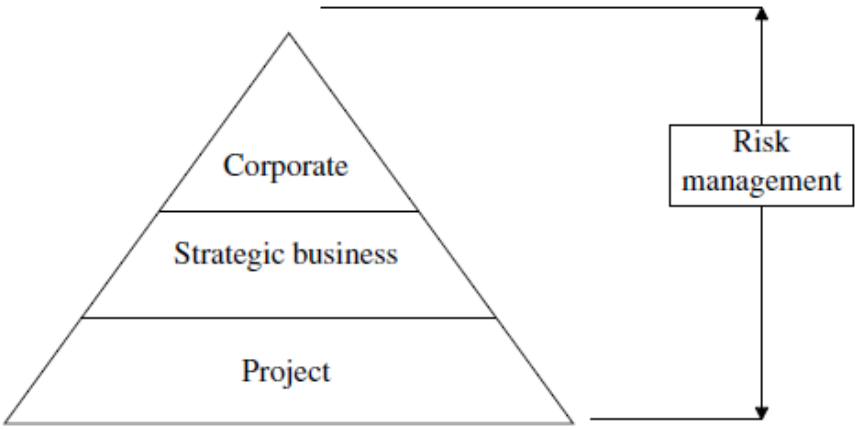

Figure 3.11 : Levels of typical corporate risk management, Smith et al. (2006).

Chapman and Ward (2003) also emphasized the positive aspects of uncertainty in corporate risk management. Uncertainty should not always be seen as a threat, on the contrary, it should be considered as an opportunity and understood well in order to be able to manage it. By achieving this and implementing an organizational risk management, it could be possible to reduce failure rates and wasted work force. This kind of achievements may increase the motivation of the employees and encourage them to participate in the risk management processes. In the Figure 3.12, Chapman and Ward (2003) illustrate the corporate benefits of risk management.

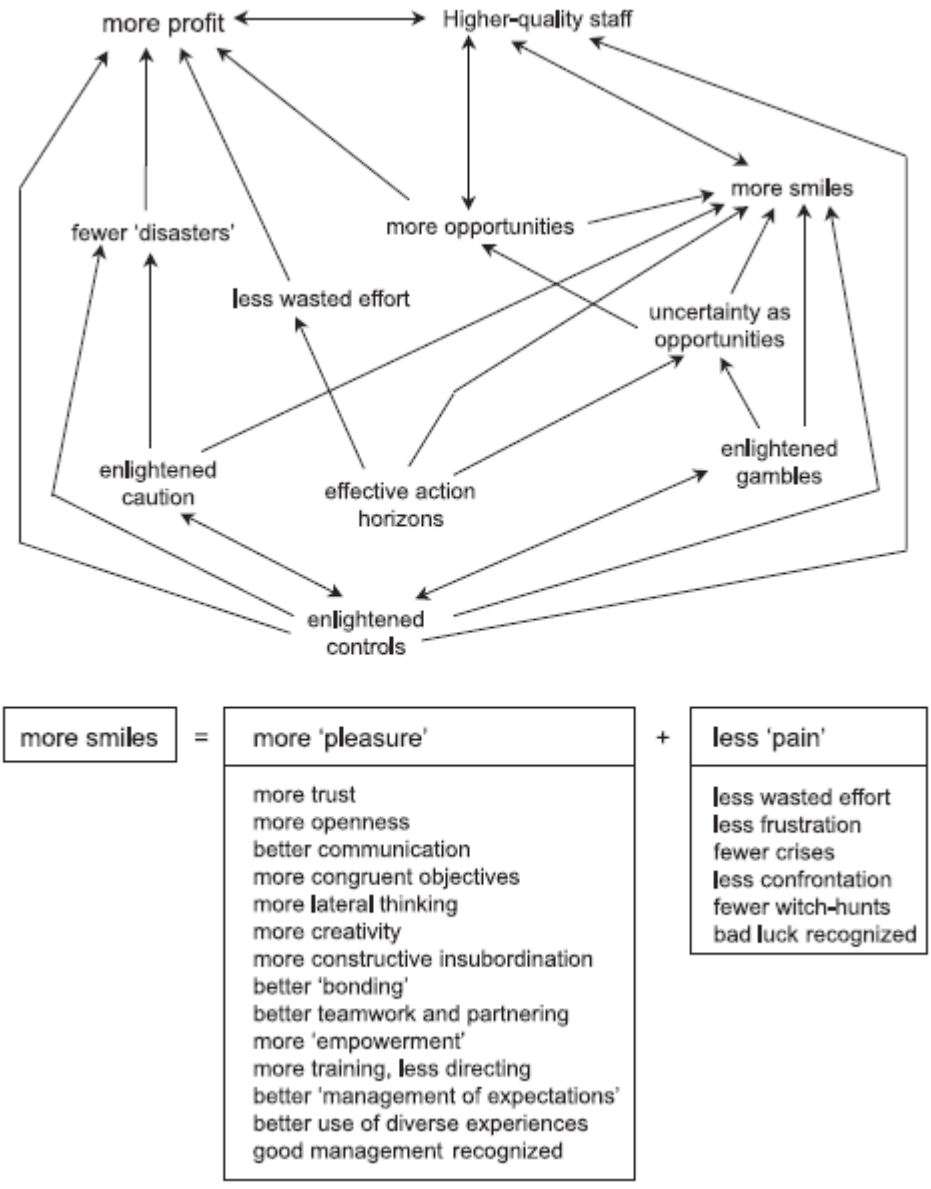

Figure 3.12 : Corporate benefits of effective risk management, Chapman and Ward (2003).

3.3 International Construction Risks and Developing Countries

3.3.1 Risk in construction

As a course of its nature, high amount of risk involves in construction projects. Since a construction project consists of various dependent activities, even a minor error during an activity can affect other activities and thus whole construction process. Akintoye and Macleod (1997) indicated that in the construction industry people frequently come up against situations that includes various anonymous, unforeseen, not anticipated factors, which are generally unwanted.

According to Smith et al. (2006), it is generally accepted the objectives of a construction project based on three primary elements, which are cost, time and quality. The risk factors affect all these three elements at the same time. Smith et al. (2006) also indicated that it is critical to designate the primary causes of risk and be aware of the fact that risk is not just a random event. That way a rational forecast can be achieved through experience and anticipation.

3.3.1.1 Characteristics of construction risk

In the literature, risks are generally grouped as following according to their characteristic features, which are quite acceptable also for the construction industry:

- Internal / External Risks
- Acceptable / Unacceptable Risks
- Short Term / Long Term Risks
- Manageable / Unmanageable Risks

In a construction project, risks are generated from external and internal factors. External risks generally derive from environmental factors. On the other hand, internal risks are project specific and develop from the uncertainties from the project (Zhi, 1995). Risks can also be described as acceptable/unacceptable, short term/long term and manageable/unmanageable risks. Ehsan et al. (2010) described unacceptable risks as the ones, which affect the critical path of the project in a negative way. While the short term risks are the ones, which have an impact that can be seen immediately, the impacts of a long-term risk can be detectable in the future, which can cause more damage than anticipated. Furthermore, a manageable risk means a controllable risk and can be easily compensated in case of occurrence. An unmanageable risk on the other hand is noncompensable and cause serious damage in the process of a project (Ehsan et al., 2010).

3.3.1.2 Categories of construction risk

According to Ehsan et al. (2010), a broad categorization of the risk types in the construction industry includes six main categories, which are Technical, Logistical, Managerial, Environmental, Financial and Socio-Political Risks.

Technical risk

Technical risks are an extensive category, which includes risk related to resources, material availability, weak site analysis, conformity of specifications, and lack of design and application defects.

Logistical risks

Logistical risks generally refer to risks related to transportation routes and facilities. In addition, the availability of essential materials and spare parts for the general construction process is a part or the logistical risks category.

Managerial risks

Managerial risks include all management related risks such as qualification level of the project team, efficiency of organization or work schedule related risks. The company's relationship and communication problems with employer(s) can be also included in managerial risks category.

Environmental risks

Environmental risks generally describe the risks, which are originated from climatic and physical (topographical) conditions of the project location including also "force majeure" which refers to natural disasters.

Financial risks

Financial risks are also another extensive category, which includes all kinds of financial exposures that the company may come up against at every stage of a project from bidding to after-sales services phase. Some of the common financial risks are economic fluctuation and inconstancy in foreign market, payment delays from employer, general inflation, risks related to local taxes/payments etc.

Socio-political risks

Socio-political risks describe the risks related to administrative regulations and social features of the country in which the business is conducted. Risk, which arises from custom/import procedures, limitations, obligation to work with local firms, can be included in socio-political risks.

3.3.1.3 Sources of construction risk

Although there are several categorizations for construction risks, there is not always a clear line between these risk categories. An environmental risk for instance, can easily turn into a financial or a time (managerial) risk. On the other hand, a technical risk such as “inadequate design” may cause re-procurement of materials and become a financial risk and can affect the working schedule negatively which needs to be compensated by taking some measures in logistics organization. Many of the risk types in construction can easily evolve to another risk since all of the activities are dependent to each other and have to be coordinated carefully. One of the reasons of this situation is the fact that risks in a construction project have many different sources in which some of them are mutual for different risk types. According to Ehsan et al. (2010), common sources for construction risk can be summarized as following:

- Revisions in the scope and technical requirements
- Deficiency in design works
- Uncertain definitions about the roles & responsibilities of parties
- Unskilled labour
- Subcontractors
- Contractor’s lack of experience
- Technological improvements
- Contractor’s unfamiliarity with local regulations & conditions
- Force majeure

3.3.1.4 Factors affecting construction risk

Construction risks generally arise from the sources, which are described above, however the impact and severity of the risk depend on some other factors. Ehsan et al. (2010) described these factors as following which may increase the probability and impact of a risk:

History: Contractor’s experience over a project has a critical importance on the severity of upcoming risks. If similar projects are done by the contractor successfully

before, the possible risks are expected, precautions are taken so that the damage would be less and the risk level becomes lower.

Management Stability: This factor refers to the determination and balance of the management team as well as the project team. Decisions and plans at the management level should be rational and realistic so that goals and project schedule can be achievable.

Staff expertise and experience: Lack of experience and skill of the project staff can cause serious defects at a construction project in terms of project budget, work schedule and quality.

Team Size: The team size of a construction project gets larger in direct proportion to the project size, which makes it more likely to face with communication problems.

Resource Availability: Availability of resource is a crucial factor in a construction project. Resources (such as money) have critical importance on providing the required material, equipment and work force for the project. However, resources cannot provide full protection against risks; they make it possible to take necessary precautions.

Time Compression: The more the time schedule is compressed in a construction project, the possibility of exposure to risk increases strongly. Availability of time makes it easier to assess the risks and develop a respond strategy against them.

Complexity: The complexity level of a construction project has a direct influence on the possible risk exposure since it is harder to manage the general construction processes in a complicated project.

Figure 3.13 illustrates the details of construction risks, which are explained in this chapter.

