Faculty of Science and Engineering

Evaluation of Factors Influencing Delay in Construction/Civil Engineering

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DECLARATION

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signed

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ABSTRACT

Civil engineering and construction projects around the world have long been subject to delays and project extensions of time; which amounts to saying that many building jobs go beyond the preliminary time/ schedule estimates for cumulative work tasks and resultantly, extend original cost estimations. Many factors contribute to delay in building work and often such variables are location specific; socio-polictical flux and knock-on economic regional (re)development issues necessitate construction professionals involved in the estimating process to seek location-specific risk reviews in order to mitigate the potential for construction project-time blow-outs. Unfortunately such location-specific guidance is currently lacking. Indeed changes in both national and local-authority political strategies (across all regions of the world) can result in degrees of instability and subsequent reassessments of construction project cost/benefit analyses, with public-sector projects particularly suseptable to the vagaries of public-purse funding reassessments. The Middle East is an example of an area where many of that region's countries experience economic unpredictability, which in turn increases the risk factor for those who aspire to invest in, and are charged with, the creation and maintenance of civil engineering/constructed assets. Non-local, foreign design-and-build-consortiums and main-contractors often underestimate the impact of these region specific factors. As Middle-Eastern countries such as Egypt, Iraq, Libya, Syria and Iran undergo change, inflation swings alongside respective weakenings of national currencies, and not least (where often oil-revenue income redistribution is a key assumption in public-sector built-asset funding) oil income fluctuation influences construction and civil-engineering project feasibility and schedule. The main goal of this research seeks to build upon an identification and analyses of region-specific risk factors (where in-depth qualitative review of expert-practitioners, case-studies and related document analyses revealed the key causes of delay in Middle Eastern countries to be feasibility-study gaps, fragmented funding/financing considerations, inflation estimate inaccuracies, and forms of contracts unable to accommodate change), towards developing, validating and presenting a best-practice model/flow-chart solution to mitigate the (negative) impact of region-specific variables on the time-estimates and timing of civil engineering and construction projects. Primary data from qualitative semi-structured interview research results alongside case study (and document) analyses confirm that inadequate funding, inflation, poor feasibility studies and excessive scope changes are the key factors of delay in this region. One can say that inadequate funding most often occurs due either to inflation or because of poor feasibility-studies/poor early cost-estimates conducted at the briefing-stage and resultantly, subsequent excessive scope changes become common.

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CHAPTER 1: INTRODUCTION

1-1) Defining the Topic: extrinsic variables influencing construction cost

According to Baloia (2001), from the design stage to the stage where the project is completed, numerous factors affect the construction costs of a project. These factors can be categorised into *intrinsic* and *extrinsic* factors. *Intrinsic* factors are factors that relate to construction organisations; whereas extrinsic factors involve various elements ranging from the socio-cultural, technological, economic and political environments within which these organisations function. Discussion in subsequent chapters explores the extent to which *Extrinsic* causes of delay, are difficult to influence or control, whereas the intrinsic causes of delay can be addressed by efficient project management. *Extrinsic* causes such as: Geopolitical Risk, Inflation and Currency Rate Drop have been often called 'global risk factors' (Baloia 2001). Global risk factors vary from region to region; each region is known to have its own region-specific causes of delay in construction projects; to establish effective project control these causes must be identified and managed.

While the majority of the scholarly papers deal with the common factors of delay, very few scholars have considered it necessary to address the *region-specific extrinsic factors*. Therefore, on the one hand, the common factors of delay have been assessed from more than one perspective; while on the other hand, there is no clear information nor assessment with regard to the region specific factors of delay, and particularly so, in the countries of the Middle East.

In this research, the focus is on *region-specific* factors and the extent of their influence upon construction phasing. It is found (and discussed in the sections to follow) that the countries of the Middle East have many commonalities: these countries are located within an area with immense resources importance and thus solicit much geopolitical attention; a number of these countries are producers of oil - their economy, being more or less, dependent on oil. Dependency on oil amounts to saying that these countries have a vulnerable economy - that is, the price of oil is normally finalized

in the *international* oil market. As Fig 3-1 (Chapter 3-2-1) shows, the price of oil has historically fluctuated as a result of world events. Wide reaching national happenings have huge influence upon international crude oil prices, such as: the USA Pennsylvanian discoveries in the 1860's; pre-Great-Depression shortage fears on the 1920's; and latterly, the Iranian revolution in the late 1970's; the invasion(s) of Kuwait and Iraq in the 2000's; and, the Arab spring of the 2010's; all leading to large spikes and subsequent troughs in global oil prices and, it might be argued, major knock-on effects in national investment and development in (public-sector) infrastructure and building projects.

Dependency on oil then, becomes a key contributor to the instigation of future development, as well as the realisation and completion of projects already at the post-contract stage, with resultant delay in a number of projects where (public-purse) interim-valuation payments for work just completed become uncertain. For example, when the oil income decreases, allocated budgets to construction projects in public sector will be decreased. It means that a majority of projects will not be allocated 100% of their funds and thus are apt to face shortages of budget. If the project is still at the early design stage, the feasibility study is often necessarily reviewed and has the option, perhaps, for a less damaging 'stop-development/abort' decision in extreme cases, or at the very least, detailed re-estimation to ensure that the pending project will not face a sudden increase in cost.

Indeed the 'stop-development/abort' option can cause much distress and mistrust amongst stakeholders as is evidenced in the recent cancellation (as a result of Australian party-political changes in state leadership) of Australian-Victoria's proposed Aus$Multi-Billion 'East West Link' road tunnel, in which transport users are argued to be satisfied with the agreement that removes city-centre construction-activity disruption, but very unhappy with the waste of taxpayers' money for a scrapped project, thus far arguably estimated at Aus$339million (Corsetti, 2015).

In a situation in which the project is already at the post-contract construction stage, changes (resulting from extrinsic variables) often lead to serious problems such as delay in materials

procurement/purchase, labour re-resourcing, and general cash-uncertainty leading to, in many cases, contractor-client disputes over increasing project values and the cost of the project, and not least liability uncertainties for such cost and time blow-outs.

Projects then require construction professionals to seek to mitigate events (that go beyond their earlier predicted risk assessments and early estimates of on-site/task risk-mitigation measures) to address such time and cost overruns, often find that such measures result in a major change in *scope* to reduce shortfalls, leaving a client with a less than fit-for-purpose design solution to house their built asset needs.

Oil-price vagaries are noted as a major extrinsic factor in project overruns in the Middle East but (as with the Australian East-West tunnel example above that highlights state leadership issues) are not the only factor. Other common location-specific issues include: *environmental conditions*; *workmanship concerns*; *socio-political factors* (such as those identified above by the Australian East-West Tunnel cancelation); as well as, *social convictions*. The following pages highlight the extent to which these other largely extrinsic factors impact upon the construction process, and is presented as a precursor for subsequent chapter discussions.

Environmental conditions:

Environmental conditions and weather might be argued to span both *intrinsic* as well as *extrinsic* variables influencing construction down-time. Construction and engineering practitioners and schedulers might well factor-in inclement weather provision and float time into their work-breakdown schedules as an *intrinsic* amount of days, but *extrinsically*, planners are unlikely to address workforce *performance* in prolonged upper (temperature) limit periods. Srinavin and Mohamed (2003) identified that there is a very important relationship between workers' productivity and the thermal environment. In this research they discussed the negative impact of humidity and high temperature as a two important factors on workers' productivity. Due to high extreme temperatures in most Persian

Gulf countries, it is onerous to carry-out physical activities and on-site construction-works during the day in this region. Indeed night shifts in a project schedule carry their own concerns of visibility and safety. Extremely hot days simply become non-working days. According to the Canadian Centre for Occupational Health and Safety (CCOHS 2015) 35-40 degrees Celsius is the limit of high temperature tolerance. Likewise, in West Australia a ~39 degree Celsius maximum tolerance is set for 'stop-work' calls to be enacted on-site (Safe Work Australia 2011). Even where temperatures fluctuate such that a maximum upper limit is not officially reached, task performance efficiency by a workforce in these high temperatures is much reduced. In the Middle East, onsite temperatures can go towards very uncomfortable levels with 50-degrees Celsius are not uncommon. Indeed this may well contribute to levels of concerns related to workmanship, as discussed below.

Workmanship issues:

Beyond workforce inefficiencies in high temperatures, workers not used to the conditions alos play a part in on-site (under) performance. Cordesman (1999) mentions that a majority of Persian Gulf states are reliant on foreign itinerant labour and due to inconsistency in immigration strategies, a stop-start level of site-worker-training provision affects on-site skill and underlies a lack of preferred workmanship attainment. To solve this problem some of these countries attempt to hire *local/native labour* but this policy has been inconsistent in many regions, due largely to levels of pay inequalities in which on-site skilled workers are renumerated substaintially less than air-conditioned office work. Given a choice between equitable rates of pay, locals simply choose occupations other than on-site work. Added to a lack of local workforce, due to inconsistencies in immigration policies such as changes in criteria in granting visa to foreign labours, main-contractors and respective construction-managers simply cannot source adequate (pre-planned & WBS/scheduled expected) labour levels on a regular basis to meet the projects needs. Thus construction projects face shortages of manpower with a knock-on effect of delay to the overall project (pre)plans.

Indeed inconsistencies in immigration policy, links with governance at the wider level. Political strategies for development of infrastructure and building work vary across political parties and this represents an other extrinsic factors in assessing the reason for project delay, as below.

Socio-political Factors:

As will be examined in chapter 3-1 political (in)stability is one of the most important issues that contractors face in a foreign country. Ling (2006) mentions work in which all stakeholders involved in construction projects believe that (any) political change is apt to have a '*negative effect on project progress*'. For example, in election years depending upon which party 'wins', the priorities and electoral promises of that party will take precedence over previous 'promises'. The rules will be changed and some projects may even be canceled.

For example, in Western Australia, recent elections saw quite different priorities for the implementation of future plans for extending urban road and railway development, urbanization as well as public projects. As a result of recent political changes, and not least differences of (political) opinion over rates for the reinvestment and redistributed of Government Service Tax rates, reassessment of previously confirmed go-ahead(s) for a building works (such as the new proposed State stadium) were reversed and cancelled. (Taylor 2015).

Whilst politics can influence greatly public-project spending, similarly social-conviction plays a large part in the extrinsic variables that affect construction project delay.

Social Conviction:

Social convictions held by stakeholders can be argued to play a large part in the scheduling of construction projects and indeed whilst *intrinsically* schedulers may well factor-in non-work days into their work-breakdown-structures, extrinsic social convictions also require to be understood. Ling (2006) stated that the social convictions of religion, tradition and culture have an important role in

people's lifestyle in many parts of the world, not least in the largest democracy in the world, India. Even though India is modernising, Ling finds that stakeholders are still very much attached to cultural convention and tradition, not least in workforce interactions in which main-contractors must align task to workforce cultural propensity.

The developed world also requires attention to social conviction. In Perth Western Australia, Main-Contractors tendering for refurbishment and maintenance contracts might be forgiven for scheduling all work tasks uniformly for *all* of their prospective clients. They may be unaware however that their usual project work-breakdown structures will be delayed if they fail to recognize that a number of clients have within their contract stipulations allocated non-work days. One such West Australian client, that of Notre Dame University, allows no work to be carried out on a Sunday in line with religious convictions and Catholic belief (Notre Dame University 2015). So these issues must be considered by a project manager in developing an achievable project schedule.

In Middle East, there is a similar situation and foreign companies must be aware of the significant role of religion in this region. They should understand and consider the impact of stakeholder belief systems on project time scheduling. Whilst Friday as a (non-work) holy-day may be intrinsically recognised and catered for by project schedulers, Ramadan as a month in which Moslem countries fast and pray and where workforces generally start jobs later and finish earlier, may result in an extrinsic variable of project delay across both labour and materials-provisions supply chains; perhaps for many unfamiliar with convention (foreign main-contractors, or local firms with itinerant workforces) the start of fasting schedules may result in unexpected performance efficiency changes.

Having introduced above the extrinsic location-specific type of factors that can affect project schedules this research seeks now to identify the research problem to be addressed, namely that the local or unique key factors of delay (risk factors) in Middle East countries, requires an analysis of their effect and importance in contributing to delay across construction projects.