As Latham (1994) pointed out, every construction project contains risk, which cannot be ignored but can be managed by sharing, transferring or even accepting it. The construction risk is an extensive term and breaks down into different categories of risks, which arise from various sources in the construction process and are affected by several factors. Risk exists almost at every step of a construction project and it cannot be neglected. The critical point is how the risk should be anticipated, assessed and managed.

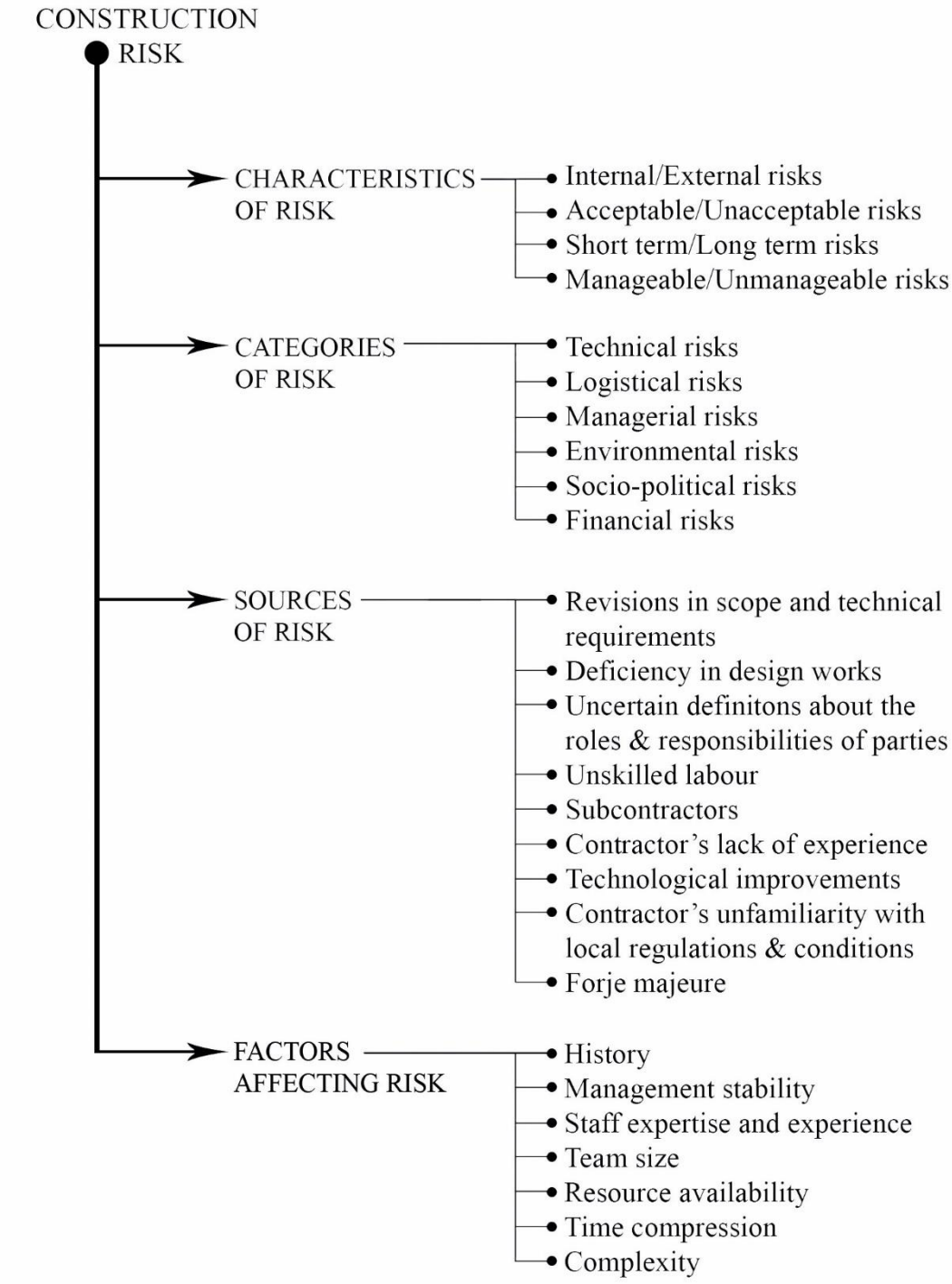

Figure 3.13 : Details of construction risk.

3.3.2 International construction in developing countries

Since developing countries get involved in globalization, international construction business in these countries also increased. The main reason for that is the need of specialized construction work for complex projects such as industrial facilities, airports, seaports etc.

According to Drewer (1980), internationalization and "importing construction" are inevitable for developing countries since the characteristics of intended projects go beyond the capacity of local construction professionals in these countries

3.3.2.1 Internationalization in construction

In the past, the construction industry often considered as a local industry since the final products are generally unmovable, large items such as buildings, infrastructure, facilities etc. However, for several industries, internationalization started to became larger after World War II due to increasing need of exchanging technology, skills, labor and services between countries. Langford (2000) indicated that in the late 1990s, there is a strong increase in internationalization in business with the help of some international institutions and agreements such as:

GAAT (General Agreement on Tariffs and Trade)
GATS (General Agreement of Trade and Services)
EU (European Union)
WTO (World Trade Organization)

Construction industry also benefits from these factors in this globalization process. Langford (2000) described the pattern for international construction trade between developed, newly industrialized and un-industrialized countries as it is illustrated in the Figure 3.14. Developed countries usually provide expertise in construction for less developed (un-industrialized) and newly industrialized (developing) countries. On the other hand, newly industrialized countries provide manufactured goods for both developed and less developed countries and receive workforce from less developed countries.

Although internationalization in many industries mostly started during the period after World War II, it is also possible to observe some examples about the concept of international construction in the history.

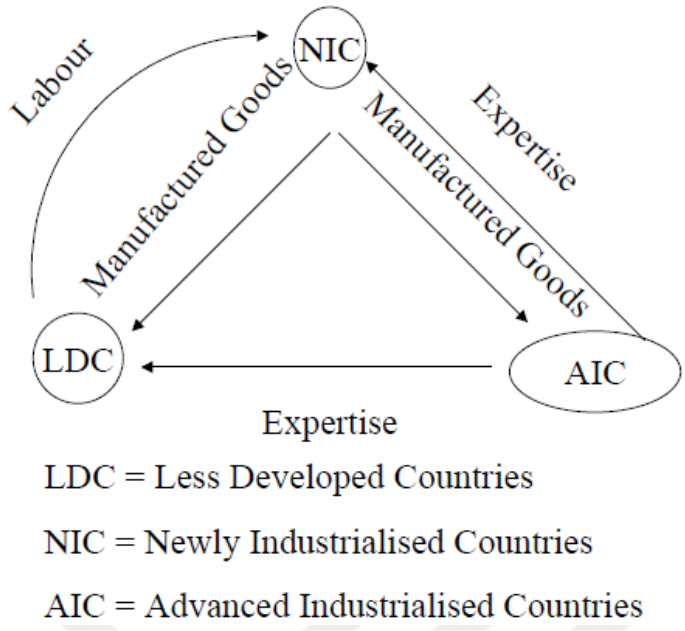

Figure 3.14 : Construction trades between countries, Langford (2000).

Langford & Male (2001) indicated that the origin of international construction reaches to the expansion of the empires. The infrastructures, which were built in northern Europe by Romans, the Suez Canal, which was constructed by French, or Ankara-Baghdad railway, which was built by Germans, are few of the many examples. However, internationalization in construction industry rapidly increased after 1950s through the financial aids for less developed countries, which were provided by important institutions such as the World Bank or African, and Asian Development Banks. Oil exploration in some regions like Middle East, South Africa and Russia is another factor, which accelerated the internationalization process in construction industry. In more recent times, growth and development of third world countries and arising nations such as the countries from USSR (Union of Soviet Socialist Republics) created opportunities for international construction market (Langford & Male, 2001).

In line with these events, a construction company may decide to get involved in the international construction market for several reasons. Langford & Male (2001) defined the reasons and motives to internationalize for a construction company based on the results a *"portfolio analysis"* which may indicate the motives of a construction company to internationalize such as:

- Insufficiency of the current portfolio in meeting company objectives, which may due to saturation, declining demand or high level of competition in local construction market.
- Having sufficient amount of resources to internationalize which means the company achieves its current objectives and has extra resources to expand.
- Expecting greater profits from international construction market.
- "Grass is greener syndrome" which means that the domestic market gets smaller in an unforeseeable way and the company may not be able to improve its position in the competitive market. That can make the company dive into international market regardless having enough information and analysis about the opportunities in the international market.

Although these four reasons summarize the reasons for developing an international strategy, there are also some other reasons to be considered for internationalization of a construction company. Langford and Rowland (1995) described the aims of a company, which operates in international construction market:

- Maximizing the profit, dividends, share value and market rating of the company
- Contributing to the growth of the company and providing employment.
- Maintaining the activity of the company.
- Creating career opportunities and job satisfaction.
- Making contribution to the economy and employment in the operation area.

3.3.2.2 International construction and competitive advantages

As it is stated previously there are various reasons and factors for contractors to head towards to international construction market. Decline in domestic demand for construction, expecting bigger profits or achieving new goals lead the construction companies to internationalization. However, competitive environment in international construction market may also be challenging for contractors. Langford & Male (2001) described some key sources, which may bring advantage to contractors on the global stage:

- Financial strength and being able to provide financial packages

- Being open to joint ventures
- Being able to managing the risks
- Investing in sales and R&D.
- Achieving procurement on global basis
- Technical expertise
- Combination of local and global knowledge
- Political support

Langford & Male (2001) also indicated that it is important to figure out the way to convert these key sources into success in international area. Porter (1990) developed a model called "Porter's diamond" which aims to analyze the competitive advantages or positions of nations and groups according to some factors effecting them. Figure 3.15 illustrates Porter's national diamond model. According to this model, regional competitive advantages can be determined by four main factors, which are following:

- Firm strategy, structure and rivalry refer to the conditions, which set by governments about company operations and rivalry.
- Demand conditions refer to the condition of the demand for industry's product in the home-market.
- Related and supporting industries refer to the existence of supplier or other related industries in the nation.
- Factor conditions refers to the condition of production factors such as skilled labor, funding, education and infrastructure.

Porter (1990) indicated that it takes some certain conditions to convert obstacles into advantage and a nation may easily succeed in an industry when these four determinants of national diamond are at their most favorable positions for that industry.

Based on Porter's national diamond model, Male described some factors affecting competitive strategies for companies, which are also applicable for international construction industry (as cited in Langford & Male, 2001):

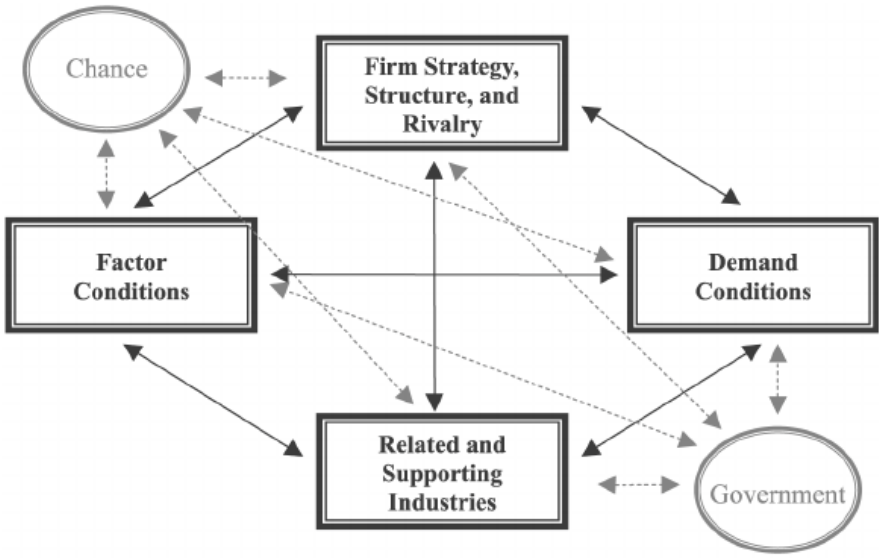

Figure 3.15 : National Diamond Model, Porter (1990).

- Early opportunities through increasing demand in international arena as well as the decline of demand in domestic market have great influence on the internationalization of construction.
- Relationships and harmony between sub-industries & firms have an effect upon the competitive advantage of companies in international arena.
- Factors such as knowledge, training, education and all kinds of resources in the domestic environment also have an important influence on the internationalization process of construction companies.
- Determining company's specific locational advantages is critical since they help the firm to adapt country specific conditions, which are described in Porter's national diamond model. That way the company may gain competitive advantage over others.

3.3.2.3 Construction risks in developing countries

As it is stated previously, problems, uncertainty and risk are many of the inherent challenges of the construction industry all over the world. However, Ofori (2000) indicated that in developing countries, these challenges exist alongside some other factors such as socio-economic problems, lack of resources, institutional and general inabilities to manage key issues and it is also observed that these problems became greater toward 2000s.

In fact, the studies about construction industry in developing countries date back to 1970s. Turin (1973) developed a matrix and classified the construction industry of developing countries under four sectors as following:

- International-modern
- National-modern
- National-conventional
- Traditional

Later, Drewer (1980) presented a modification of Turin's matrix and classified the construction services as international and large-medium-small national. However, as Ofori (2000) pointed out that these models only focus on the physical construction and do not consider other aspects of construction projects such as planning, design, administration or issues with clients. In the light of these studies, Ofori (1990) suggested an alternative matrix, which is illustrated in the Figure 3.16. According to this matrix, construction in developing countries is classified under six sectors, which are following:

- International: Modern and complex projects such as large factories, dams, luxury complexes, airports, seaports etc.
- Conventional-large: Modern large projects such as office buildings, mass housings, highways etc.
- Conventional-medium or small: Modern medium size construction projects such as roads, schools, medium size housing projects etc.
- Self-help: Projects such as social facilities, roads etc.
- Monetary-traditional: Small building projects like houses, shops etc.
- Subsistence: Projects such as public facilities, houses, barns etc.

In the matrix, these six types of construction activities in developing countries are studied in terms of the resources to accomplish these projects and the limiting factors against them. According to Ofori's matrix, international construction activities in developing countries described as modern and technically sophisticated large projects such as dams, major factories, luxury complexes etc. In addition, major airport and seaport projects may be considered in this category. As it is stated

previously, for carrying out such types of projects in developing countries qualifications of the local contractors may not be enough so that “expertise” may be imported. In some cases, when the country’s own resources are very inadequate, whole construction services for the project may be exported from foreign countries. That kind of a construction activity has its own types of risks alongside with regular project risks. Resources for large international projects in developing countries are described as following in Ofori’s Matrix:

- Foreign construction firms
- Foreign consultancy
- Imported equipment and construction materials
- Professional personnel (may be expatriate staff)

Limiting factors for these resources are also described in the matrix as foreign exchange, executive ability and professional skills (Ofori, 1990).

TYPE	RESOURCES	LIMITING FACTORS
International (dams, motorways, special factories, conference complexes, luxury hotels)	Foreign-owned contracting firms. Some foreign consultancy. Imported materials and equipment. Professional and managerial personnel.	Foreign exchange (S/MT). Executive capacity of client organisation. (L/MT) Professional and managerial skills (MT).
Conventional-large (offices, highways, factories, blocks of flats)	Large local contractors. Some imported materials. Plant and equipment. Skilled personnel.	Foreign exchange (S/MT). Professional skills (MT). Intermediate skills (MT).
Conventional-medium or small (modern, medium or small: schools, feeder roads, houses)	Small local contractors. Imported/local materials. Few skilled managerial or technical staff. Skilled operatives.	Skilled operatives (MT). Intermediate skills (MT). Efficiency of contractors (LT).
Self-help (social communal facilities, roads)	Government technical aid. Local/imported materials Voluntary labour by community.	Government's extension services (LT) Local initiative and enthusiasm (cooperative habit) (L/MT).
Monetary-traditional (houses, shops and similar small buildings).	Traditional materials and tradesmen.	Attitudes of clients and users (LT).
Subsistence (houses, barns, communal facilities)	Traditional materials. Owner/Cooperative labour.	Attitudes of clients and users (LT). Clients' initiative and leisure time (ST).

Abbreviations: ST = Short Term; MT = Medium Term; LT = Long Tend; S/MT = Short and Medium Term; L/MT = Long and Medium Term

Figure 3.16 : Matrix for construction in developing countries, Ofori (1990).

4. RISK MANAGEMENT IN DEVELOPING COUNTRIES: A CASE STUDY FROM TURKMENISTAN

As it is already stated several times, construction is a business with high levels of risk due to its large number of participants, connected activities and many uncertainties. Many studies in the literature such as Ofori (1990) indicated that regular construction risks are perceived stronger in developing countries due to economical and socio-political factors. There are many surveys or case studies in the literature in order to evaluate international project risks. However, most of these studies are focused on the project risks in general levels such as market level, country level and project level risks. Furthermore, many of these studies involve in various projects from various countries, which may have different dynamics so that the results of these kind of broad surveys can mislead the researcher. Socio-political and economic status of the country and the features of the project such as size, scope, limitations, contract type etc. are critical factors affecting the project risks. That is why here we a have detailed survey for a large-scale international project, which is being constructed in Turkmenbashi, Turkmenistan. Details of the project and survey are explained in the following sections.

4.1 Research Methodology

A case-based approach and open-ended interviews were applied in order to capture a full perspective of risk management associated with international construction projects in developing countries. The selected project is Turkmenbashi International Seaport, which is a large-scale complex project located in Turkmenbashi, Turkmenistan and was undertaken by a single Turkish construction company. The details of the project are presented in the section 4.1.2.

4.1.1 Data collection

A case study was employed, which allows for an in-depth investigation of risk management in construction projects in developing countries and consists of three main parts as following (Appendix A):

Part 1: Background information of the respondents, e.g. their age, gender, position, education, working experience and professional background.

Part 2: Questionnaire regarding to risk assessment.

Part 3: Interviews with the executives.

Regarding to the questionnaire design, the classifications of risk factors specific to international construction projects in developing countries were selected from an extensive literature review. In addition to the six risk categories retrieved from the literature, "3rd party related risks" were also identified due to the characteristics of the selected project, which are also explained in the following sections. As a result, 50 risk factors were identified under seven categories as following:

- Socio-political risks
- Managerial risks
- Financial risks
- Technical risks
- Logistic risks
- 3rd party related risks
- Environmental risks

These 50 specific risks under seven categories are listed in Table 4.1. Afterwards the identification of the risks, a questionnaire was designed, in which the participants should evaluate these risks in terms of risk impact level and probability of occurrence. Prior to this questionnaire, in the first part of the survey, a general information form was handed out to participants in order to gather background information about them such as age, gender, working experience and professional background. Afterwards the first and second part of the survey, in the final part open-ended interviews were carried out with the executives at the company. The general purpose of these interviews were collecting information about the risk management approaches used at the company.

The participants of the survey were employees from project management team of the selected project. The details and highlights about the survey and participants are presented in the section 4.1.3.

Table 4.1 : List of identified construction risks for an international project in a developing country.

Risk categories & risks
A. Socio-political risks
a.1. Effect of political events and decisions on intercountry relations
a.2. Political instability in the project region
a.3. Frequently changing government regulations
a.4. Corruption in legal system
a.5. Adaptation difficulties for the functioning of the company
a.6. Social adaptation difficulties for the employees
B. Managerial risks
b.7. Uncertainties about the scope of the works (employer's requirements)
b.8. Limited time for bidding process
b.9. Inadequate price analyses at bidding phase
b.10. Uncertain definitions in the contract about responsibilities of the parties
b.11. Managing unsolved items from bidding phase (post-bid negotiated items)
b.12. Severe sanction clauses regarding to delay penalties
b.13. Delays in work schedule
b.14. Missing the deadline for project completion
b.15. Constraints on employment of expatriate staff
b.16. Lack of qualified personnel with experience in the region of the project
b.17. Lack of qualified personnel with experience in the type of project
b.18. High salary scales (foreign currency based) for expatriate personnel
b.19. Abroad mobilization costs for compound and facilities
C. Financial risks
c.20. Global currency and inflation
c.21. Delayed payments from the employer
c.22. Budget overrun
D. Technical Risks
d.23. Risks related to project delivery system (design & build)
d.24. Designer's lack of experience in the specified project type
d.25. Insufficient design & incorrect material selection
d.26. Late submittal of project

Table 4.1 (continued) : List of identified & typical risks for an international project in a developing country.

Risk categories and risks
d.27. Large amount of project revisions
d.28. Providing incorrect material/service according to employer's requirements
d.29. Shortage of qualified products in the local market
d.30. Risks related to long lead items
d.31. Overseas procurement risks
d.32. Shortage of qualified suppliers in the local market
d.33. Insufficient supplier choices by the contractor
d.34. Lack of procurement experience
d.35. Cost based procurement policies
E. Logistic risks
e.36. Long shipping times due to challenging shipping routes
e.37. Large or heavy equipment shipping
e.38. Air cargo expenses for urgent or belated items
e.39. Large amount of shipping costs due to route and material types
F. 3rd party & employer related risks
f.40. Difficulties in obtaining design & material approvals from employer or local authorities
f.41. Project revision requests from employer
f.42. Material/equipment change requests from the employer
f.43. New type of material/equipment or service demands which are not defined in the contract
f.44 3rd party inspection fails and related design revisions
f.45 3rd party inspection fails and related material re-procurement
f.46 3rd party inspection fails and related re-application on the site
f.47 Failure of 3rd party inspection firm (giving approval for insufficient design/material or application)
G. Environmental Risks
g.48 Transportation difficulties to the project site
g.49 Tough climatic conditions
g.50 Force majeure (natural disasters, wars, etc.)