1-2) Research Problem

The primary problem within the construction and civil engineering industry, which has motivated this research, is delay in construction projects. According to El-Sayeghb(2006) it is vital to the benefits of all parties that delays, or their effects, are reduced. Even quite small advances in the recovery of a delayed schedule are likely to have a significant impact on the financial returns of those involved. Since delay is costly for all the parties involved in the construction industry, it must be identified and its causes addressed. Sweis (2007) mentioned construction delays are often responsible for turning profitable projects into losing ventures; Time overrun 'always' result in the project facing cost overrun and price escalations. Price escalation not only produces delays in construction projects but also causes the need to reduce the scope or even cancel projects. Even when the project is not cancelled, there are problems: for example, the owner has to find increased budget(s) for the project from alternative funds. If an alternative fund sources is not found, the project has to be brought to a complete stop or to continue the project in a different way. Hence, the harmful effects of delay and the negative impacts of cost overruns are extremely significant problems, for those who are involved in the project namely: the *Local* Contractor, the Consultant and Owner, as well as the *International* Contractor, Consultant and Investor

1-3) Purpose of the Research

The purpose of this study is to gain a better understanding of the construction market in the Middle East countries and mitigate the negative impact of delays on projects. This study will be useful for (Australian) contractors and consultants that wish to enter the international construction market in this region. Hamzah Abdul-Rahman (2012) stated that the lack of risk assessment and management before venturing abroad, especially in the Middle East Persian Gulf region has caused many to suffer losses. This work seeks to go towards addressing the need for guidance.

1-4) Research Objectives

In order to evaluate the regional delay factors in Middle East countries explicitly, the following *objective*s were identified:

- Review and compile current key variables of delay in construction market in the Middle East
- Identifying the regional risk in Middle East Countries
- Identifying and ranking the main factors of delay in civil projects in the Middle East
- Evaluate the share of each key factor of delay contributing to cost and time overrun in this region.

1-5) Research Questions

The major research questions posed by this study are:

What are the key region-specific (risk) factors of delay in construction projects in Middle Eastern countries?

What is the share (level of importance) of each factor in contributing to delay in building projects?

In order to examine this major question, a number of sub questions are considered;

What is the impact of each delay factor on civil project?

What is the interrelationship of delay factors?

This research sets as its objectives, a way to answer the questions above (made explicit in chapter 4.1).

1-6) Significance of the Research

A number of benefits will be gained from the current research project. These benefits will take the form of both theoretical benefits and benefits to industry, as outlined below.

1-6-1) Theoretical Benefits

The results (described in this report's later chapters) of this research are expected to have a number of theoretical benefits including: addressing a main aim to provide a clear perspective of the

construction industry in Middle East countries for foreign companies who are interested in entering in this industry.

This research identifies the regional risk factors and provides some suggestions to mitigate the negative impact of these factors on construction projects.

1-6-2) Benefits to Industry

The results of this research are expected to have a number of significant benefits to the overseas/Australian consulting and construction industry. These include the ability to:

- Improve knowledge about regional Risk Factors in the Middle East.
- Make better decisions when entering international construction market.
- Gain profit or at least reduce their loss in international project

1-7) Research Design

The nature of the research questions played a significant role in determining the most appropriate research methodology. Data collection was undertaken in the form of qualitative research (in- depth interviews), case study and projects' documents analyses (as detailed in the methodology chapter).

Data analysis in qualitative research refers to the organisation, categorisation and interpretation of the data (Creswell, 2007). This study utilised a broad three stage process which can be broken down into the following steps:

1. Data collection.
2. Data Analysis
3. The interpretation and display of this data to draw conclusions.

For more detail on the data analysis process used in this study refer to Section 4.5 of this research.

Verification of the study was then carried out as outlined in Section 4.6 of this research.

1-8) Research Report (thesis) Overview

This research paper comprises eight chapters.

Chapter 1 provides the foundation for the research, giving a brief overview of the research topic including the significance of the research to the construction industry.

Chapter 2 presents the background of the research by providing an understanding of the context of the study, an outline of the previous research undertaken on the topic and justification for the research.

Chapter 3 contains a more detailed insight into the literature related to the research topic and questions.

Chapter 4 discusses the methodology/ research design, highlighting the differences between qualitative and quantitative research methods and provides a justification for the research strategy and interview technique used specifically to target the objectives outlined by this research. This chapter ends with a discussion of the methods of validation and ethical issues related to the qualitative research methodology.

Chapter 5 provides the results of this research including the results of the interviews and document analyses and case study conducted as part of primary data collection for this study.

Chapter 6 provides a discussion relating to interviews' results. The main factors are identified and ranked and the share of each factor in delay of a civil project identified.

Chapter 7 outlines the conclusions drawn from this research and provides recommendations for further research in key areas relating to the research topic.

CHAPTER 2: BACKGROUND

2-1) Problem identification

The construction industry plays an important role in the national economy and in gross domestic product (GDP) in countries, especially in (newly) developing countries Lopes (2003). According to Crosthwaite (2000), the share of construction spending in GDP first grows during the stage of less developed countries (LDC) and reaches its peak during the stage of newly industrializing country (NIC), and as countries move from NIC to advanced industrialized country (AIC) status, the share of construction expenditure declines.

Since the countries of interest in this research are moving towards development, the construction industry plays a significant factor in the consideration of these markets. As an example, Arshi Shakeel (2006) mentioned that United Arab Emirates (UAE) construction has a vital role in its development and contributes 14% to the GDP (El-Sayeghb 2006). It is worth mentioning that in Iran, in the previous five years, the budget allocated to the construction industry has gradually increased; in 2010-2011 the budget reached a peak with a 148.6% growth (Raz 2011; Shada 2011). As construction budgets increase, it appears to be necessary for traditional approaches towards project management to be reconsidered.

Mas'udi, (2010) an expert in construction projects in Iran, considers poor project management to be one of the key factors of delay in construction projects (Shiri 2010). As discussed in chapter 1, poor project management is an intrinsic factor and related to construction organization. It goes without saying that Middle East countries have many issues in common: first and foremost, they are situated in an area with extreme geopolitical (resources) significance. Secondly, all of these countries are oil-producers and their economy is more or less dependent on oil. This issue, as the research will explain further, is a main cause of delay in some of these locations. Other common factors in this region (alluded to above) are deemed to include social conviction, weather conditions, lack of workmanship and political systems. Discussion below extends these themes and shall seek to assess the extent to which regional differences dictate the key variables for delay and the extent to which these variables influence construction phasing.

As mentioned earlier, one key factor that contributes to delays in this region is the reliance of the construction budget on oil income. As the oil price is determined in an international market and does not remain constant at all times, the fluctuations in oil price are argued to have a potentially negative effect on construction projects. Diagram 3-2-1 shows how world events such as the Iranian revolution in 1979 or invasion of Iraq and the Arab Spring had significant impact on oil price. As El Shazly and El Hag (2012) mention this region has about 45% of the world's proven oil reserves and 25% of crude oil exports. Consequently, oil has a significant share in GDP which makes up 75% of the annual government exports (Shazly 2012). Reliance on oil exports will eventually lead to vulnerability as oil prices have proven to be extremely unstable.

For instance, in Iran, *85% of the construction projects are totally reliant on oil income* as their main source of budget. Hence, the fluctuations of oil price should be considered a significant factor affecting delay in these projects (Shiri 2010). Therefore, these (Iranian) projects will face budget issues as oil revenue changes as a result of international price fluctuation; a very unique circumstance (Shiri 2010).

On the other hand, whilst other countries in the Persian Gulf area such as Bahrain, Iran, Kuwait, Qatar, Saudi Arabia, and the UAE are oil-exporting countries, they are not 'equally' dependent on oil as a key source of income and means to finance construction projects. Certain countries, the UAE for instance, have been successful in decreasing their dependency on oil income by building new cities, & real estate, via tourism and international travel revenues. Resultantly the vagaries of international crude oil indices have less impact upon the feasibility and go-ahead of infrastructure and building projects.

For less oil-revenue orientated countries, it is such reforms that have resulted in the diversification of their export structure. Statistics show that in UAE construction constitute 83% of GDP whereas the share of oil and gas is as little as 8%. This is in contrast with the situation in other neighbouring countries such as Qatar in which the share of oil and gas in GDP reaches 37% and the share of construction industry is 39% of GDP (Shazly 2012).

Othman (2008) stated Brunei to be a country which, whilst seeking diversification, remains largely dependent on oil income. Brunei owes its prosperity to its plentiful oil and gas resources. As such, due to dependency on oil income Brunei is very vulnerable to external shocks, particularly given the prospect of an eventual reduction of these resources. Therefore creating constant growth in the non-oil private sector is one of the most important challenges in Brunei. Brunei has long-term goal of trying to reduce the role of the government, as well as strengthen the economic diversification program. As alluded to above, addressing such extrinsic variables may then lead to a more predicable (time-target achievable) construction industry.

Economic and political instability has been argued here to contribute to delay in major construction projects. In Iran, in particular, 'foreign supply chains' have a negative impact on construction projects. Firstly, there is civil engineering excavation equipment that must be imported from foreign country supply-chains, in which 'sanctions' exacerbate difficulties (Trembath 2015). Secondly, economic instability leads to fluctuation in localised exchange rates. Since the currency is not stable, when compared to international currencies, the price of equipment will significantly increase (fluctuate significantly) from the price estimated at the beginning of the project. This research results (described below) pay close attention to these key region specific factors of delay and will discuss the extent to which these factors will have negative effect on civil projects in this region.

2-2) Delay: Intrinsic and Extrinsic Listings

2-2-1) Key Delay Factors

A number of researchers have discussed and studied the delay factors in construction projects around the world from different points of view. According to Sweis (2007) in Jordan, in residential ventures *projects owners* can be considered as a very common cause of delay; whilst severe weather conditions and changes in laws and regulations have, interstingly the *least* impact on delay of Jordanian projects. In other words Jordanian construction industry practitioners are able to address resources within their respective remit adequately, but somewhat struggle with extrinsic issues related to clients.

Conversley, Kaliba (2009) discussing projects in the Central African country of Zambia, recognised heavy rain and flood has the most significant role in delay in road construction projects when compared to other factors such as client vagaries.

A number of researchers including Kaliba (2009) have studied cost and time overruns in road construction projects. They acknowledged that a number of factors have significant impact on these projects, namely: heavy rain and floods (as mentioned), too many changes in the projects' scope, strikes, technical challenges, inflation and local government pressures.

Moreover researchers have recognised as influencing project time-line delays, factors including: delay in payments; long financial process; form of contract irregularies and ambiguities; economics problems; material procurement; equipment unavailability; poor supervision; construction mistakes, and poor coordinations on site, each having significant roles in time overrun in road construction projects.

Assaf and Al-Hejji (2006) conducted a field survey which included 23 contractors, 19 consultant, and 15 owners. In this survey they identified *73 (seventy-three)* causes of delay in civil projects and they found that the average of time overrun is between (10-30%) of initial estimation. Seventy-three causes is somewhat unweildly and a number that the resaerch argeus to require to be reduced based upon a level of importance. A region-specific analysis is argued here to be of more use to construction practitioners that trying to address 73 separate items to maintain scheules and remain on-track.

Too many *scope changes* in orders was identified as a very common cause of delay by all the parties (contractors, consultant, and owner) in a study by Frimpong (2003). In addition, the survey's results showed that about 70% of projects experienced delay. Furthermore Frimpong (2003) stated a majority of projects in the Central African country of Ghana (75% of all projects undertaken) exceeded the initial time and cost estimation, and that only 25% were completed on time and on budget. Frimpong also listed the important causes of delay in Ghana in (groundwater) construction projects and identified the following as crutial: Payment problems, poor contractor management,material procurement, poor technical performances and rises in material price.

In his research Frimpong (2003) concentrated on the construction phase, arguing that the major delays occured on-site.

Sambasivan (2006) studied the delay factors and their impact on construction projects in Malaysia. This study identified the 10 most important causes of delay and listed these as: inadequate planning, poor site management, inexperienced contractors, inadequate financing and payments for completed work, subcontractors dispute mechanisms, materials under-estimations, labour supply issues, equipment availability, lack of communication between parties and, finally technical mistakes during the construction stage. Once again technical irregularies seem to be the least important factor in project delay. In other words construction practitioners globally know how to build and seldom are delayed because they lack the technical expertise.

This research (Sambasivan, 2006) also found the six main effects of delay on construction projects are: time overrun, cost overrun, dispute, arbitration, litigation and total abandonment. They identified the most important causes of delay and categorised them as client-related, contractor-related, consultant-related, material related, labour-related, contract-related, Contract relationship-related and *external* factors. On the other hand Neguyen Duy Long (2004) classified delay factors under five major groups including: incompetent designers/contractors, poor estimation and change management, social and technological issues, site related issues and improper techniques and tools.

Odeh (2002) demonstrated that according to contractors and consultants points of view the most important factors of delay are: Owner interference, inadequate contractors experience, financial problems and payment, labour productivity, slow decision making, improper planning and subcontractors.

Low Sui Pheng (2005) agreed with several other studeies by stating that a project manager has a vital role in any project. Pheng (2005) alongside the other researchers discussed emphasised the need to improve project managers' performance by identifying the variables in the work place which have a significant impact on their performances.

For a better understanding of the delay factors, it is important to know more about the causes and origins of these factors. Some of these factors are within the control range of organisations such as inadequate planning and poor site management whereas others are uncontrollable such as economics problems and shortage of labour. The following section will expand upon these discussions towards the two board categories of delay factors in civil projects: *Intrinsic* and *Extrinsic* delay factors (introduced above in chapter 1) shall be developed in the section below.

2-2-2) Intrinsic & Extrinsic Delay Factors

As suggested porevioulsy Baloia (2001) mentioned that ***all*** delay factors can be divided into two main categories: *intrinsic* and *extrinsic* factors. It is worth restating that *Intrinsic* factors are related to construction organizations whereas *extrinsic* factors are those related to socio-cultural, economic, technological and political environments within which these organizations operate. Unlike extrinsic causes, intrinsic causes of delay in construction projects can be overcome by efficient project management (Pheng 2005). Chapter 1 mentioned that Extrinsic causes are often called 'global risk factors'. The following section shall take Balio's two distinct sub-divisions and re-categorise all delay factors in terms of these two issues towards a better understanding of the (as yet under-emphasised extrinsinc) unknowns.

2-3) Preliminary re-categorised intrinsic/extrinsic variables identified through secondary research

The following table (Table 2.1), developed as a result of the secondary research methodology adopted in this project, clarifies the key variables of construction delay. In the following table, the intrinsic and extrinsic causes of delay have been grouped separately for the first time.

Table 2.1: Key Variables causing delay in construction project

Category	**N**	**Variable**	***References***
Intrinsic factors	1	Traditional contract (contract is awarded to the lowest bidder as the prime selection criteria)	*(M.Odeh and Hossein T 2002)* *(Yaw Frimpong 2003; Jyh-Bin Yang a 2009)* *(Ramanathan 2012)* *(M. Al-Khalil 1999)* *(T.MEZHER 1998)* *(Mansfield et al 1994)* *(Lo et al.2006)*
	2	Many scope changes	*(Kaliba, Muya et al. 2009)* *(Assaf and Al-Hejji 2006)* *(Neguyen Duy Long a 2004; G. Sweis a 2007)* *(Mohan R. Manavazhi 2002)* *(Koushki, Al-Rashid et al. 2005)* *(A.Al.Moumani 2000)* *(Kazaz 2012)*
	3	Delay in payment	*(Jyh-Bin Yang a 2009)* *(Yaw Frimpong 2003)* *(M.Odeh and Hossein T 2002)* *(Assaf and Al-Hejji 2006)* *(Koushki, Al-Rashid et al. 2005)* *(T.MEZHER 1998)*
Intrinsic factor	4	Financial issues	*(G. Sweis a 2007)* *(Kaliba, Muya et al. 2009)* *(Koushki, Al-Rashid et al. 2005) (Murali Sambasivan 2006)*

cont.			*Al-Kharashi and Skitmore 2009*
	5	Poor project management	*(Kaliba, Muya et al. 2009)* *(Murali Sambasivan 2006)* *(Neguyen Duy Long a 2004)* *(Daniel Baloia 2001)* *(A.S.Faridi 2006)* *(H.Abdul-Rahman 2006* *M.A.Berawi;A.K.Berawi;* *M.Othman and I.A.Yahya* *Odeh and Bullain 2002* *Sambasivan and Soon 2007*
Extrinsic factor	6	Shortage of manpower	*(El-Sayeghb 2006)* *(Assaf and Al-Hejji 2006)* *(Anaman 2004)* *Sambasivan and Soon 2007* *Odeh and Bullain 2002*
	7	Inflation	*(Yaw Frimpong 2003)* *(Kaliba, Muya et al. 2009)* *(N R Mansfield 1994)* *(H.Abdul-Rahman 2006)* *(ROUKEMA 2011)* *(Chou 2011)*

Extrinsic factor *cont.*			*(Toussi 2013)* *(Ramanathan 2012)* *(Florence Yean Yng Ling a 2006)*
	8	Bad weather condition	*(G. Sweis a 2007)* *(Kaliba, Muya et al. 2009)* *(A.Al.Moumani 2000)*
	9	Fluctuation in oil price	*(ROUKEMA 2011)* *(Anaman 2004)* *(Toussi 2013)*
	10	Instability in economic situation	*(Toussi 2013)* *(Kazaz 2012)* *(Florence Yean Yng Ling a 2006)*
	11	Currency rate drop	*(Ramanathan 2012)* *(Toussi 2013)* *(Florence Yean Yng Ling a 2006)*

These eleven items are argued to be a noteworthy reduction form the unweildly 73 variables identifed by literature previoulsy.

Further discussion of the eleven key items above are presented below, with sectional cross-referencing detailing description and clarifcation, that builds upon the list above.

Form of Contract: As will be discussed in chapter 3, the foremost aim of a standard form of contract is providing clear risk allocation for all parties involved in contract but due to failure in this goal, traditional forms of contract have been discarded by major contractors in their main projects.

Scope change: In chapter 3-2-7, according to a survey conducted by Assaf (2006) it was found that the most frequent delay factor in Saudi Arabia is too many (scope) changes in orders. In addition, as a

precursor to the work described in chapter 5 (the result of interviews here revealed), too many changes is one of the most important delay factotrs in civil projects in Middle East. While a majority of interviewees believed that poor feasibility studies lead to too many changes in execution stage, some of the respondents assumed clients' change in mind is a main reason for too many changes.

Delay in Payment: Delay in payment is a very common problem in civil projects in public sector and it leads to claims and dispute in contracts.As will be discusssed in financial issues,due to shortage of budget or fund allocation in installment someimes clients in public sector are not able to pay the contractor on time. Considering the inflation and instability in economic late payment will lead to a major issue.

Financial issues: According to the interviews results in chapter 5 (again as a taste of results to be described later by this project), most of the civil projects in Middle East countries are facing shortages of budget. As will be discussed later, financial issues in civil projects in this region arise as a result of unpredictable inflation, currency rate drops and poor initial cost estimation.

Poor project management: As mentioned in chapter 2-1, while some of the less developed contries, such as Iran move towards the industrialized countries, they face an (unplanned/unexpected) increase in construction budgets, whilst still trying to adopt a traditional approach in project management for intrinsic resourcing. So it is vital to reconsider project management in these contries relative to extrinsic variables.

Shortage of manpower: As discussed in chapter 1, civil projects in Southern states of the Persian Gulf due to a shortage of labour, are very dependent on foreign labour and the lack of manpower is considered as a delay factor in these states.

Inflation: According to Kazaz (2012), fluctuation in material price and inflation can be considered as a very important delay factors in civil projects in Turkey. Furthermore as will be stated in chapter 5-2 in the project chosen as a case study, inflation has a main role (almost 23%) in cost overrun in the project.

Bad weather conditions: Climate conditions in a majority of countries in Persian Golf affect worker efficiency.

Fluctuations in oil price: A majority of countries in Middle East are oil-exporting countries and their economies are dependent on oil price; fluctuation in oil price will have a significant impact on construction industry in this region. Fluctuation in oil price is considered an important regional delay factor in Middle East.

Instability in Economic situation: In the following chapter, geopolitical risk in this region will be discussed as another regional risk factor in Middle East. Barzegar (2012) stated that the recent uprising of Arab countries, various regional conflicts and serious economic crises lead to instability in economy in this region., with knock-on effects in construction feasibility maintenance.

Currency rate drop: When currency rates are not stable compared to international currencies, projects in which equipment and resources are supplied from overseas markets increase dramatically project time and the potential for cost overrun.

Given these eleven variable identifications, the following chapter develops project and regional *Risk Factors* more explicilty relative to the Middle Eastern region.

CHAPTER 3 – LINKING RISK AND DELAY FACTORS

3-1) International Projects & Uncertainities

Considering the gradual growth of international projects and the entry of foreign companies into international bids, it is essential to identify the potential risks of each and every region. Considering the special circumstances and situations in the Middle East and the large number of international projects in this region, it is even more important to know the risks particular to this region.

Due to importance of this issue (covered in more detail below in chapter 4), the objectives of this research centre on the need to review and compile current key variable of delays in a location-specific construction market and also identify and rank the regional risk factor in Middle East. One should note that even domestic construction projects are inherently complex in all regions, and prone to uncertainties; a construction project in a foreign country can be even more challenging: considering the fact that one is not familiar with the rules and regulations, currency rates and other factors.

Abdul-Rahman (2012) mentioned international projects have a *high risk of loss* because they are exposed to more diverse and complex risks than domestic projects. For instance, international construction is more vulnerable to regional conditions like currency reduction, currency exchange restrictions, cultural differences, or unstable laws or regulations. Due to the uncertainties and complexities associated with the international construction domain, the entry decisions for international construction markets are complicated. Abdul-Rahman (2012) added that due to the inherent challenges and massive uncertainties under the overseas market conditions, contractors have to be flexible in managing the different dimensions of construction projects including design, engineering, procurement, estimating in a fluctuation market and construction. The contractors gradually achieve the balance in such growth as they pursue the opportunities in the overseas market. Ling (2006) stated when undertaking projects not in the home country, international *[Architecture, Engineering and Construction (AEC)]* firms face a multitude of different risks which can be summarised as; typical risks and *unique risks*.

Design risks and construction risks are typical risks but *Unique risks* relate to location, politics, and scoial conviction stemming from religion and culture. Unique risks arise due to different location. As mentioned this report flags fluctuations in oil price for conisderation as an unique risk in oil-exporting countries.

3-1-1) Risk Identification:

According to ISO 31000, risk is the "effect of uncertainty on objectives" and an effect is a positive or negative deviation from what is expected. Risk management starts with identifying the risks followed by analysing, evaluating and eventuallly treating. Ling (2006) stated after identifying the risks, several techniques can be applied by managers for elimination, transferation, retention and reduction of the risks. In addition (to extend discussion above)**,** Ling categorised the existing risks in India into two major categories: *unique* and general risks. *Unique risk* such as political, social and cultural risk and general risks are regulatary, design, natural and management risk**s**.

In Table 3-1 below different risks are classified within two major categories: natural risk**s** and human risk**s,** where natural risk is related to a project location alongside general risk such as technical issues, in contrast to unique location-specific risks related to soic-political-cultural factors**.**

Table 3-1 Natural & Human Risk; adapted from Ling (2006)

Type of risk	Risk	Related to
Natural risk	Weather condition	huricano.typhoon,flood
	Geological issues	earthquakes,volcanic,eruption
	Political risk	War, civil disorder, corruption, change in law, delay in approval, expropriation
	Economic risk	Material supply/Labour supply/Equipment availability, inflation,tariffs, fiscal policies, exchange rate
	Financial risk	Interest rate, credit ratings,capital supply,cash flow, rentals
Human Risk	Legal risk	Contract clauses, regulations and codes, risk allocation
	Health risk	Life expentency, infant mortality
	Managerial risk	Productivity,quality assurance, cost control, human resources management
	Technical risk	Design failure,equipment and system failure,estimation, collision and accidents
	Social risk	Criminal acts,civil torts and substance abuse
	Cultural risk	Religion, culture and custom

As Ling (2006) states, *Unique risks* relate to location, politics, religion and culture. Unique risks arise due to different location.In the following section, unique risks in Middle Eastern countries are discussed in more detail.

3-2) Risk Factors in Civil Engineering and construction Projects in Middle East Countries

As mentioned in section 3-1 above, there are numerous risk factors for international construction stakeholders to consider; the key risk factors in civil engineering projects in Middle East are highlighted.