4.1.2 Case study project background: Turkmenbashi International Seaport

Turkmenistan is located in Central Asia and surrounded by the countries Kazakhstan, Uzbekistan, Afghanistan, Iran and the Caspian Sea. The country became independent in 1991 after the dissolution of the Soviet Union and ruled by presidential republic since then. According to the World Report of Human Rights Watch (2014), Turkmenistan is still one the most restrictive countries in the world. However, the data of HDR (Human Development Report) indicated that the country's HDI factors such as life expectancy, education level, GNI per capita increased in the recent years as shown in the Figure 4.1 (UNDP, 2016). International Model United Nations Association (2017) also consider Turkmenistan as developing country according to some key statistics and indicators such as GDP growth, per capita income and human development index.

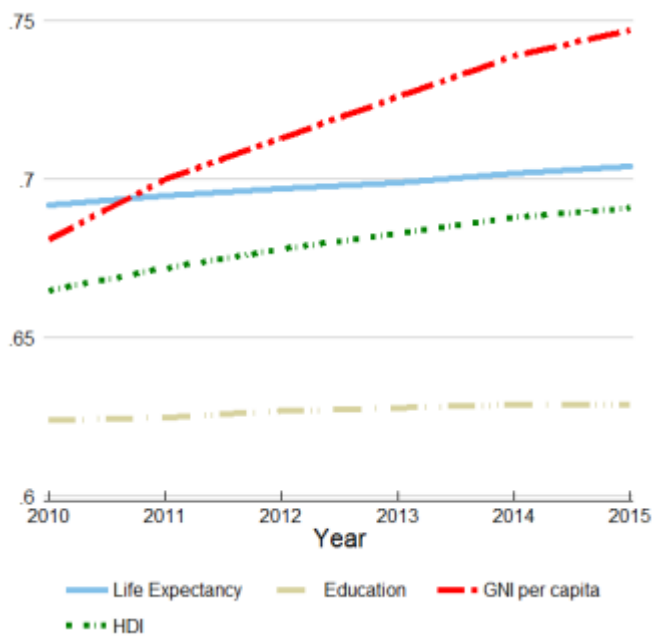

Figure 4.1 : HDI levels of Turkmenistan between 2010 and 2015, UNDP (2016).

In order to revive the historical Silk Road route, there are several investments in the world, including also the Turkmenbashi International Seaport Project, which is located in Turkmenbashi, Turkmenistan, near the Caspian Sea as shown in the Figure 4.2.

The project was undertaken by a single Turkish construction company under an EPC (Engineering-procurement-construction) contract. The scope of the project could be described as a turnkey complex, which is illustrated in the Figure 4.3 and includes a

ferry/passenger terminal, cargo ports, a shipyard, a ro-ro and polypropylene terminal. The by-pass roads, bridges and railways are also within the scope of the project. The contract type of the project is EPC, which means the contractor is responsible for handing over a turnkey project to the employer. The contractor outsourced design works of the project as well as some applications on site. General construction materials were provided from Turkey, since usually it is not possible to provide any materials from Turkmenistan's local market except for concrete and simple tools.

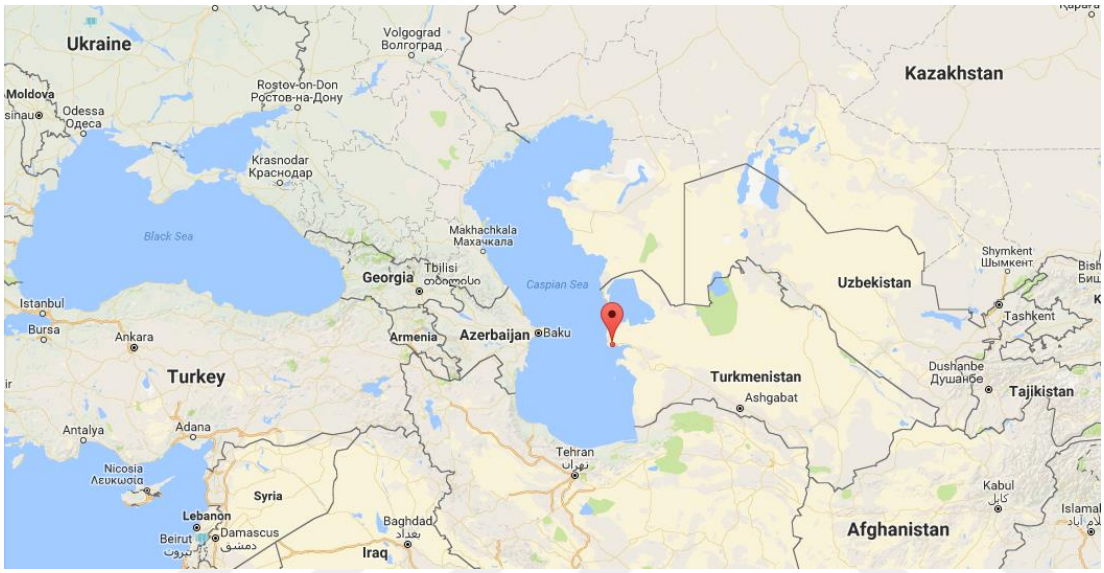

Figure 4.2 : Location of the city of Turkmenbashi, Google Maps (2017).

Special equipment such as harbor cranes, rails, locomotives and quay equipment were procured from expert firms of Europe, USA or the Far East.

Most of the application projects and procured materials were dependent on the approvals of third party inspection firm, the employer's representative and the related governmental departments. Other details about the project are as following:

Employer: Turkmenistan Sea and River Transport Vehicles Authority

Project start date: 06.01.2014

Project completion date: 31.12.2017

Value: 1.5 billion USD

Contract type: EPC (Engineering-procurement-construction)

The participants of the project also include some third parties such as:

Employer's representative: A German company

Third party inspection firm: An Italian company

Figure 4.3 : Turkmenbashi International Seaport Project, TCA Web Page.

4.1.3 Case survey

The case survey is structured afterwards the data was collected from an extensive literature review. As it is mentioned previously, the survey includes three sections: background information about participants, the questionnaire about risk assessment and open-ended interviews.

The participants of the survey are members of project management department of the Turkmenbashi Seaport Project. Employees from head office and construction site office contributed the research. These 20 employees are entrusted with the coordination of design, procurement, logistic and on site application activities. General information about the participants of the survey are as following:

- The positions of the respondents in the company vary from non-managerial to top management level.
- 10 employees from head office in Turkey and 10 employees from construction site office in Turkmenistan contributed to the research survey.
- The respondents have 3 to 34 years of total experience in construction business.
- The professions of the respondents are architect, civil engineer, mechanical engineer and electrical engineer.
- 20% of the respondents are female, 80% of the respondents are male employees.

After collecting the background information of the participants, second part of the study was applied, which is a questionnaire about risk assessment. The respondents are asked to specify “risk impact level” and “probability of occurrence” values according to their opinion for every risk factor listed in the Table 4.1. Table 4.2 shows the evaluation scale for risk impact level and Table 4.3 shows the evaluation scale for probability of occurrence.

Table 4.2 : Evaluation scale for risk impact level.

Degree of impact	Detail
1 (negligible)	Very low impact. Almost inconsequential and ineffective to construction process.
2 (minor)	Low impact. The consequences are slight and repairable.
3 (moderate)	Noticeable impact. The results are influential to construction process but still repairable when precautions are taken.
4 (likely)	Strong impact on the construction process. Results may not be repaired.
5 (very likely)	Very strong impact on the construction process. Causes unrepairable damage and serious time shift in the work schedule.

Table 4.3 : Evaluation scale for probability of occurrence.

Probability of occurrence	Detail
0-10% (rare)	Unexpected. Not seen in familiar cases.
10-25% (unlikely)	Exceptional. Seen rare in familiar cases.
25-40% (moderate)	Occasionally. Not expected again in 3-5 years.
40-75% (likely)	Expected but not very common.
75-100% (very likely)	Expected. Almost certain to occur.

After values were collected for risk levels and probability of occurrence, risk scores for each risk were calculated through the multiplication of these two values. Since the risk impact level was evaluated in a scale from 1 to 5 and the probability of occurrence was evaluated in a scale from 0% to 100%, the maximum and minimum values for risk scores are 5 and 0. For instance, if a risk impact level is rated 4 and probability of occurrence is rated as 80% for a risk factor, the risk score will be 3,2 as following: 4 (risk impact level) x 0,8 (probability of occurrence) = 3,2 (risk score).

In the final part of the case study, open-ended interviews, in a complementary manner, provided situated information of risk strategies. A number of interviews were carried out with the executives in order to obtain information about the company's mitigation and response techniques against the highest rated risks in the second part of the survey. For this purpose, 15 top-rated risk are identified with the help of the data collected from the questionnaire in the second part of the case study. These findings are presented in the section 4.3.

4.2 Results from Questionnaire

4.2.1 Descriptive analysis

Twenty employees from project management team of the contractor were chosen as contributors to the research survey. 50 risk factors were identified which are common for an international construction project in a developing country. The respondents were asked to specify the values of "risk impact levels and probability of occurrence values" according to their opinion and experience in the construction industry. The background information of the respondents were also collected at the beginning of the survey. At the final stage, after rankings were calculated for 50 risks, the managers of related departments were interviewed in order to collect information about risk response techniques against top rated risks of the research survey.

After the data were collected for the background information of the respondents as well as the values for risk impact level and probability of occurrence, risk scores were calculated for each risk individually. In the next step, the average risk scores and standard deviation values were calculated for each risk. Average standard deviation value is 0.84, which indicated that the results were mostly consistent but still included some different opinions based on different characteristics of the respondents such as profession, years of experience, position at the company etc. The results according to these characteristics were also analyzed. Different opinions from different employees were also valuable for a healthy risk assessment, therefore applying methods like Delphi, in order to receive similar results, was not considered necessary.

The results of the research survey were examined in following aspects:

- List of 50 identified risks according to risk scores from highest to lowest is shown in Table 4.4.
- 10 of the highest rated risks and 10 of the lowest rated risks are described in Table 4.5 and Table 4.6.
- Highest rated risks according to the head office employees and construction site office employees are shown in Table 4.7 and Table 4.8.
- Highest rated risks according to managerial level employees and non-managerial level employees are shown in Table 4.9 and Table 4.10.

The results indicated that the highest risks for the project are financial, managerial and technical risks in general. “Delayed payments from the employer” is considered as the most crucial risk factor, which is followed by “missing the deadline for project completion” and “budget overrun”. In addition, some technical risks related to design process such as “late submittal of projects” and “large amount of project revision” or some managerial risks such as “delays in work schedule” and “constraints on employment” are also considered as some the most important risk factors for the project.

Logistic risks such as “long shipping duration” have also high risk scores most probably due to project location. Since the project is located Turkmenistan and it is difficult to provide qualified construction materials, which comply with the employer’s requirements, from the local market. Most of the materials and equipment have to be procured and shipped from Turkey, Europe or other countries, which are located far from Turkmenistan. This kind of an operation makes the site activities vulnerable against the logistic risks.

Some of the risks related to third parties, which are employer’s representative and inspection firm in this case, have also high risk scores. Most of the materials have to be inspected & approved by a third party inspection firm before shipment. Employer’s representative and related governmental departments should also approve design works, material and equipment choices. That could be the reason for high risk scores of the risks such as “difficulties in obtaining design or material approvals from the employer.

Table 4.4 : List of risks according to the risk scores from highest to lowest.