3-2-1) Oil price fluctuation

Oil price fluctation is known to be one of the most significant unique risk factors as far as the construction projects in the Persian Gulf area are concerned. As previously mentioned in chapter 2, this area exports approximately 45% of all crude oil exports. Therefore, oil has a significant share in the these countries' GDP and constitues 75% of the annual governmental exports.

Gupta (2008) stated that the Middle East is home to 60% of the international oil reserves. Countries that are members in the Organisation of Petroleum Exporting Countries (OPEC), including countries such as Angola, Algeria, Indonesia, Iran, Iraq, Saudi Arabia and Venezuela, hold 75.2% of international oil reserves and control about 41.7% of the oil industry. Unfortunately, a majority of these oil-supplying countries are politcally and economically instable.

Two-thirds of global oil is transported through several sea channels including the Strait of Hormoz, the Strait of Malacca, Strait of Bob el Mandeb, Suez Canal and Bosphorus. These channels are, unfortunately, vulnerable to terrorist attacks and shipping accidents (Gupta,2008). The extent to which a construction professionals, charged to estimate timing of construction projects, are at liberty to mention explicitly and factor-in '*pirate-activity'* is an aspect which ultimately *must* be considered (no matter how unorthodx) since financing of public-sector projects and related supply-chain price flutauations can and do influcne cost/benefit anlaysis and go-ahead decisions.

The peak oil factor is another significant factor that controls the international oil market as well as the international oil price. In approximately fifiy countries across the globe, the production of crude oil has already risen to its highest peak.(Gupta, 2008)

The vulnerability of the oil industry and the dependency of oil-exporting countires on oil income has a negative influence on the construction industry; for instance, in Iran, it is perceived that 85% of the construction projects are entirely reliant on oil income as their main source of budget (Toussi 2013). Othman(2008), as mentioned above, notes that Brunei owes its prosperity to its plentiful oil and gas resources. However, reliance on oil income increases Brunei's vulnerability to external shocks, particularly given the prospect of an eventual reduction of these resources. Othman's report stateds that creating constant growth in the non-oil private sector is one of the most important challenges in Bruneias the North Borneon independantly country attempts to develop the role of its private-sector industry, as well as seeking to reinforce the economic diversification programme.

As (Chapter 4 & 5 shall describe) this project's interviews results shows a majority of civil projects in the public sector do indeed ultimately face shortage of budgets since the allocated funds become much less than initial approved fund due to financing issues and subsequent shortages of government oil income. Figure 3-1 below illustrates this point and the extent to which world-events have impacted upon oil price during 1861-2011. One can see how oil price fluctuated dramatically after Iranian revolution (1979) till the invasion of Iraq and the Arab Spring. Again given the huge influence upon public-sector financing and project go-ahead, construction practitioners and stakeholders are increasingly going to be charged to take such extrinsic factors into account in their localised project estaimations.

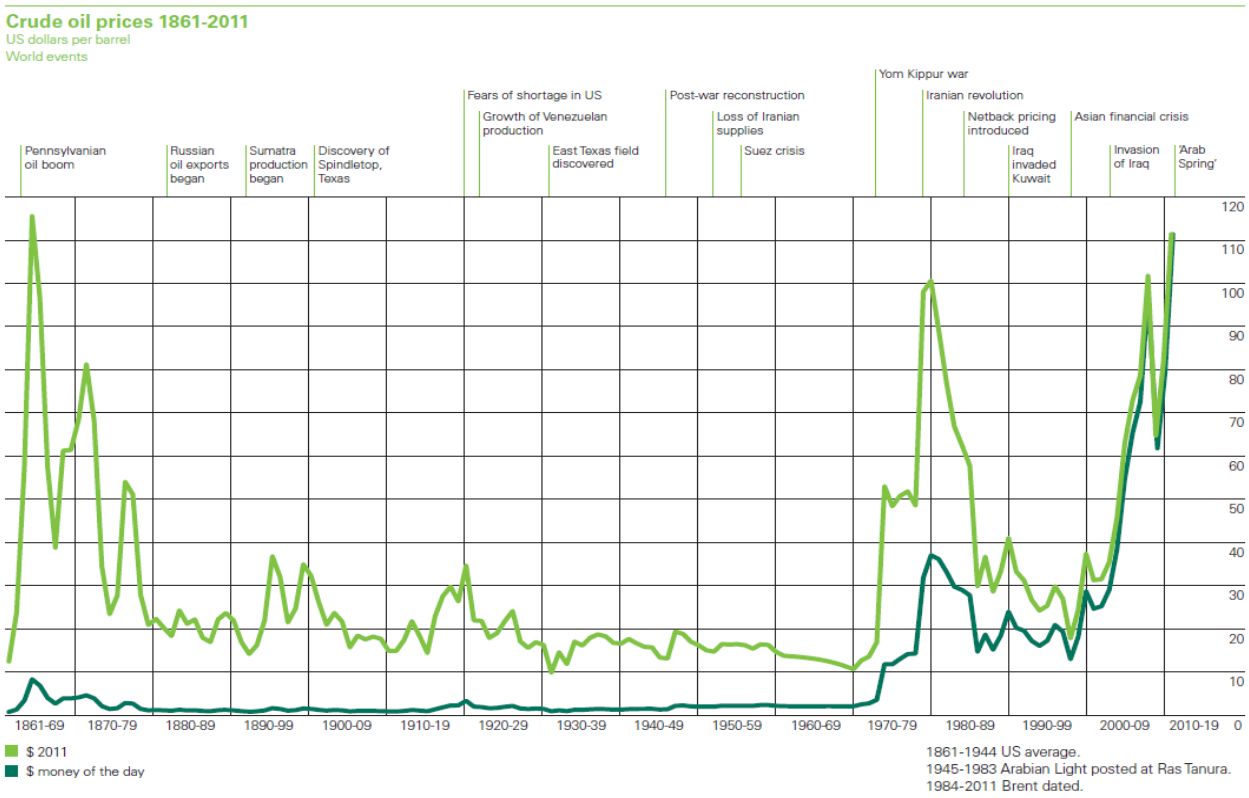


Fig 3-1: Oil Price Peaks & Troughs

When oil prices dramatically decrease in the international market, a negative impact can be experienced on regional construction industry ventures. In the public sector a decreasing of oil prices can lead to shortages of government oil -income, and affected governments will be unable to allocate 100% of previoulsy anticipated revenues to civil project funds, thus the construction industry is very vulnerable to such unrest or instability, with investors both domestic and international being unwilling to invest in construction projects.

3-2-2) Geopolitical risk: political/social instability

A major *unique risk* in the Middle East area is the geopolitical risk. Barzegar (2012) stated that the recent uprisings of the Arab countries constitutes a major defining moment so far as the geopolitical developments of the Middle East are concerned. In the contemporary history of the Middle East, one comes across several major turning points all of which have affected the regions's political-security equations in one way or another; events such as the Iranian revolution of 1979, the collapse of the USSR and the September 11 attacks. All of which can be argued to have had knock-on effects for construction project instigation and activity.

The critical geopolitical issue affecting the region under study by this resaerch is whether or not the Middle East will fuction as a *stable* oil and gas exporter. The issue is not easily predictable considering the fact that this region has been constantly involved in various regional and intra-regional conflicts, serious enonomic crises, that foten stem from demographic issues (Cordesman 1999). As mentioned earlier energy exports is one of the most important financial resources in many Middle East countries but at the same time due to dependency on oil income, construction industry is very vunereble to any event that causes fluctuation in oil price. War and sanctions have had a significant impact on energy exports in countries such as Iran, Iraq, and Libya (Trembath 2015); often leading to and stemming from another major risk in Middle East, namely cultural risk.

Hain (2011) mentioned that *cultural risk* is assessed as more important in the business environment than political, financial, and economic risk. Culture plays a very vital role in the scheduling of construction work-tasks across both developed and newly developing countries. For example in a multicultural country such as Malyasia, design professionals and on-site Project Managers must be recognisant of up to five sets of stop-work public holidays to encompass cultural festivals celebrated by its diverse stakeholders from communities representing Muslims, Christians, Hindus, Chinese, as well as traditional animist Harvest Festival celebrants in the Malaysian states of Sabah and Sarawak, in respective project building design and construction schedules (New Staints Times 2015).

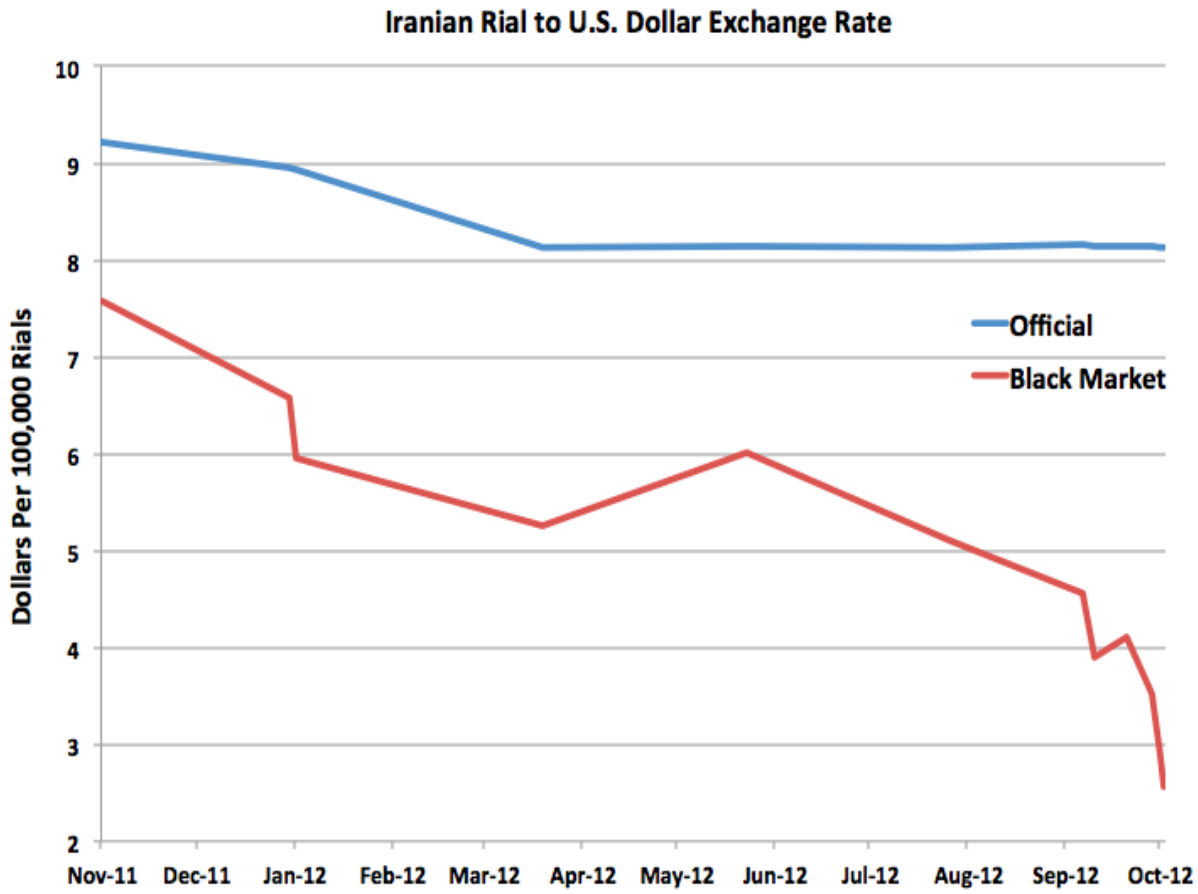
An inability to factor-in culture can create uncertainty, as can instability. Political and social instability have negative effects on construction projects, because uncertainities lead to a fluctuation in market and in this situation it is very hard to have an accurate estimation of project costs (mentioned in chapter 2-2) such that the inappropriate estimation that results makes up one of the five major delay factors in construction projects.

3-2-3) Currency Rate Drop

As mentioned earlier in this chapter, there are numerous risks to international construction markets which require identification. One of these risks is *currency rate drop*. Where currency rates are impacted by (non-local) oil-prices instabilty arise; when compared with international (stable) currencies, the price of the equipment (soucred across stable supply-chains) will significantly increase from the price estimated at the beginning of the project and resultantly projects are apt to face cost overrun. Such fluctuation in price provides opportunity for claims and dispute in contractual relations. Once again Iran presents a case-study in which oil-price, related revenue redistribution, international sanction agreements, international supply chains and curenty rate drops affect public sector building projects greatly.

The chart below shows the currency rate drop in Iran from November 2011 to October 2012 (O'Brien, 2012). This chart compares the official and unoffcial (so-called) black market exchange rate. The official rate (the top-line) is argued by O'Brien as the theoretical ideal that the Iranian Government strives to embrace, with the unofficial rate (the lower line) representing a widely perceived 'black market' rate which construction professionals and building project stakeholders might be expected to negitiate on a day-to-day, project-interim-evaluation, Bills of Quantities payments, basis. Iran's currency has collapsed in two ways -- gradually and then suddenly The figure below shows Iran's monetary unit the 'Rial' dramatically dropping during last year with (an argued real-term) free fall between Sep 12 to Oct 12.

Figure 3-2: Iranian Currency Rate Adopted from O Brian, 2012



3-2-4) Labour Availability

Discussion above related to inflation and real-time wage payment leads onto discussions of labour and labour availability. Cordesman (1999) mentions that a majority of the Persian Gulf states are reliant on foreign itinerant labour-forces and due to inconsistency in immigration strategies this problem is reinforced. As alluded to in Chapter-1, local/native labour does not provide a solution to itinerant workforce issues, since on-site work is deemed of less appeal due to inclement on-site working conditions for no real related financial reward in comparison to other (office-based/ air-conditioned environment) occupations. Due to inconsistency in immigration policies construction projects face shortages of manpower and (eventual?) increases in wage rates; El-Sayegh (2007) found that the productivity as a function of training provision uncertaincies and related upskilling requirements, alongside the shortages of (both domestic and international on-site operatives and) labour are the key factors of delay in civil project in UAE and the Middle East generally.

3-2-5) Form of Contract

According to Bing and Tiong (1999), the standard engineering form of contract (adopted by localised national construction industries) is a key instrument in building project realisation and timeous completion. Standard forms of (construction) contract are the legal definition of liability and responsibility between the involved parties and stakeholders (contractors, clients, consultants).

Shnookal (2010) stated that in Australia there are three main, standard forms of contracts for traditional contracting on the basis of construction to the principal's design. They are the AS 4000 – 1997, ABIC MW-1 2003 and PC-1 1998. He mentioned that in Australia across the past 20 years ago there has been increasing recognition of the standard form of contract in all major civil projects, despite the use of "bespoke" contractual options (a custom-made client's interpretation of the obligations and responsibilities of building relationships). The standard form of contract is utilised/ adapted by major employers in their main projects and they apply AS 2124 or AS 4000 in medium sized projects. However

adaptations mean that often they have to attach special conditions that exceed the general condition in these contracts.

Beyond local standard forms of contract, international forms of contract exist; the most commonly used contract in construction projects internationally is The International Federation of Consulting Engineers contract (commonly known as FIDIC, from its French/Swiss name Fédération Internationale Des Ingénieurs-Conseils). FIDIC contracts are used all around the globe and its usage is growing (Whyte 2015). For example the World Bank, as client for a wide range of international (charity) building works specifies the compulsory use of FIDIC conditions of contract.

Only The New Engineering Contract (NEC), or NEC Engineering and Construction Contract, as a formalised system created by the Institution of Civil Engineers (UK) is deemed similarly compatible for international use. NEC is gaining ground for multi-national projects. Both FIDIC and NEC seek to stabilise contractual arrangements and formalise the realisation of scope such that cost-blow-out and indeed time extensions can be contained and regulated and effectively reduced.

FIDIC has three main forms of contract. The first FEDIC (Red book) is the Conditions of Contract for civil engineering construction. In this contract a traditional contract seeks a contractor constructing the design which prepared by an independent consultant The second FEDIC contract (yellow book) is directed to Mechanical and Electrical works, for contracts dealing with Plant and Design-Build. With FIDIC-Silver drafted to Conditions of Contract for EPC/Turnkey Projects.

The main aim of contracts is providing clear risk allocation as between the parties with an ultimate goals of mitigation towards on-time, on-cost completions. Risk allocation in three main forms of FIDIC contract has been shown in the table 3-2.

Table 3-2: Risk allocation in three main forms of FIDIC contract

KEY:

Employer's risk

Contractor's risk

Shared risks

Risk	CONS [Red]	P&DB [Yellow]	EPCT [Silver]
Delayed drawings or instructions			
Errors in the Employer 's requirements			
Right of access to the Site			
Setting out			
Unforeseeable physical conditions			
Fossils			
Testing delays by Employer			
Rejection of materials			
Remedial work			
Extension of Time for Completion - Variation			
Extension of Time for Completion - delay giving entitlement to an EOT			
Exceptionally adverse climatic conditions			
Unforeseeable shortages and the availability of personnel or Goods caused by epidemic or government actions			
Delay, impediment or prevention caused by the Employer its personnel or other contractors			
Delay caused by Authorities			
Rate of progress			
Consequences of Suspension			

Failure to pass Tests on Completion			
Failure to remedy Defects			
Increased of quantities during construction			
Omission of work through a Variation			
Failure to pass tests after Completion			
Variation procedure			
Adjustment for changes in legislation			
Adjustment for changes in cost			
Delayed payment			
Payment after Termination			
Indemnities			
Care of the Works prior to the Taking Over Certificate			
Consequences of Employer's risks			
Consequences of force majeure			
Contractor's claims			

KEY:

Employer's risk

Contractor's risk

Shared risks

Table 3-2: Risk allocation in three main forms of FIDIC contract

Odeh and Hossein (2002) examined traditional standard forms of contract as one of the most important factors influening delay in construction projects; stating that time-over-run provided a good opportunity for contractors to dispute and claim, such that it is vital to pre-detect the *causes* of delay and seek early measures to mitigate (the potential for) delay in civil projects. Results of Odeh's survey shows that the top ten key factors of delay in contractors' and consultants' point of view are: owner interference, inadequate contractor experience, financing and payments, labour productivity, slow decision making, improper planning, and subcontractor vagaries. They reflected that in public projects in Jordan with the traditional type of contract, the lowest bidder is *always* the 'winner' and that this problem manifests itself negatively in subsequent time-and cost blow-outrs as the chosen contractor seeks to recoup time and money in their repsective delivery of the project's work-tasks.

Odeh (2002) also listed contract factors of delay to include changed orders and mistakes and inconsistencies in contract documents and contractual relationships factors that include: main disputes and debates during construction, inappropriate organizational structure linking all parties involved in the project, and poor communication between these parties. According to this survey, disputes and negotiation are very important to contractors in public projects in Jordan since arbitration is 'never undertaken' since legal action through law courts blacklists the proponent and not least takes disproportionate time and effort to conduct. In this paper research paper Odeh suggests that options to mitigate the disputes in contracts are as follows:

1-applying liquidated damage clauses explicitly in contracts without fear of blacklist reprisal;

2- Implementing a new method for contract award procedure. Instead of considering the lowest price it is better to put more value on *capabilities* and past performances of contractors;

2- Adopting new approaches to contracting; it is suggested that use of other forms of contract can reduce delays like design-build and construction management (CM) types of contracts. These kinds of contracts can mitigate the delay by controlling owner interference, improving the design, and improving the contractual relationships among all parties to the project.

Aligned to standard forms of contract as a means to address unnecessary delay clauses are *fluctuation clauses*. Due to fluctuations in material prices and labour wages it is essential to consider the need for and indeed an ability to use an 'escalation clause' in contracts to cover unpredictable rises and falls in resoucres prices during the construction course; (Roukema 2011) states that *escalation* is a necessary provision in a contract to adjust the price in case of considerable (potentially extrinsic) changes.

Roukema argues for an added escalation clause as its vital (especially in civil engineering dredging contracts) due to significantly changesing steel, labour and fuel prices Roukema recommend a need to consider escalation clauses in (dredging) contracts with duration of more than 3 months. Historically after the oil price crisis in early 1970s, when the crude oil costs forced a huge spike in prices generally, the use of escalation-clauses became an essential way to ensure equity in project realisation across the stakeholders. Sometimes there is clients' misunderstand as to why tenderers subject their offers to oil price escalation, but it seems a reasonable and practicable positive idea to address such substaintial risk *inclusions* into their prices to cover for (potentially) increasing labour, plant and materials rates in volatile times.

Beyond fluctatuations clauses Kazaz (2012) listed managerial factors such as encounters between parties on-site, contract related arguments, Contractor's excessive work load, Poor initial estimation, and poor site management as inlfuencing contract delay. And can be seen in Table 3-3, poor initial estimation is argued by Kazaz to have a relative importance index of 2.38 which can be classified as a *very important factor* whilst contract related *disputes* record a relative importance factor is 1.64.

Table 3-3 : Managerial factors; *adapted from Kazaz (2012)*

Factor	Index value	Effect
Design and material changes	2.73	Very important
Estimation Problems	2.38	Very important
Poor site management	2.17	Important
Poor coordination between the parties in the site	2.13	Important
Lack of contractor's experience	2.05	Important
Poor quality control	1.94	Important
Conflicts between the parties in site	1.84	Important
Contractor's excessive work load	1.81	Important
Contract related dispute	1.64	Important

Whilst in the above table, Kazaz has found design and material changes as a very important factor, this resaerch study (with findings described in detail in chapter 6-1-1) finds inadequate fund as a key *'location-specific'* factor of dispute in contracts in the Middle East.

In order to mitigate the negative impact of shortages of budget, it has been argued by some resaerchers that Value–Engineering might be helpful to decrease the finished price of the project. Mansour (1994) stated Value Engineering is known as an accepted method to optimize the cost of the projects while improving the quality of them. Mansour (1994) added that by applying both value engineering and project controls techniques (and well-known management tools) civil engineering practitioners will enhance their benefits and lead to higher quality and lower cost of the projects, whilst also addressing approrpaite time.

3-2-5-1) The impact of poor time estimation on contracts

Irfan and Labi (2011) investigated the estimation of highway project duration on the basis of variables *known* at the planning-phase such as: planned cost and project type, and contract type. They mentioned that establishing precise time durations for completion of the project can be useful ina '*bid process'*, and knowledge of such variables in advance can mitigate negotiation-delay in contracts. Having what they term a 'good guess' in the early estimation of a project can be helpful in different types of construction management like tender evaluation, construction planning and also contract administration. Furthermore accurate time esto project delays depends on the type of projects.

However project durations due to complexity and diversities of construction activity (and also an awareness of the uncertainties which exist in construction project such as material inadequacies, severe weather condition, instability in economy such as inflation or depression) are not expected to be exact. There will always exist uncertainties and these intrinsinc variables can and should be factored into project scheules as work-tasks in terms of efficicy rates.

3-2-6) Cost estimation (in)accuracy

Cost estimation (in)accuracy levels presents an additional factor that causes cost escalation (and knock-on delay) in many construction project. Doloi (2010) snotes that cost estimation has a significant role in project management, since its detailed analysis provides considerably information at the outset towards decision making, cost schedules and resource (time) management.

Dolio argues that there are different methods in cost estimating: analogy, parametric and detailed indvidual cost estimation methods discussed below.

Analogy cost estimation: in this method practitioners use a cost profile from historical projects which are similar in size and design towards an approximate estimate.

Parametric cost estimation is a method in which previous information will be converted in parametric input and across elements and subelements towards a preliminary cost estimate of a generalistic breakdown of a job towards greater accuracy.

Detailed individual es involved in the cost estimate is individually accounted for with a cumulatiove summing- up to find an accurate final cost of project.

Kaliba, Muya et al. (2009) stated that nine out of every ten construction projects experienced cost escalation and most of the cost escalation happens before construction begins. Some of the key factors are noted (and extend the discussion of the three techniques described by Dolio above) to include:

- Initial estimates were preliminary and not designed to be trustworthy predictors of project costs;
- Initial estimates were modified to reflect more detailed plans and specifications as a project is designed; and,
- Inflation and changes in scope occurs during a project to be designed and built.

3-2-7) Listing Delay factors relative to scope-change

A survey on time performance of different types of construction projects in Saudi Arabia by Assaf and Al-Hejji (2006) was conducted to find out the causes of delay in civil project. As has been alluded to above, Al-Hejji found that the most frequent factor of delay in this region is *scope-change variations* to a contract. Similarly previous discussion highlighted work by Kazaz (2012) (related to inflation importance, has also subsequently listed his findings' top ten factors causing delay in civil projects in Turkey. As is tabulated below in this ranking, design and material changes are flagged as the most important factor of delay.