Ranking	Risk	Scores	
		Average	Stdev.
1	(c.21) Delayed payments from the employer	3.83	0.6
2	(b.14) Missing the deadline for project completion	3.67	1.09
3	(c.22) Budget overrun	3.47	0.85
4	(d.26) Late submittal of project	3.39	0.76
5	(b.13) Delays in work schedule	3.3	1.01
6	(d.27) Large amount of project revisions	3.27	0.93
7	(d.23) Risks related to project delivery system (design & build)	3.14	0.78
8	(b.15) Constraints on employment of expatriate staff	3.07	1.21
9	(d.24) Designer’s lack of experience in the specified project type	3.05	0.72
10	(d.25) Insufficient design & incorrect material selection	2.97	0.91
11	(d.35) Cost based procurement policies	2.64	0.98
12	(e.36) Long shipping times due to challenging shipping routes	2.59	1.15
13	(f.40) Difficulties in obtaining design & material approvals from employer or local authorities	2.51	0.86
14	(e.39) Large amount of shipping costs due to route and material types	2.50	1.02
15	(b.09) Inadequate price analyses at bidding phase	2.44	1.23

Table 4.4 (continued) : List of risks according to the risk scores from highest to lowest.

Ranking	Risk	Scores	
		Average	Stdev.
16	(a.03) Frequently changing government regulations	2.27	0.91
17	(d.30) Risks related to long lead delivery items	2.21	0.97
18	(f.41) Project revision requests from employer	1.89	1.66
19	(d.29) Shortage of qualified products in the local market	1.88	1.15
20	(f.42) Material/equipment change requests from the employer	1.76	1.03
21	(f.43) New type of material/equipment or service demands which are not defined in the contract	1.73	1.03
22	(d.31) Overseas procurement risks	1.71	0.96
23	(d.32) Shortage of qualified suppliers in the local market	1.70	1.13
24	(b.11) Managing unsolved items from bidding phase (post-bid negotiated items)	1.62	1.18
25	(b.8) Limited time for bidding process	1.6	0.93
26	(f.44) 3rd party inspection fails and related design revisions	1.57	0.75
27	(b.7) Uncertainties about the scope of the works (employer’s requirements)	1.56	1.04
28	(b.12) Severe sanction clauses regarding to delay penalties	1.51	1.05
29	(b.10) Uncertain definitions in the contract about responsibilities of the parties	1.50	1.07
30	(e.38) Air cargo expenses for urgent or belated items	1.49	0.99

Table 4.4 (continued) : List of risks according to the risk scores from highest to lowest.

Ranking	Risk	Scores	
		Average	Stdev.
31	(e.37) Large or heavy equipment shipping	1.44	1.02
32	(a.04) Corruption in legal system	1.39	1.12
33	(f.46) 3rd party inspection fails and related re-application on the site	1.36	0.64
34	(f.45) 3rd party inspection fails and related material re-procurement	1.32	0.76
35	(d.33) Insufficient supplier choices by the contractor	1.19	0.97
36	(d.28) Providing incorrect material/service according to employer's requirements	0.97	0.57
37	(b.18) High salary scales (foreign currency based) for expatriate personnel	0.93	1.10
38	(b.17) Lack of qualified personnel with experience in the type of project	0.90	0.56
39	(b.16) Lack of qualified personnel with experience in the region of the project	0.85	0.34
40	(c.20) Global currency and inflation	0.84	0.75
41	(b.19) Abroad mobilization costs for compound and facilities	0.81	0.95
42	(a.06) Social adaptation difficulties for the employees	0.78	0.84
43	(f.47) Failure of 3rd party inspection firm (approval for insufficient design/material/application)	0.65	0.32
44	(a.05) Adaptation difficulties for the functioning of the company	0.54	0.59
45	(d.34) Lack of procurement experience	0.53	0.35

Table 4.4 (continued) : List of risks according to the risk scores from highest to lowest.

Ranking	Risk	Scores	
		Average	Stdev.
46	(a.01) Effect of political events and decisions on intercountry relations	0.52	0.51
47	(g.49) Tough climatic conditions	0.49	0.48
48	(a.02) Political instability in the project region	0.41	0.36
49	(g.48) Transportation difficulties to the project site	0.38	0.36
50	(g.50) Force majeure (natural disasters, wars, etc.)	0.29	0.24

Top ten highest rated risks according to the average values came from all of the participants are listed in the Table 4.5. It can be seen in general that risks related to financial problems and work schedule were rated as highest risks by the participants. Progress payment delays were considered as the highest risks in the project, since they can effect almost all of the other internal processes including the payments of subcontractors and material suppliers. These kind of financial problems could also trigger all the other risk factors.

Table 4.5 : Highest rated risks.

Ranking	Risk	Score
1	Delayed payments from the employer	3.83
2	Missing the deadline for project completion	3.67
3	Budget overrun	3.47
4	Late submittal of projects	3.39
5	Delays in work schedule	3.33
6	Large amount of project revision	3.27
7	Risks related to project delivery system (design & build)	3.14
8	Constraints on employment of expatriate staff	3.07
9	Designer's lack of experience in the specified project type	3.05
10	Insufficient design & incorrect material selection	2.97

Missing the project deadline also was considered as one of the highest risk factors, in fact according to the site employees this risk factor has the highest risk score. Both due to contract clauses about delay penalties and the business culture in Turkmenistan, missing the deadline is one of the worst scenarios in a construction project. Some related technical and managerial risks, which can cause missing the deadline such as late project submittals, large amount of revisions, designer errors or budget overrun also, have significantly high scores.

One of the risks, which can be considered as a managerial risk, "constraints on employment of expatriate staff", was also evaluated as one of the major risks. According to the current regulation in Turkmenistan, the contractor is obligated to employ nine local workers for every expatriate staff. This kind of a regulation forces the contactor to make limited choices about employment of foreign/expatriate personnel. Apparently, both head office employees in Turkey and construction site team in Turkmenistan considered this circumstance as a significant risk.

On the other hand, the lowest rated risks according to the average values came from all of the participants are listed in the Table 4.6. Generally, risks related to the environmental events

and political stability were considered as negligible risks. Since the political situation is stable for a long time in Turkmenistan and the intercountry relationship between Turkey and Turkmenistan is good, socio-political risks were evaluated as low risks by the participants.

Some features about the culture of the company such as adaptation difficulties or lack of experience were also rated as low risks. The possible reason for these opinions is the previous success of the company both in Turkmenistan and in other foreign countries.

Table 4.6 : Lowest rated risks.

Ranking	Risk	Score
1	Force Majeure (Natural disasters, wars, etc.)	0.29
2	Transportation difficulties to the project site	0.38
3	Political instability in the project region	0.41
4	Tough climatic conditions	0.48
5	Effect of political events/decisions to intercountry relations	0.52
6	Lack of procurement experience	0.53
7	Adaptation difficulties for the functioning of the company	0.54
8	Failure of 3rd party inspection firm	0.65
9	Social adaptation difficulties for the employees	0.78
10	Abroad mobilization costs for the compound and facilities	0.81

The responses from Turkey head office and Turkmenistan site employees were also evaluated separately in order to see if there was a difference in risk perception between them. Highest rated five risks according to employees from head office and construction site are listed in Table 4.7 and Table 4.8.

Top rated risks were generally the same except for some minor difference and the ranking of the highest risk. While head office employees rated “delayed payments from employer” as the highest risk, the construction site employees rated “missing the project deadline for completion” as the highest risk. This difference is understandable since the consequences of financial problems are felt stronger in headquarters and the pressure to complete the project on time is felt stronger on the construction site.

Budget overruns, delayed payments, work schedule delays and large amount of project revisions are considered as the most significant risks by both head office and construction site office employees since the consequences of these risks effect almost every department at the company.

Table 4.7 : Highest rated risks according to the head office employees

Ranking	Risk	Score
1	Delayed payments from employer	4.00
2	Late submittal of projects	3.47
3	Budget overrun	3.36
4	Delays in work schedule	3.34
5	Large amount of project revision	3.30

Table 4.8 : Highest rated risks according to the site office employees

Ranking	Risk	Score
1	Missing the deadline for project completion	4.11
2	Delayed payments from employer	3.65
3	Budget overrun	3.58
4	Delays in Work Schedule	3.36
5	Large Amount of Project Revision	3.30

Furthermore, the responses of managerial and non-managerial employees were also evaluated separately in order to see if there was a difference in their risk perception. According to the results, the top rated risks were almost the same for managerial and non-managerial employees. The average scores for the top rated two risks, which are missing the deadline and delayed payments, were relatively higher according to the responses of managerial employees.

Table 4.9 : Highest rated risks according to managerial employees

Ranking	Risk	Score
1	Missing the deadline for project completion	4.28
2	Delayed payments from employer	4.08
3	Budget overrun	3.95
4	Delays in work schedule	3.70
5	Large amount of project revision	3.65

Table 4.10 : Highest rated risks according to non-managerial employees

Ranking	Risk	Score
1	Missing the deadline for project completion	3.47
2	Delayed payments from employer	3.46
3	Late submittal of projects	3.31
4	Budget overrun	3.30
5	Delays in work schedule	3.20

4.2.2 Inferential analysis

In order to see the correlation and unanimity between the responses of participants, Pearson correlation coefficient (PCC) and Kendall's W test were used. PCC indicates the linear correlation between the variables and have a value between -1 and +1, where -1 value refers to total negative correlation, the value 0 refers to no correlation and +1 value refers to total positive correlation. On the other hand, Kendall's W is a non-parametric statistic, which shows the correlation between the rankings made by participants and has a coefficient of concordance between 0 (no agreement) and 1 (total agreement):

- The value 0.10 as a correlation coefficient means very low level of unanimity between the respondents.
- The value 0.30 as a correlation coefficient means low level of unanimity between the respondents.
- The value 0.50 as a correlation coefficient means moderate level of unanimity between the respondents.
- The value 0.70 as a correlation coefficient means high level of unanimity between the respondents.
- The value 0.90 as a correlation coefficient means very high level of unanimity between the respondents.

According to PCC analyses (Appendix B) of the risk scores in a specific risk category, there is a strong positive correlation between the score of the risks listed below:

- Corruption in legal system (A4) and social adaptation difficulties for the functioning of the company (A5).
- Limited time for bidding process (B8) and inadequate price analysis at bidding phase (B9).
- Uncertainties about employer's requirements (B7) and managing unsolved items from bidding phase (B11).
- Delays in work schedule (B13) and missing the deadline for project completion (B14).
- Overseas procurement risks (D31) and shortage of qualified suppliers/products in local market (D32).

- Long shipping times due to challenging routes (E36) and large amount of shipping costs (E39).
- Third party inspection fail related design revisions (F44), re-procurement of materials (F45) and re-application on site (F46).

It was observed that strong correlation exists between several related risks, which indicated the consistency in responses of participants. Another result obtained from the PCC analyses is that the highest rated risk "delayed payments from the employer" has a risk score, which is in a positive correlation with the managerial level as shown in Table 4.11.

Table 4.11 : Correlation between indicators (financial risks) and control variables (characteristics of participants).

Indicators	Gender	Title	Experience
CC20	.196	.044	.131
CC21	-.063	.450*	-.286
CC22	-.386	.147	-.126

Furthermore, following results were obtained according to Kendall's W tests (Appendix B) applied for the risk rankings made by the participants according to their managerial level, gender and profession:

- There is a moderate level of unanimity between the responses of male and female participants as shown in the Figure 4.4.
- There is a high level of unanimity between the responses of managerial and non-managerial employees as shown in the Figure 4.5.
- There is a very high level of unanimity between the responses of participants according to their professions as shown in the Figure 4.6.

	Null Hypothesis	Test	Sig.	Decision
1	The distributions of Averagerankingaccordingtomaleemployees and Averagerankingaccordingtofemaleemployees are the same.	Related-Samples Kendall's Coefficient of Concordance	.572	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 4.4 : Unanimity between the responses of male and female participants.

	Null Hypothesis	Test	Sig.	Decision
1	The distributions of Average Rankingformanagerialemployees and AverageRankingfor Nonmanagerialemployees are the same.	Related-Samples Kendall's Coefficient of Concordance	.777	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 4.5 : Unanimity between the responses of managerial and non-managerial participants.

	Null Hypothesis	Test	Sig.	Decision
1	The distributions of Architects, CEngineers, MEngineers and EEngineers are the same.	Related-Samples Kendall's Coefficient of Concordance	.926	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 4.6 : Unanimity between the responses of participants according to their profession.

Afterwards these descriptive and inferential analyses of the data collected from the questionnaire section of the case survey, 15 highest rated risk factors were taken into consideration for the next section of the survey. These 15 risks originated from almost every risk category in the questionnaire and were considered as the most critical risks for the project by the participants of the case survey. For this reason, these 15 risk factors were used for the final part of the survey, which was open-ended interviews with the executives at the company.

4.3 Results from Interviews

In the third part of the research survey, it is aimed to collect information about the risk response approaches used at the company. 15 top rated risks according to the survey results was listed separately. Risks were classified according to their categories and also as “market & country level risks” and “project & company level risks” seen in the Table 4.12.

Afterwards the identification of 15 top rated risks, interviews were carried out with the managers from related departments about the mitigation methods used for these 15 risks.

Table 4.12: Highest rated 15 risks and risk categories

Risk factor	Risk category
1. Delayed payments from employer	Financial risks – Country & market level
2. Missing the deadline for project completion	Managerial risks – Project & company level
3. Budget overrun	Financial risks – Project & company level
4. Late submittal of projects	Technical risks – Project & company level
5. Delays in work schedule	Managerial risks – Project & company level
6. Large amount of project revision	Technical risks – Project & company level
7. Risks related to project delivery system	Technical risks – Project & company level
8. Constraints on employment of expatriate staff	Managerial risks – Country & market level
9. Designer's lack of experience in the specified project type	Technical risks – Project & company level
10. Insufficient design & incorrect material selection	Technical risks – Project & company level
11. Cost based procurement policies	Technical risks – Project & company level
12. Long shipping times due to challenging shipping routes	Logistical risks – Country & market level
13. Difficulties in obtaining approvals from the employer	3rd party related risks – Country & market level
14. Large amount of shipping costs	Logistical risks – Country & market level
15. Inadequate price analysis at bidding phase	Managerial risks – Project & company level

Following risks are considered as country & market level risks. Their sub-categories are financial, managerial and logistical risks so that interviews were carried out with finance, logistics and project management departments. The risk response approaches in the company for these risks are explained below and summarized in Table 4.13.

- Delayed payments from employer: This is considered as one of the greatest risks existing in the specified geographic region, Middle East. In order to avoid this risk, the company tries to develop good relationship with the employer by trying to respond positively to the revision requests at a certain level. In addition, the communication channels are always kept open, which is an important issue in the eastern culture.
- Constraints on employment of expatriate staff: This risk is a country specific risk, which refers to the government regulation that forces the contract to employ at a certain number of local personnel for every foreign employee. For instance, according to the current

regulation, for their every foreign personnel, the contractors have to employ nine local personnel from Turkmenistan. This is one of the risks, which are accepted before entering the business. However, in order to mitigate the impact, the company is careful with the timing of recruitment schedule of foreign personnel.

- Long shipping times due to challenging shipping routes: Due to the location of the city of Turkmenbashi, challenging shipping routes have to be overcame such as mountainous areas, old roads, bridges etc. In order to achieve this and mitigate the risk, route surveys are done before the operations and critical points are identified to develop shipment solutions.
- Difficulties in obtaining design, material & method approvals from the employer or local authorities: Since employer and local authority approvals are critical for the success of the project, this risk is also one of the significant managerial risks. In order to avoid and mitigate this risk, the company tries to maintain healthy relationship with the related authorities by performing detailed presentations and responding the revision requests positively as much as possible.
- Large amount of shipping costs: Due to the location of the project city and challenging shipping routes, the shipping costs increase naturally. In order to avoid major costs, the company tries to make shipment plans earlier by combining different shipment types and by mostly trying to use vessel and railroad transportation.

Table 4.13: Country & market level risks and risk response methods

Risk factor	Risk response methods
Delayed payments from employer	Avoid/Mitigate. Maintaining good relationship with the employer and funding from progress payments of other projects.
Constraints on employment of expatriate staff	Avoid/Mitigate. Being careful with the timing of recruitment schedule of foreign personnel.
Long shipping times due to challenging shipping routes	Accept/Mitigate. Carrying out route surveys to identify critical points and develop solutions.
Difficulties in obtaining approvals from the employer	Avoid/Mitigate. Maintaining good relationship with the employer and performing presentations about the details of the project.
Large amount of shipping costs	Avoid/Mitigate. Combining different shipment types and trying to use vessel and railroad transportation.

Following risks are considered as project & company level risks. Their sub-categories are financial, managerial and technical risks so that interviews were carried out with finance, design, procurement and project management departments. The risk response approaches in the company for these risks are explained below, which is also summarized in the table 4.14.

Table 4.14: Project & company level risks and risk response methods

Risk factor	Risk response methods
Missing the deadline for project completion	Avoid. Paying extra attention on the activities on critical path, increasing the number of teams, overlapping activities.
Budget overrun	Avoid/Mitigate. Budget transfers and design revision.
Late submittal of projects/ Large amount of revision/ Insufficient design & incorrect material selection	Avoid/Mitigate. Establishing a design team to monitor the designer and in-house design works for quick solution.
Delays in work schedule	Avoid/Mitigate. Closely monitoring the activities on the critical path and compensating the delays by speeding up non-critical activities.
Risks related to project delivery system	Mitigate/Share. Risk identification according to the categories and sharing the risk with the sub-contractors.
Designer's lack of experience in the specified project type	Avoid/Mitigate Getting consultancy services and employing experienced design manager to assist the designer.
Cost based procurement policies	Avoid. Establishing a project team, which works coordinated with the procurement department.
Inadequate price analysis at bidding phase	Mitigate. Budget transfers and design revisions.

- Missing the deadline for project completion: This is one of the most significant risks according to the project management team. In order to avoid this risk, CPM (Critical path method) is used in the work schedule. The activities on this path are paid extra attention and shifts are compensated by shortening the duration of other activities. Also increasing the number of teams and overlapping some construction activities are the methods used to avoid the risk.

- Budget overrun: Exceeding the budget is one of the critical financial and managerial risks. To avoid this risk, the company monitors purchasing and negotiating processes closely. In order to mitigate the risk impact, budget transfers are carried out from other budgets, which remain larger according to the actualized purchase amount. Another avoidance method is revising the design according to the items under budget. Increasing the quantity of under budget items may prevent budget overruns.
- Late submittal of projects, large amount of revision and insufficient design: Late delivery of the projects and revised projects as well as insufficient design/incorrect material selection are the critical risks, which affects the site application of several disciplines. In order to avoid the risk, the company establishes a design team at the head office, which monitors the works of designer closely. In addition, some in-house design works may sometimes be carried out in order to mitigate the impact of this risk.
- Delays in work schedule: The risk of delays in works schedule threatens the project completion date and therefore the risk responses are based on the critical path in work schedule. To avoid this risk, critical activities are monitored closely and to mitigate the risk impact, delays are compensated in other non-critical activities by overlapping some of them.
- Risks related to project delivery system: EPC contract, in other words design & build system is used for the project and there are some certain risks about it. In this system, the employer manages only one general contract with the contractor. That is why all of the risks originated from designers, sub-contractors or suppliers return to contractor eventually. Therefore, ignoring or transferring these risks are not an option for the company. These risks are identified according to their categories as mentioned before. Afterwards, risks are mitigated or shared with the subcontractors accordingly.
- Designer's lack of experience in the specified project type: Lack of experience is a serious risk especially in a large scaled complex project like a seaport. In order to avoid the impact of such a risk, the company works with some experienced consultants to identify the errors in design works. Also experienced design managers are employed by the contractor to mitigate the impact of this risk by producing project solutions in-house.
- Cost based procurement policies: One of the first priorities of procurement departments in a company is to provide the materials with best possible prices. However, that can lead to some problems such as providing the incorrect material according to the employer's

requirements. In order to avoid that risk, the company appoints a project team to work coordinated with the procurement department and requires approval from the project team prior to purchases.

- Inadequate price analyses at bidding phase: Inadequate price analyses can cause significant problems in the budget planning as the project moves forward. This risk can only be avoided at the bidding phase of the project by getting consultancy services from experienced people. During the project, the impact of this risk can only be mitigated by design revisions or budget transfers, similar to risk response methods for the risk of budget overrun.

5. CONCLUSION

5.1 Evaluation of the Study and Conclusion

The study reveals that international construction business is exposed to high amount of risk, which occurs with stronger impact in developing countries. Construction industry always had a major role in emerging economies, since its ability to provide a nationwide economic mobility through various sub industries. Especially with the accelerating globalization phase after 1950s, internationalization in construction increased rapidly and developing countries became popular markets due to increasing need of special construction projects, which could not be covered by local contractors.

Contractors from all over the world enter international arena due to several reasons such as saturation in domestic market, expecting greater profits from international market or having enough resources to expand the company. However, the opportunities in international construction market are presented alongside various construction risks, which are more threatening than the ones in domestic market. Common construction risks exist with stronger impact and higher probability of occurrence in the international market. Especially in developing countries, as Ofori (2000) stated, common challenges about construction occur under the influence of socio-economic pressure, lack of resources and general inabilities to solve key issues about business.

Considering the characteristics of international construction market and developing countries along with the nature of construction business, the literature review in this study highlights the importance of risk management in the success of international construction projects. In order to achieve a successful risk management for an international construction project in a developing country, a project specific approach is critical. However, this project specific approach should also consider the factors related with the target country and international construction market, since every country and every project have different dynamics so that the risk factors and impact levels may vary from one project to another. Therefore, the case study in this research presented a detailed survey including 50 specific risks under seven risk categories for international construction projects. The subject of the case study was Turkmenbashi International Seaport project, a large construction project located in

Turkmenbashi, Turkmenistan. 20 employees from head office in İstanbul, Turkey and site office in Turkmenbashi participated the survey and were asked to rate identified risks in terms of impact levels and probability of occurrence. Highest risks according to different characteristics of participants such as managerial level, gender, working location were listed separately and correlations between the responses were also analyzed in the previous sections of the study. After analysis of the results, several interviews were carried out with the executives from the company in order to collect information about risk response and mitigation techniques used against top 15 rated risks and these methods were briefly explained alongside other results in the previous chapter of the study.