Factor Groups	Factors	Rank	Importance Level
Managerial factors	Design and material changes	1	Very important
Financial factors	Delay of payments	2	Very important
Financial factors	Cash flow problems	3	Very important
Financial factors	Contractor's financial problems	4	Very important
Labour-based factors	Poor labour productivity	5	Very important
Managerial factors	Estimation problems	6	important
Project-based factors	Lack of feasibility studies	7	important
Labour-based factors	Construction defects	8	important
Labour-based factors	Unbalanced number of workers	9	important
Financial factors	Fluctuation in material prices	10	important

Table 3-4 Importance level of delay factors adapted from both Kazaz et al (2012)

3-2-8) Inflation and instability in across general economic

According to Kazaz (2012): delay of payments, cash flow problems, contractor's financial problems, fluctuation in material price and inflation; are classified as financial factors with Kazaz's research finding these factors as far as importance is concerned, can be considered somewhere between *very important* and *important* in civil projects (Table 3-5). Kazaz notes that 'unstable inflation' has a great effect on material prices. In addition the factor 'unstable economy' has an indirect effect on time overrun in projects. While Kazaz (2012) considered fluctuation in material prices and inflation as an important delay factor in Turkey discussion above by O'Brien (2012) and others allows an extrapolation that 'inflation', is a very important factor in Iran.

Delay Factor	Index Value	Effect
Delay of payment	2.62	Very Important
Cash flow problems	2.61	Very Important
Contractor's financial problems	2.59	Very Important
Fluctuation in material prices	2.25	Important
Inflation	2.04	Important

Table 3-5 Index value for different factors of delay: adapted from Kazaz (2012)

Chapter 3 above presents an extensive literature review towards an identification of the *key delay factors* in Middle Eastern countries; consensus exists amongst a multitude of scholars that the principal aspects of delay can be described as:

- Oil fluctuation
- Geopolitical risk
- Currency rate drop
- Shortage of labour
- Form of contract
- Poor cost estimation
- Inflation
- Instability in economics
- Scope changes and variations

To further examine these factors towards addressing a best-practice solution for a location-specific means to model delay avoidance in the Middle East, Chapter 4 below describes the developed methodology.

CHAPTER 4: METHODOLOGY

The method undertaken in conducting this research builds upon earlier (chapter 1-3) clarification of the research objectives as a first step, towards an appraisal of the key variables of delay in construction in the Middle East; subsequently, identification and ranking of the regional risk factors and an evaluation of the relative importance of each of the key factors of delay that contribute to cost and time overrun is developed. Research design, (chapter 1-6) builds upon an initial discussion stemming from literature-review/ secondary research towards primary research data gathering via qualitative research techniques, alongside document and Bills of Quantities (case-study) analyses.

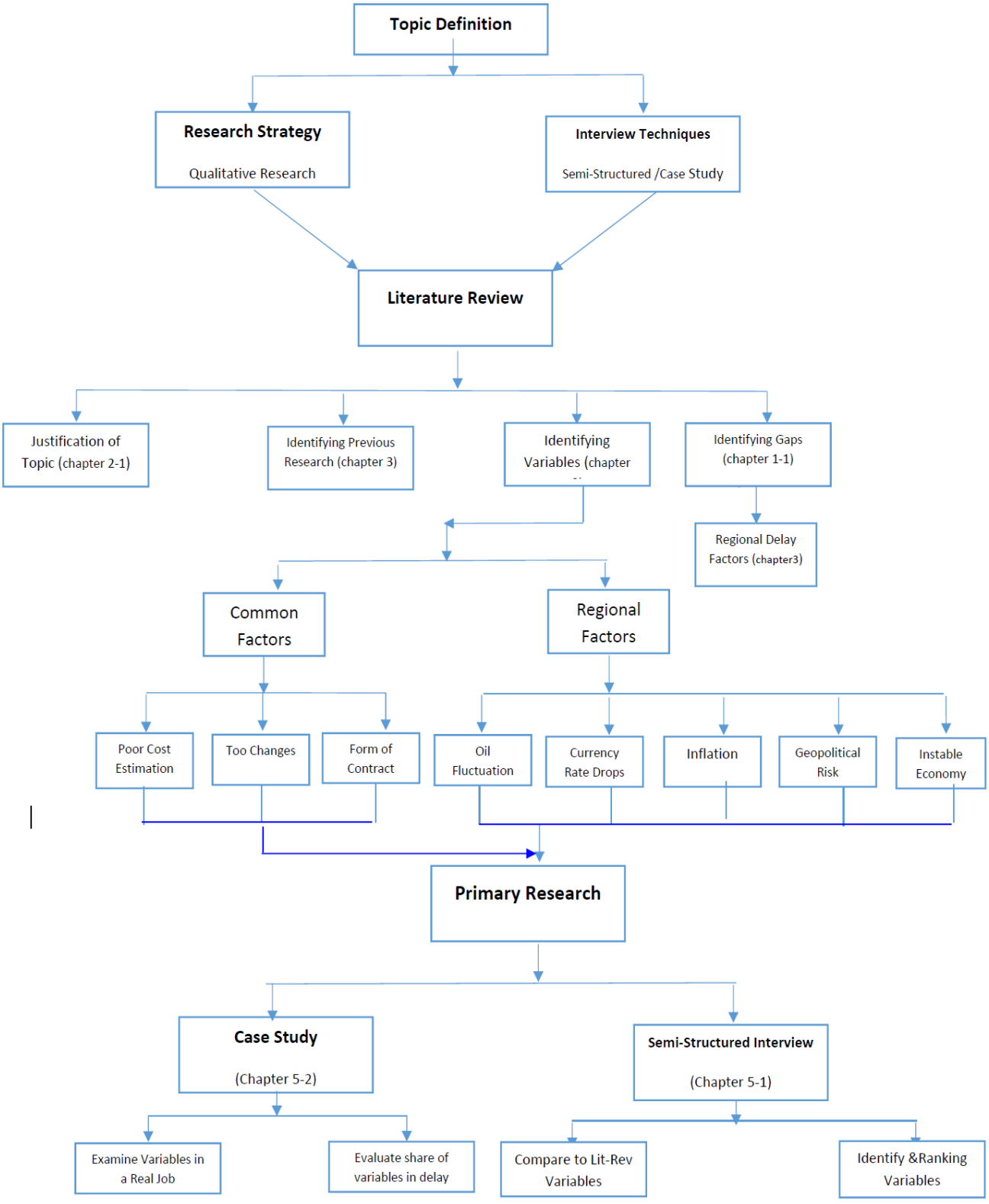
This study utilises the 3 stage process namely data collection, data analysis and data interpretation to progress deeper understanding. The last part of this chapter discusses the method to validate the research through standardised credibility, dependability, transformability and conformability format.

As mentioned (chapter 1-1) while common delay factors have been discussed and studied by a number of scholars, region-specific factors have been largely neglected. So the main objectives of this research is to identify the regional risk factor in Middle East and evaluate to extent to which they contribute to cost and time overrun in civil projects in this region. This study has gathered and analysed available ideas posited to explain delay in civil projects. Due to the nature of the topic which is exploratory research, a qualitative research approach has been chosen as a research strategy requiring in-depth interview with experts and furthermore utilisation of case-study methods to examine the delay factors in real projects.

The findings from secondary (literature review) research and primary research (via semi-structured interview and case-study) have been compared; these factors are added to delay variables unearthed by secondary research. Key variables and interrelationship are identified and ranked by a selected sample of expert practitioner interviewees. In the case study (detailed in Chapter 5-2) the share of each delay factor contributing to delay is recognised. Finally towards a more robust trustworthiness of the research findings, a structured validation check through sample-group consistency check and conformability has been applied.

The flowchart below (Figure 4.1) summarises the methodology undertaken (& findings) in this research.

Fig 4.1 Methodology Summary flowchart



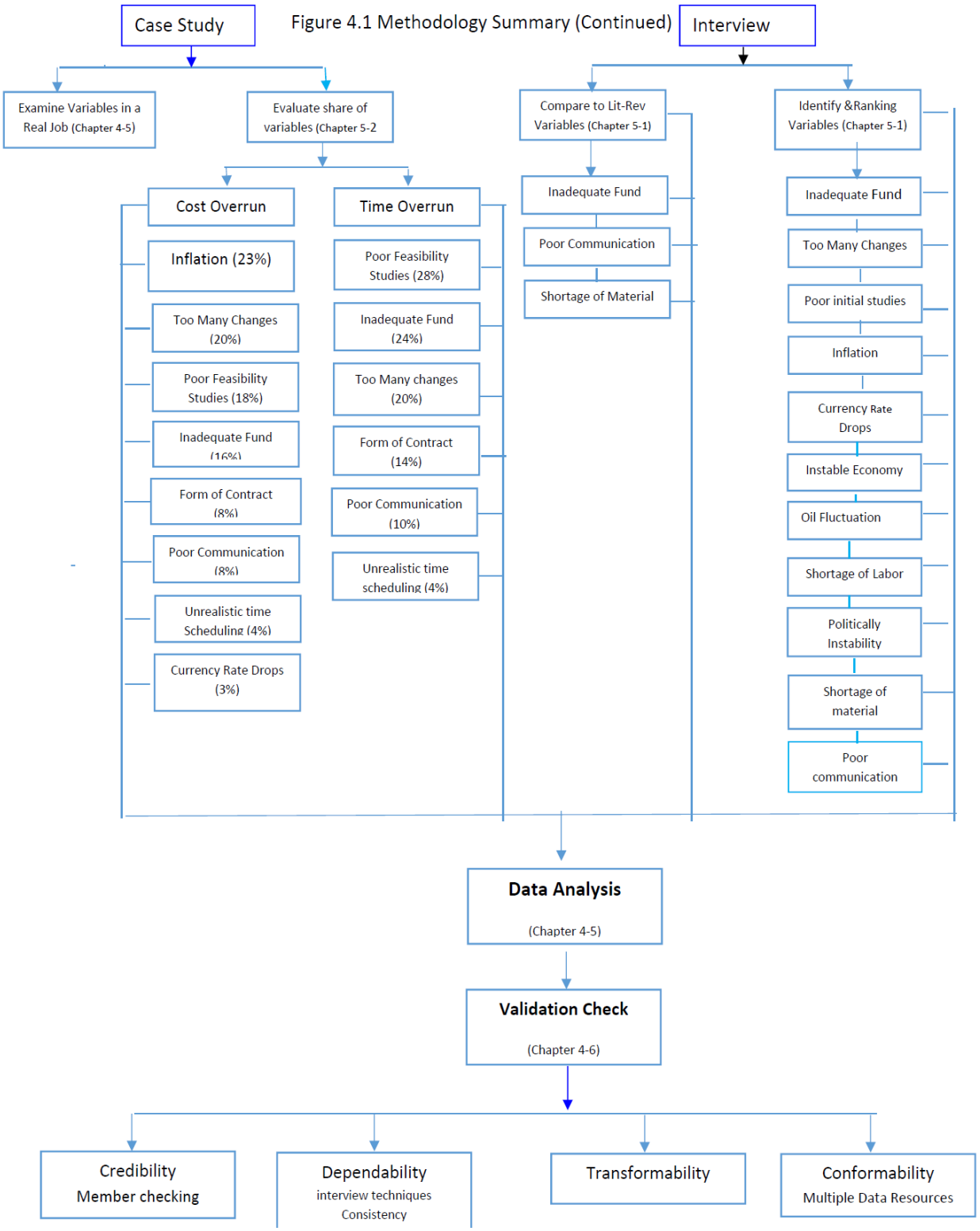


Figure 4.1 Methodology Summary (Continued)

Fig 4.1 Methodology Summary Flowchart *(cont.)*

4-1) Research Objectives

Chapter 3-1 discussed the extent of uncertainity when operating construction projects in foreign parts; international projects are more vulnerable to regional risk factors such as changes in laws and regulations, currency rate drops, culture risk and political issues. Previous chapters have established that international projects in Middle East countries are very much at risk (of delay) due to their geopolitical situation, fluctuation in oil price and political and economical instability in this region**.**

In order to evaluate the regional delay factors in Middle East countries explicitly, the following *objective*s were identified:

- Review and compile current key variables of delay in construction market in the Middle East
- Identifying the regional risk in Middle East Countries
- Identifying and ranking the main factors of delay in civil projects in the Middle East
- Evaluate the share of each key factor of delay contributing to cost and time overrun in this region.
- Examine the share of each factor of delay in a real project.