The general results of the case study indicate that some identified risks, which are not common for every construction project, have significantly high risk scores due to specific conditions of the target country and type of the project. It is also understood that risk response and mitigation techniques should be developed project specific by considering the special conditions of the target country. In conclusion, the findings from literature review and the case study in this research confirm the statements from the earlier stages of the study as following:

- Construction industry has a significant role in developing country economies and by this means creates a major opportunity for international contractors.
- International construction includes high amount of risk, which occurs with stronger impact in the construction market of developing countries.
- A detailed risk management approach should be developed for the construction risks in developing countries, since the socio-political, economical or cultural features of developing countries are relatively more delicate so that a regular construction risk may have a stronger impact than expected.

5.2 Suggestions for Future Studies

The findings of this research reveals the importance of project based risk management approach for international construction projects in developing countries. Future studies may focus on specific economical or socio-political events in developing countries, which may affect the risk and crisis management processes in a construction company. Findings may be supported by the data collected from a real time case study as it is in this research.

Furthermore, the survey in this research was conducted in the last quarter of the project, approximately 6 month before the project completion date. Future studies may apply this kind of surveys both at the beginning and at the end of the project in order to be able to see the differences at risk perception of participants.

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APPENDICES

APPENDIX A: Case study documents

Dear All,

Your help is solicited in exploring the risk management and risk analysis of carring out a large-scale overseas construction project in a Developing Country. You have been identified a potential contributer to this research project. Enclosed please find a questionnaire which contains three sections to facilitate data collection.

The first section aims to collect the background information of the respondents, e.g. their age, gender, position, education, work experience and professional background.
The second section includes the respondents' opinion on the risk factor in terms of its probability and impact to overall construction project success. "Risk Impact" and "Probability of Occurence" parts needs to be filled. After that Risk Score will be calcutaled by the researcher according to your data.
The third section includes the respondents' opinion on the risk consequences for construction project performance measures as well as the risk assessment and response practices.

Table 1.

RISK-PROBABILITY Evaluation		
Degree		**Detail**
1-10 %	Rare	Unexpected. Not seen in familiar cases.
10-25 %	Unlikely	Exceptional. Seen rare in familiar cases.
25-40 %	Moderate	Occasionally. Not expected second time in 3-5 years.
40-75 %	Likely	Expected. Not very common.
75-100 %	Very Likely	Expected. Common, almost certain.

Table 1 shows the Degree of the Occurence of a Risk from 1 to 5.
1. Degree Risk is a rare and unexpected Risk to occur.
5. Degree Risk is a very likely Risk which is almost certain to occur.

Table 2.

RISK IMPACT Evaluation		
Degree		**Detail**
1	Negligible	Very low impact. Almost inconsequential and ineffective to construction process.
2	Minor	Low impact. The consequences are slight and repairable.
3	Moderate	Noticeable impact. The results are influential to construction process but still repairable when precautions are taken.
4	Major	Strong impact on the construction process. Results may not be repaired.
5	Catastrophic	Very strong impact on the construction process. Causes unrepairable damage and serious time shift in the work schedule.

Table 2 shows the Impact of a Risk in a scale of 1-10.
1 point indicates the minimum Impact. Risk does not cause severe results in case of occurence. The consequences are easy to manage.
5 points indicate the maximun Impact. Risk causes severe results in case of occurence.

Risk Impact: **1 (min.)** **5 (max.)**

SECTION 1

• **Project Type:**	International Seaport
• **Project Location:**	Turkmenbashi/Turkmenistan
• **Project Value:**	1,5 Billion USD
• **Company Role at the Project:**	Main Contractor
• **Contract Type:**	EPC (Engineering-Procurement-Construction)
• **Estimated Project Duration:**	43 months
• **Proffession:**	
• **Gender:**	Male O Female O
• **Age:**	
• **Area of Responsibility at the Project:**	
• **Years of Experience in the Construction Industry:**	
• **Years of Experience at the Company:**	
• **Years of Experince at the Project (years, months):**	
• **How would you rate the complexity of this project? 1(Very Simple) to 5(Very Complex)**	① ② ③ ④ ⑤

• **Please rank the following objectives in your opinion from 1 to 5 in order of priority on this project:**	1=Very low 2=Low 3=Moderate 4=High 5=Very high				
Cost	①	②	③	④	⑤
Time	①	②	③	④	⑤
Quality	①	②	③	④	⑤

SECTION 2

No	Risk Categories & Risks	Risk Impact (1.00 - 5.00)	Probabilty of Occurence (% percentage)
A.	**SOCIO-POLITICAL RISKS**		
	Political Risks		
1	Effect of Political Events / Decisions on intercountry Relations		
2	Political Instability in the Project Region		
	Governmental (Administrative) Risks at the Project Location		
3	Frequently Changing Government Regulations		
4	Corruption in Legal System		
	Cultural Risks in International Business		
5	Adaptation Difficulties for the Functioning of the Company		
6	Social Adaptation Difficulities for the Employees		
B.	**MANAGERIAL RISKS**		
	Bidding and Contact Risks		
7	Uncertainties about the Scope of Work (Employer's Requirements)		
8	Limited Time for Bidding Process		
9	Inadequate Price Analyses at Bidding Phase		
10	Uncertain Definitions about Responsibilities of Parties at the Contract		
11	Managing Unsolved Items from Bidding Phase (Post-Bid Negotiated Items)		
12	Severe Sanction Clauses		
	Time Risk		
13	Delays in Work Schedule		
14	Missing the Deadline for Project Completion		
	Human Resources Risks		
15	Constraints on Employment of Expatriate Staff		
16	Lack of Qualified Personnel with experince in the Region of the Project		
17	Lack of Qualified Personnel with experince in the specified Project Type		
18	High Salary Scales (foreign currency based) for expatriate Personnel		
19	Abroad Mobilization Costs for Compound and Facilities		
C.	**FINANCIAL RISKS**		
20	Global Currency and Inflation		
21	Delayed Payments from the Employer (Self Funding Risks)		
22	Budget Overrun		

SECTION 2

No	Risk Categories & Risks	Risk Impact (1.00 - 5.00)	Probabilty of Occurence (% percentage)
D.	**TECHNICAL RISKS**		
	Design Related Risks		
23	Risks related to Project Delivery System (Design & Build)		
24	Designer's Lack of Experience in the specified Project Type		
25	Insufficient Design & Incorrent Material Selection		
26	Late Submittal of Projects		
27	Large Amount of Revisions		
	Procurement Related Risks		
28	Providing incorrect Material/Service according to Employer Requests		
29	Shortage of Qualified Products in the Local Market		
30	Risks related to Long Lead Delivery Items		
31	Overseas Procurement Risks		
32	Shortage of Qualified Suppliers in the Local Market		
33	Insufficient Supplier Choices by the Contractor		
34	Lack of Procurement Experience		
35	Cost - based Procurement Policies		
E.	**LOGISTIC RISKS**		
36	Long Shipping Times due to Challenging Shipping Routes (Irregular Topograpfy, Banned Routes etc.)		
37	Large/Heavy Equipment Shipping		
38	Air Cargo Expenses for urgent or belated Items		
39	Large Amount of Shipping Costs due to Route and Material Types		
F.	**3RD PARTY RELATED RISKS**		
	Local Authority and Employer Risks		
40	Difficulties in Obtaining Desing, Material & Method Approvals from Employer or Local Authorities		
41	"Project Revision" Requests from the Employer		
42	"Material/Equipment Change" Requests from the Employer		
43	New Material/Equipment or Service Demands which are not defined in the Contract		
	3rd Party Inspection Related Risks		
44	Fail related Revisions (Design)		
45	Fail related Re-Procurement (Material)		
46	Fail related Re-Application on the Site		
47	Failure of 3rd party Inspection Firm (Giving Approval for insufficient Design or Material)		
G.	**ENVIRONMENTAL RISKS**		
48	Transportation Difficulties		
49	Tough Climatic Conditions		
50	Force Majeure (Natural Disasters, Wars etc.)		
	OTHER RISKS TO BE ADDED ACCORDING TO YOUR OPINION:		

SECTION 3

		Top Rated 15 Risks		Mitigation Methods
1.	3,83	C.21	Delayed Payments from Employer	
2.	3,67	B.14	Missing the Deadline for Project Completion	
3.	3,47	C.22	Budget Overrun	
4.	3,39	D.26	Late Submittal of Projects	
5.	3,33	B.13	Delays in Work Schedule	
6.	3,27	D.27	Large Amount of Project Revision	
7.	3,14	D.23	Risks related to Project Delivery Sistem (Design & Build)	
8.	3,07	B.15	Constraints on Employment of Expatriate Staff	
9.	3,05	D.24	Designer's Lack of Experience in the specified Project Type	
10.	2,97	D.25	Insufficient Design & Incorrect Material Selection	
11.	2,64	D.35	Cost - based Procurement Policies	
12.	2,59	E.36	Long Shipping Times due to Challenging Shipping Routes	
13.	2,51	F.40	Difficulties in Obtaining Desing, Material & Method Approvals from Employer or Local Authorities	
14.	2,5	E.39	Large Amount of Shipping Costs due to Route and Material Types	
15.	2,44	B.9	Inadequate Price Analyses at Bidding Phase	

APPENDIX B: Correlation tables

Correlations

		AA1	AA2	AA3	AA4	AA5	AA6
AA1	Pearson Correlation	1	.413	-.598**	-.029	-.289	-.021
	Sig. (2-tailed)		.070	.005	.903	.216	.931
	N	20	20	20	20	20	20
AA2	Pearson Correlation	.413	1	-.266	.078	-.186	.214
	Sig. (2-tailed)	.070		.257	.745	.432	.365
	N	20	20	20	20	20	20
AA3	Pearson Correlation	-.598**	-.266	1	.401	.215	-.074
	Sig. (2-tailed)	.005	.257		.080	.364	.758
	N	20	20	20	20	20	20
AA4	Pearson Correlation	-.029	.078	.401	1	.511*	.478*
	Sig. (2-tailed)	.903	.745	.080		.021	.033
	N	20	20	20	20	20	20
AA5	Pearson Correlation	-.289	-.186	.215	.511*	1	.424
	Sig. (2-tailed)	.216	.432	.364	.021		.062
	N	20	20	20	20	20	20
AA6	Pearson Correlation	-.021	.214	-.074	.478*	.424	1
	Sig. (2-tailed)	.931	.365	.758	.033	.062	
	N	20	20	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