In the literature review presented in chapter 3, previous studies sought to gain a better understanding about the topic (regional risk factors such as oil fluctuation, geopolitical risk and currency rate drop were identified). While numerous studies have been carried out by scholars regarding the delay factors in civil project around the world, regional factors of delay remain under-assessed. Therefore this study has sought close attention to regional key delay factors.

Primary research, semi-structured interview results (chapter 5) confirm the delay factors obtained from secondary research and (as a precursor at this stage it can be stated that) three more factors became noteworthy, namely ‘inadequate funds’, ‘poor stakeholder communication’ and ‘shortage of materials’. In the case-study (discussed in detail in chapter 5-2 below) the importance share of each factor in respective contribution to delay were recognized.

The below table summarises the explicit link between the *objectives* and the *method* used to gather primary data for further analyses.

Item	Objectives	Method	Data
1	Review and Compile key delay factors in the Middle East Region	Secondary Research (Literature review)	Oil fluctuation, Geopolitical risk, Currency rate drop, shortage of labor, Form of contract, poor cost estimation, inflation, instability in economics, Too changes in order
2	Identify the regional risk factors in the Middle East Countries	Secondary Research (Literature review)	Oil fluctuation risk, Geopolitical risk, Currency Rate Drops risk, inflation risk and Shortage of labour risk
3	Identify and Rank the main factors of delay in civil Projects in Middle East	Primary Research Semi-structured Interview	Precursor data-set summary: Inadequate funds, excessive scope changes, Poor initial estimation, Form of contract, Currency Rate drops, Instability in Economics, Inflation, Oil Fluctuation, Shortage of Labour, Political instability, Shortage of Material, Poor Parties' Communication
4	Evaluate the share of each variable in contribution of Delay	Primary Research	Poor Feasibility Studies at the outset (28.6%) + Inadequate Funding measures (24.4 %) + Client's Scope Changes (20.5%) + Ambiguous forms of Contact (12.3%) + Inadequate Stakeholder Communication (10.2%) + unseasonable task scheduling (4%)
5	Examine the share of each factors of delay in a real project	Primary Research (Case Study)	***Delay*** = Poor Feasibility Studies at the outset (28.6%) + Inadequate Funding measures (24.4 %) + Client's Scope Changes (20.5%) + Ambiguous forms of Contact (12.3%) + Inadequate Stakeholder Communication (10.2%) + unseasonable task scheduling (4%)

Table 4-1: liking project objectives with data-gathering methodology

There were two major primary research strategies considered when approaching the project question, these being *qualitative* or *quantitative* research. The choice of which approach to use is dependent on the problem to be researched (Creswell, 2008).

4-2) Research Development

4-2-1) Research Strategy

As the below table (table 4.2) shows, employing either a *qualitative* or *quantitative* approach depends on the nature of the research. Literature review above notes previous researcher perceptions differ across the variables deemed key factors of delay in civil project and can be location-specific. Therefore one can say that delay factors in civil construction projects are not perceived to be uniform, thus requiring an aproach that explores the variables in a specific region.

Table 4.2: Comparison of Qualitative and Quantitative Research Methods *(Creswell 2008)*

Quantitative Method	**Qualitative Method**
Familiar variables	Gathering and analyzing exploratory data
Preconceived hypotheses	Conceptual framework arises from data
Familiar research area	New area of research
Focus to get breadth	Focus to get depth
Rely on statistics	Rely on coding and themes
How many	How much
Research tools are surveys by mail, online or phone	Research tools are interview, observations and focus group
Structured interview	Semi structured interview

Table 4.1 highlights the fundamental differences between qualitative and quantitative research relating to their analytical objectives, the research questions they pose, the types of data collection instruments they use, the forms of data they produce and the degree of flexibility built into the study.

This Research strategy adopts a qualitative approach due to the wish to explore all delay factors which contribute in cost and time overrun in Middle East countries.

4-2-2) Interview Technique

There are 3 basic techniques considered when conducting interviews as part of the qualitative research strategy (Kvale & Brinkmann, 2009), namely: structured interview, semi-structure interview and unstructured approaches.

Structured interviews are those where a set of specific questions are posed with a predetermined fixed set of responses (ie a multiple choice survey).

Semi-structured interviews are those where a set of key questions has been developed as a guide of general topics to be covered. This allows interviewee to talk about their experiences regarding the problem openly.

Unstructured interviews, in this type there is no script or order and researcher must have a checklist of topic which must be covered during interview.

In this research, semi-structured interview has been chosen to conduct the research.

4-2-3) Case study

According to Fitzgerald (2014) case study is a useful research tool for conducting exploratory research. Particularly, case study is very useful in complex context where there are multiple influencing variable factors. Furthermore case study can deliver a different variable of date and these date can be supplemented by in–depth interviews with experts; a case study is used here, chosen from among the projects of an interviewee's organisation for detailed analysis.

Here a case-study of a US$14m library building project in Iran is assessed (Chapter 5.2)

4-3) Literature Review

Secondary research was undertaken by way of a literature review (as above). Four outcomes were achieved by conducting this review. These include;

- Identification of the key factors of delay which determined by the other researchers These were investigated in terms of factors influencing delay in civil project, cost overrun, changing scope of the projects, disputing in contracts. A literature review matrix (shown in Appendix A) was utilised in order to identify patterns in literature discussions. These factors became the basis for this projects primary research as outlined in Section 4.4.

- Justification for the research topic: As discussed earlier in chapter 3-1, it is vital to the benefits of all parties that delays, or their effects, are reduced. Even quite small advances in the recovery of a delayed schedule are likely to have a significant impact on the financial returns of those involved. Since delay is costly for all the parties involved in the construction industry, it must be identified and its causes should be addressed. As mentioned in chapter 3-1 construction delays are often responsible for turning profitable projects into loosing ventures.
- Identification of previous research and finding the gap in previous studies.

  Undoubtedly delay factors in civil projects has been researched by numerous scholars around the world but delay factors may vary from each region therefore there's still need to study regional delay factors.
- Comparing the results of secondary and primary researches

  The key delay factors were identified by other researchers will compare to factors which obtained from interview results and case study results.

4-4) Data Collection

4-4-1) Interviews

In order to discover common delay factors in this region, primary research was undertaken in the form of eight semi–structured interviews [Creswell (2009) indicates 8 respondents as suitable] with executive managers and contract professionals within the engineering industry. Interview participants were identified using 'purposeful sampling' with a view for 'maximal variation' (Creswell, 2009). On this basis participants were chosen for their likely ability to best answer the proposed questions from a variety of company profiles ranging in size, industry, sector (ie public/private) and position (ie client/contractor). This method of sampling allows for the documentation of variations and identification of common patterns (Creswell, 2007). The interview population comprised two participants from consulting companies and two participants from client companies and also two from contractor companies. Considering the fact that a majority of interviewees, stated inadequate funds is a key factor of delay in civil project in Iran, another interview carried out with a representative of the Iranian government in civil projects budgetary department(s). (Interviewee 8) The 7th interviewee was an expert in civil project in public sector in WA. This interview result was compared to results obtained from other interviewees in Iran. This comparison alluded to the key *regional* factors.

Semi-structured interview questions were developed in order to elicit the best response from the participants without influencing or leading their answers. These were then followed by probing questions in order clarify and elaborate on participants initial responses. Interview transcripts are shown in

Appendix B of this report. These questions originated from literature review studies. While interviews were conducted in a semi-structured format to allow flexibility, *all* topics were covered within each interview to ensure a suitable comparison could be drawn between participants.

Due to special circumstances in the region, all Iranian respondents opted to remain anonymous. However, full detailed hand written notes were taken throughout with the validity of notes re-confirmed by the respondents; transcripts in Appendix C. Local mentor affidavit, asserting Iranian participation, available.

4-4-2) Participant Sample Profiles

In this research, in order to collect different points of view from all parties involed in civil projects, 8 interviewees with respectively more than 10 years' experiences each, in civil projects in public or private sectors have been chosen. They have different roles such as senior project manager, project engineer, Civil Engineer and Architect in different companies and represent the client, consultant and contractor respectively. This research investigates delay in construction projects from different expert perspectives.

Table 4.2 summarises the participants' profiles by position, experience with contracts, company position stakeholder alignment, industry and sector.

Interviewee 1:

He has worked in Medical University of Mashhad facility Management about 35 years as a senior project manager. He has much experience in different fields of Construction projects. Currently with a public sector company; projects' budgets allocated by government; engaged as a client's representative.

Interviewee 2

She has worked in Ferdowsi University of Mashhad (facility management department). She is responsible for building design input. She has 15 years experiences: 10 years in a Consultant Company and 5 years as a client's representative. She has experience in both private and public sector.

Interviewee 3

He has worked in a consultant company for 18 years as a project engineer. His company carries out different projects for public and private sectors.

Interviewee 4

He has worked as a project manager for 10 years in public sector. His qualification is master in Project Management.

Interviewee 5

He is working in the Saderat Bank Iran as a facility manager; has 25 years' experience as a project manager. He has run many large projects with this organisation.

Interviewee 6

He has worked as a project engineer for 10 years in a contractor company.

Interviewee 7

He has been working with the main-roads' public works department principally as Superintendent's Representative on major rural road works projects for more than 35 years.

Interviewee 8

She is a senior budget officer and she been involved with the construction industry for 21 years. She has worked as a government representative in budgetary phase of public sector projects.

Table 4.3: Sample/Participants Profile Summary

Interviewee	Position	Experience	Client/ Contractor/ Consultant	Industry	Sector
1	Senior Project Manager	35 years	Client	University Facility Management	Public
2	Architectural project manager	10 years 5years	Consultant Client	University Facility Management	Public
3	Project Engineer	18 years	Contractor	Civil	Private
4	Project manager	10years	Client	University Facility Management	Public
5	Project Manager	25years	Client	Bank Facility Management	public
6	Project Engineer	10 years	Contractor	Civil	Private
7	Senior project manager	35years	client	Main road	public
8	Senior Budget officer	21years	Consultant	Programing and Budgeting organization	public

4-5) Data Analysis

Data analysis in qualitative research refers to the organisation, categorisation and interpretation of the data (Creswell, 2007). This study utilised a broad three-stage process which can be broken down into the following steps;

1. Coding the data by identifying and reducing key segments and assigning these segments a name
2. Categorising these codes to form themes; then
3. The interpretation and display of this data to draw conclusions.

Information obtained from such analysis take the form of one of three categories (Creswell, 2007);

- Information the researcher expected to find before the study;
- Information that the researcher did not expect to find before the study; or
- Information that is conceptually interesting or unusual to the researcher, participants or audiences.

The information obtained through the analysis of this primary data, compared and ranked that obtained as part of the initial secondary research.

4-6) Validation of the Research

Qualitative validity refers to the accuracy or truthfulness of measurement or the trustworthiness of the research findings (Trochim, 2006). Validation of qualitative findings ensures a suitable level of quality in the research has been achieved. There are four main criteria that are to be satisfied in order to establish qualitative validity (Trochim, 2006). These include credibility, transferability, dependability and conformability.

Credibility is likened to verifying the internal validity within a quantitative study. It involves establishing the results of qualitative research as credible or believable, from the perspective of the participants in the research (Trochim, 2006). Given the purpose of qualitative research is to understand and describe the opinions of the participants, it is the participants who must validate the credibility of the research.

Transferability refers to the degree to which results of qualitative research can be generalised or transferred to other contexts or settings (Trochim, 2006). This is likened to verifying the external validity within a quantitative study (Trochim, 2006). Transferability is achieved by ensuring the context of the research and assumptions are clearly stated within the research.

Dependability is likened to verifying reliability within a quantitative study. In quantitative studies researchers are concerned with whether results could be accurately replicated and therefore reliability is

synonymous with repeatability (Walonick, 1993). While in quantitative studies reliability may be tested by repetition (ie using the test, re-test method), this is difficult to achieve within qualitative research as the "experimental conditions" cannot be replicated easily, if at all. Dependability within qualitative research emphasises the need for consistency of both the research process and product (Golafshani, 2003). Lincoln and Guba (1985) identify "inquiry audits" as a suitable method to improve dependability throughout data collection and during the analysis of data to deduce findings.