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

Correlations

		BB7	BB8	BB9	BB10	BB11	BB12	BB13	BB14	BB15	BB16	BB17	BB18	BB19
BB7	Pearson Correlation	1	.654**	.489*	.912**	.752**	.095	.128	-.118	.304	.118	.174	.197	.391
	Sig. (2-tailed)		.002	.029	.000	.000	.691	.592	.619	.193	.619	.462	.404	.089
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB8	Pearson Correlation	.654**	1	.715**	.673**	.661**	.390	.357	.141	.468*	.048	.288	.161	.408
	Sig. (2-tailed)	.002		.000	.001	.002	.089	.122	.552	.038	.841	.218	.497	.074
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB9	Pearson Correlation	.489*	.715**	1	.535*	.470*	.387	.288	.233	.792**	-.164	.031	.197	.243
	Sig. (2-tailed)	.029	.000		.015	.036	.091	.218	.324	.000	.490	.896	.405	.302
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB10	Pearson Correlation	.912**	.673**	.535*	1	.867**	.038	.136	-.028	.415	.008	.319	.120	.463*
	Sig. (2-tailed)	.000	.001	.015		.000	.875	.569	.908	.069	.972	.171	.614	.040
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB11	Pearson Correlation	.752**	.661**	.470*	.867**	1	.179	.277	.042	.372	.150	.433	.084	.531*
	Sig. (2-tailed)	.000	.002	.036	.000		.450	.236	.860	.107	.527	.056	.724	.016
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB12	Pearson Correlation	.095	.390	.387	.038	.179	1	.472*	.088	-.027	.498*	.237	.325	.231
	Sig. (2-tailed)	.691	.089	.091	.875	.450		.036	.713	.909	.026	.314	.163	.328
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB13	Pearson Correlation	.128	.357	.288	.136	.277	.472*	1	.781**	.178	.472*	.461*	-.008	.227
	Sig. (2-tailed)	.592	.122	.218	.569	.236	.036		.000	.454	.036	.041	.974	.336
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB14	Pearson Correlation	-.118	.141	.233	-.028	.042	.088	.781**	1	.357	.122	.229	-.174	-.038
	Sig. (2-tailed)	.619	.552	.324	.908	.860	.713	.000		.122	.607	.331	.463	.873
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB15	Pearson Correlation	.304	.468*	.792**	.415	.372	-.027	.178	.357	1	-.294	.002	-.050	.080
	Sig. (2-tailed)	.193	.038	.000	.069	.107	.909	.454	.122		.208	.992	.836	.738
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB16	Pearson Correlation	.118	.048	-.164	.008	.150	.498*	.472*	.122	-.294	1	.434	.383	.321
	Sig. (2-tailed)	.619	.841	.490	.972	.527	.026	.036	.607	.208		.056	.096	.168
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB17	Pearson Correlation	.174	.288	.031	.319	.433	.237	.461*	.229	.002	.434	1	.312	.857**
	Sig. (2-tailed)	.462	.218	.896	.171	.056	.314	.041	.331	.992	.056		.181	.000
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB18	Pearson Correlation	.197	.161	.197	.120	.084	.325	-.008	-.174	-.050	.383	.312	1	.572**
	Sig. (2-tailed)	.404	.497	.405	.614	.724	.163	.974	.463	.836	.096	.181		.008
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
BB19	Pearson Correlation	.391	.408	.243	.463*	.531*	.231	.227	-.038	.080	.321	.857**	.572**	1
	Sig. (2-tailed)	.089	.074	.302	.040	.016	.328	.336	.873	.738	.168	.000	.008	
	N	20	20	20	20	20	20	20	20	20	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

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

Correlations

		CC20	CC21	CC22
CC20	Pearson Correlation	1	.027	-.273
	Sig. (2-tailed)		.909	.243
	N	20	20	20
CC21	Pearson Correlation	.027	1	.258
	Sig. (2-tailed)	.909		.272
	N	20	20	20
CC22	Pearson Correlation	-.273	.258	1
	Sig. (2-tailed)	.243	.272	
	N	20	20	20

Correlations

		DD23	DD24	DD25	DD26	DD27	DD28	DD29	DD30	DD31	DD32	DD33	DD34	DD35
DD23	Pearson Correlation	1	.224	.137	.654**	.217	.550*	.678**	.339	.694**	.614**	-.011	.288	.552*
	Sig. (2-tailed)		.342	.566	.002	.357	.012	.001	.143	.001	.004	.965	.217	.012
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD24	Pearson Correlation	.224	1	.446*	.618**	.521*	.196	.125	.164	-.052	.140	.668**	.311	.112
	Sig. (2-tailed)	.342		.049	.004	.018	.408	.600	.489	.827	.555	.001	.183	.638
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD25	Pearson Correlation	.137	.446*	1	.475*	.730**	.243	.303	.464*	.280	.171	.324	.042	.177
	Sig. (2-tailed)	.566	.049		.034	.000	.303	.194	.039	.232	.470	.164	.859	.455
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD26	Pearson Correlation	.654**	.618**	.475*	1	.731**	.214	.329	.333	.401	.266	.271	.133	.540*
	Sig. (2-tailed)	.002	.004	.034		.000	.365	.157	.152	.079	.257	.247	.576	.014
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD27	Pearson Correlation	.217	.521*	.730**	.731**	1	.009	.143	.196	.097	.116	.260	-.188	.282
	Sig. (2-tailed)	.357	.018	.000	.000		.971	.549	.407	.685	.626	.269	.426	.229
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD28	Pearson Correlation	.550*	.196	.243	.214	.009	1	.305	.175	.309	.343	.297	.482*	.406
	Sig. (2-tailed)	.012	.408	.303	.365	.971		.191	.461	.185	.139	.203	.031	.076
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD29	Pearson Correlation	.678**	.125	.303	.329	.143	.305	1	.564**	.774**	.882**	.027	.225	.174
	Sig. (2-tailed)	.001	.600	.194	.157	.549	.191		.010	.000	.000	.910	.340	.462
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD30	Pearson Correlation	.339	.164	.464*	.333	.196	.175	.564**	1	.656**	.414	.189	.192	.009
	Sig. (2-tailed)	.143	.489	.039	.152	.407	.461	.010		.002	.070	.424	.418	.969
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD31	Pearson Correlation	.694**	-.052	.280	.401	.097	.309	.774**	.656**	1	.598**	-.064	.181	.125
	Sig. (2-tailed)	.001	.827	.232	.079	.685	.185	.000	.002		.005	.790	.445	.599
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD32	Pearson Correlation	.614**	.140	.171	.266	.116	.343	.882**	.414	.598**	1	.043	.156	.129
	Sig. (2-tailed)	.004	.555	.470	.257	.626	.139	.000	.070	.005		.856	.512	.588
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD33	Pearson Correlation	-.011	.668**	.324	.271	.260	.297	.027	.189	-.064	.043	1	.487*	.088
	Sig. (2-tailed)	.965	.001	.164	.247	.269	.203	.910	.424	.790	.856		.030	.711
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD34	Pearson Correlation	.288	.311	.042	.133	-.188	.482*	.225	.192	.181	.156	.487*	1	.210
	Sig. (2-tailed)	.217	.183	.859	.576	.426	.031	.340	.418	.445	.512	.030		.375
	N	20	20	20	20	20	20	20	20	20	20	20	20	20
DD35	Pearson Correlation	.552*	.112	.177	.540*	.282	.406	.174	.009	.125	.129	.088	.210	1
	Sig. (2-tailed)	.012	.638	.455	.014	.229	.076	.462	.969	.599	.588	.711	.375	
	N	20	20	20	20	20	20	20	20	20	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

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

Correlations

		EE36	EE37	EE38	EE39
EE36	Pearson Correlation	1	.308	.338	.865**
	Sig. (2-tailed)		.186	.145	.000
	N	20	20	20	20
EE37	Pearson Correlation	.308	1	.791**	.428
	Sig. (2-tailed)	.186		.000	.060
	N	20	20	20	20
EE38	Pearson Correlation	.338	.791**	1	.488*
	Sig. (2-tailed)	.145	.000		.029
	N	20	20	20	20
EE39	Pearson Correlation	.865**	.428	.488*	1
	Sig. (2-tailed)	.000	.060	.029	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

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

Correlations

		FF40	FF41	FF42	FF43	FF44	FF45	FF46	FF47
FF40	Pearson Correlation	1	.649**	.541*	.273	.124	.127	.130	.285
	Sig. (2-tailed)		.002	.014	.244	.601	.594	.585	.223
	N	20	20	20	20	20	20	20	20
FF41	Pearson Correlation	.649**	1	.810**	.544*	.303	.306	.244	.187
	Sig. (2-tailed)	.002		.000	.013	.194	.189	.300	.430
	N	20	20	20	20	20	20	20	20
FF42	Pearson Correlation	.541*	.810**	1	.618**	.240	.222	.105	.085
	Sig. (2-tailed)	.014	.000		.004	.308	.347	.660	.721
	N	20	20	20	20	20	20	20	20
FF43	Pearson Correlation	.273	.544*	.618**	1	.407	.595**	.347	.172
	Sig. (2-tailed)	.244	.013	.004		.075	.006	.134	.469
	N	20	20	20	20	20	20	20	20
FF44	Pearson Correlation	.124	.303	.240	.407	1	.834**	.727**	.014
	Sig. (2-tailed)	.601	.194	.308	.075		.000	.000	.953
	N	20	20	20	20	20	20	20	20
FF45	Pearson Correlation	.127	.306	.222	.595**	.834**	1	.852**	.139
	Sig. (2-tailed)	.594	.189	.347	.006	.000		.000	.559
	N	20	20	20	20	20	20	20	20
FF46	Pearson Correlation	.130	.244	.105	.347	.727**	.852**	1	.371
	Sig. (2-tailed)	.585	.300	.660	.134	.000	.000		.108
	N	20	20	20	20	20	20	20	20
FF47	Pearson Correlation	.285	.187	.085	.172	.014	.139	.371	1
	Sig. (2-tailed)	.223	.430	.721	.469	.953	.559	.108	
	N	20	20	20	20	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

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

Correlations

		GG48	GG49	GG50
GG48	Pearson Correlation	1	.578**	.624**
	Sig. (2-tailed)		.008	.003
	N	20	20	20
GG49	Pearson Correlation	.578**	1	.403
	Sig. (2-tailed)	.008		.078
	N	20	20	20
GG50	Pearson Correlation	.624**	.403	1
	Sig. (2-tailed)	.003	.078	
	N	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

CURRICULUM VITAE

Name Surname **: Tuna Erata**

Place and Date of Birth **: Turkey, 02.05.1991**

E-Mail **: erata@itu.edu.tr**

EDUCATION:

- **High School:** 2010, İstanbul Erkek Lisesi (High School)
- **B. Sc.:** 2014, İstanbul Technical University, Faculty of Architecture, Department of Architecture

PROFESSIONAL EXPERIENCE:

- Since February 2016: GAP Construction Company
  Project Coordination Architect,
  Turkmenbashi International Seaport.

- June 2014 – January 2016: Polimeks Construction Company
  Project Coordination Architect,
  Ashgabat Olympic Complex.

- December 2013 – June 2014 : Polimeks Construction Company
  Intern Architect,
  Ashgabat Olympic Complex.