Conformability refers to the degree to which results can be confirmed or corroborated by an external body. This is particularly important within qualitative research as it is generally accepted that the researcher has a unique perspective and therefore biases the research findings. This is likened to objectivity within quantitative research studies. In order to improve conformability the researcher should seek out and describe contradictions in observations throughout the study.

In this research, to validate the data gathered and in line with requirements stated above, a *member checking* procedure was adopted, alongside third-party corroboration with a very senior project manager in Main-Roads Western Australia public-works department.

Strategies employed in order to validate this research are summarised in Table 4.3 (which aligns approaches undertaken to validate the research against the validation criterion)

Table 4.4: Summary of Strategies to Validate Research

Qualitative Validity Criteria	Strategy	Action
Credibility	Question Verification / Pilot Study Member Checking	 Receiving feedback from different participants or expert reviewers. The interview results were checked by interviewees themselves
Dependability	Inquiry Audit *(Continual Code Assessment)* *(Consistent Interview Technique)*	Peer Debriefing
Transferability	Use of Thick Description	Sufficient data(documents) has been collected
Conformability	Triangulation Clarification of Bias	Using different sources of data. An interview has been carried out with an expert practitioner who has been involved in civil projects in WA. As Malterud (2001) writes: "*Preconceptions are not the same as bias, unless the researcher fails to mention them*" (p. 484).

Qualitative Validity Criteria	Strategy	Action
	Presentation of negative or discrepant information	Peer debriefing
	External Auditing	A senior civil engineer has reviewed the study and the study edited according his feedback

As mentioned, the interview questions were semi-structured to give interviewees the opportunity to talk about their problems during their experiences in civil projects. In addition they were asked to state their opinion about the factors obtained from primary research and rank them.

Case-studies subsequently identified for detailed analysis a US$14m library building in Iran, highlighting Bills of Quanitties documentation explicilty.

Iteratively (based on the interviews results detailed in Chapter 5-1), some new factors were added to the list, some of them changed, modified, or omitted**.**

4-7) Ethics

In qualitative research prior to conducting primary research, ethical issues should continuously be considered. Building a good relationship with participants in qualitative research is very desirable. This can only be built on strong ethical foundations. Although ethical issues should be considered at every stage of qualitative research, the main issues generally arise during the interview stage during the primary collection of data. Information elicited is often of a personal or professionally sensitive and must be dealt with a high level of confidentiality and respect. Given the nature of this study ethical issues focus around informed consent and confidentiality flagging:

- The position of the researcher
- The purpose of the study
- Method of data collection (semi-structured interviews)
- The expected time investment required by participants

Prior to conducting interviews, an interview protocol (shown in Appendix D) was sent to interviewees following initial contact, further specifying the aim of the study and outlining the questions to be asked. In this protocol informed participants of their right to withdraw consent at any stage and offered participants the opportunity to be sent a copy of the findings of the research at the conclusion of the study.

The interview protocol also included a privacy statement. Confidentiality has been maintained, where requested, by ensuring anonymity. In this case a confidentiality agreement was drafted between the university, the researcher and the company to ensure confidentiality was upheld. To address this point, this study discussed data collection methods and methods undertaken to validate the obtained data.

In the following chapter, this study will deliberate upon interview results, analyse and tabulate.

CHAPTER 5 - RESULTS

5-1) Interview Results

As mentioned in chapter 4, this research applied the semi-structured interviews and case study method to identify the key delay factors in Middle East countries. In this chapter the results are presented concisely in a number of tables, which summarise interviewee responses to questions related to delay factors' inter-relathionships.

While participants were allowed to answer the questions very flexible, *all* topics were covered. Although interview questions focused on delay factors obtained from literature review, participants had the opportunity to add any delay factors according their experiences.

Interview questions outline:

1- Interviewees were asked about their occupation, experience and organisation and also about delay in their projects that they were involved.

2- Interviewees were asked about each delay factors which obtained from literature review such as poor initial studies financial issues, too many changes in order, form of contract and shortage of labour.

3- Participants answered questions regarding the importance of each factor, its likelihood, and delay factors interrelationship.

4- Interviewees were questioned to discuss about delay factors interrelationship and rank them.

5- They evaluated and ranked delay factors which discussed.

6- Participants were asked to talk about their experience in civil projects and problems which these projects are facing.

7- They were asked to give any suggestion to mitigate the negative impact of delay factors in civil projects.

Table 5.1 represents a summary of the interview results from the expert-practitioner participants (1-6) who have been involved in civil projects in Iran.

Participants represented a variety of company profiles ranging in size, industry, sector (public/private) and position (client/contractor/consultant).

Considering the fact that a majority of interviewees, stated inadequate funds as a key factor of delay in civil project in Iran, another interview [table 5-3(d)] was also carried out with a representative of the Iranian government related to civil construction projects budgetary issues (interviewee 8).

The 7th interviewee is an expert in civil project in public sector in WA. This interview result (table 5-2) was compared to results obtained from other interviewees in Iran. This comparison sought to reveal the common key factors and regional key factors in the Middle East.

Table 5.1: Interview Results

No	Question	Interviewee 1 (university facility management)	Interviewee 2 (university facility management)	Interviewee 3 (private Company)
	Context			
1	What is your current position?	Senior Project Manager	Architect	Project Engineer
2	How many years' experience do you have in this position?	35 years	15 years	18 years
3	In your organization how many percent of project have delay?	90%	(80-90)	80%
	Poor initial Estimation			
4	In your organization which method do you use for initial estimation?	Detailed Individual estimation	Detailed Individual estimation	Parametric cost estimation
5	To what extent initial estimation are accurate?	(10-20)%	10%	10%
6	Why most often initial estimation are not accurate?	Poor estimation, delay and inflation	Lack of detailed plan, too many changes in order and big gap between market price and official price	Too many changes in order and unpredictable inflation
7	What are key factors of cost overrun in projects?	Delay, inflation, lack of suitable contractor and poor estimation	Some changes in order add expenses, re-work and inflation	Inflation, currency rate drop and too many changes in order
8	Which of the above factors is the most important?	Inflation(in large projects)	Lack of detailed plan	inflation
	Financial issues			
9	In your organization how many percent of project have	90%	90%	60%
10	How many percent of fund will **allocate** to projects?	(60-90)%	(70-90)%	90%

No	Question	Interviewee 1 (university facility management)	Interviewee 2 (university facility management)	Interviewee 3 (private Company)
11	To what extent do you think **inflation** has negative effect on projects?	100%(especially in large projects)	100%	90%
12	To what extent do you think fluctuation in **oil price** has negative effect on projects?	80%	90%	60%
13	To what extent do you think **Currency rate Drop** has negative effect on projects?	(80-90)%	80%	70%
14	To what extent do you think **instability in Economics** has negative effect on projects?	(60-70)%	60%	70%
15	Which of the above factors is the most important?	Inadequate fund	Inadequate fund	Inflation
	Too many changes			
16	In your opinion what are the factors cause **too many changes** in order in projects?	Poor feasibility studies, unpredictable issues	Poor understanding of clients requirements or clients change their mind	Poor feasibility studies(allocated time to feasibility studies is too short)
17	In your opinion what are the factors cause **re-work** in project?	Poor quality, changes in order	Usually changes in design	Clients change their mind
18	Which factor is the most important?	Poor feasibility study	Poor feasibility study	Poor feasibility study
	Form of contract			
19	To what extent do you think form of contract has negative effect on projects?	(50-60)%	50%	60%

No	Question	Interviewee 1 (university facility management)	Interviewee 2 (university facility management)	Interviewee 3 (private Company)
20	How form of contract has a negative effect?	Due to inflation and fluctuation in materials' price contracts cause dispute		Inflation has not considered in traditional contracts properly
21	How can we prevent disputing?	Considering + 25% or -25% of contract in case of inflation	With considering escalation clause reassure contractor in case of rising price or wages	Escalation clause
22	To what extent do you think tender process has negative effect on projects?	70%	60%	60%
23	How tender process has a negative effect?	Lower bidder is winner	Lower bidder is winner	Lower bidder is winner
24	How can we prevent of this negative effect?	Changing the criteria of winner in tender process(capabilities and performance instead of lower price)	Changing the criteria of winner in tender process	Changing the criteria of winner in tender process
25	Which factor is the most important?	Tender process	Tender process	Form of contract
	Political instability			
26	To what extent do you think political instability has negative effect on projects?	(10-20)%	National project(10-20)% International project(80-100)%	10%
27	Election year	Positive effect on some projects Negative effect on others	Due to political reason some projects complete in the Election year.	
28	Sanction	In large projects for buying equipment Sanction has a negative effect	Sanction Causes problems in Fund of the project	

No	Question	Interviewee 1 (university facility management)	Interviewee 2 (university facility management)	Interviewee 3 (private Company)
	Shortage of labor			
	To what extent shortage of labor has negative effect on projects?	10%	10%	30%

Table 5.1: Interview Results (continued)

No	Question	Interviewee 4 (university facility management	Interviewee 5 (Saderat Bank facility management)	Interviewee 6 (private company)
	Context			
1	What is your current position?	Team member in project management	Project Manager	Project Engineer
2	How many years experiences do you have in this position?	10 years	25 years	10 years
3	In your organization how many percent of project have delay?	90%	(90-100) %	80%
	Poor Initial Estimation			
4	In your organization which method do you use for initial estimation?	Detailed individual estimation	Parametric cost estimation	Detailed individual estimation
5	To what extent initial estimations are correct?	20%	(20-30%	10%
6	Why most often initial estimations are not accurate?	Inflation	Fluctuation in material price and wages	Poor estimation and unpredictable inflation
7	What are key factors of cost overrun in your projects?	Inflation, too many changes order, poor estimation	Fluctuation in material price and wages and shortage of some basic materials during the course of projects	Poor estimation, inflation
8	Which of the above factors are the most important?	Inflation	Fluctuation	Poor estimation
	Financial issues			
9	In your organization how many percent of projects have inadequate **fund**?	90%	80%	70%

No	Question	Interviewee 4 (university facility management	Interviewee 5 (Saderat Bank facility management)	Interviewee 6 (private company)
10	How many percent of fund will **allocate** to projects?	%(70-90)	90%	100%
11	To what extent do you think **inflation** has negative effect on projects?	In large projects 100%	90%	80%
12	To what extent do you think **fluctuation in oil price** has negative effect on projects?	60%	50%	60%
13	To what extent do you think **Currency rate Drop** has negative effect on projects?	70%	60%	70%
14	To what extent do you think **instability in Economics** has negative effect on projects?	50%	50%	50%
15	Which of the above factors is the most important?	Inadequate fund	inflation	inflation
	Too many changes in order			
16	In your opinion what are the factors cause **too many changes** in order in projects?	Poor feasibility study, clients change their requirements	Poor feasibility, change scopes of project	Unpredictable issues
17	In your opinion what are the factors cause **re-work** in project?	Too many changes, poor quality	Poor quality	Too many changes
18	Which factor is the most important?	Poor feasibility study	Poor feasibility study	Unpredictable issues
	Form of contract			
19	To what extent do you think	(40-50)%	(20-30)%	(50-60)%

No	Question	Interviewee 4 (university facility management	Interviewee 5 (Saderat Bank facility management)	Interviewee 6 (private company)
	form of contract has negative effect on projects?			
20	How form of contract has a negative effect?	Fall and rise in material price does not consider in contract properly	They cause dispute	They cause dispute
21	How can we prevent disputing?	Escalation clause	Escalation clause	With considering escalation clause reassure contractor in case of rising price or wages
22	To what extent do you think tender process has negative effect on projects?	Choosing Inexperienced contractor	Lower bidder is winner	Inexperienced and financial problem contractor win
23	How can we prevent of this negative effect?	Changing the criteria of winner in tender process	Changing the criteria of winner in tender process	Changing the criteria of winner in tender process
24	Which factor is the most important?	Form of contract	Tender process	Form of contract
	Political instability			
25	To what extent do you think political instability has negative effect on projects?	National projects(0-10)% International projects 90%	(10-20)%	(10-20)%
26	Election year			
27				
	Shortage of labor			
	To what extent shortage of labor has negative effect on projects?	10%	20%	10%

Interviewee 7

Table 5-2: Interview Result (Expert in Civil Projects in Australia)

No	Question	Answer
1	Your Experience in Civil Projects	35 year career with Main Roads' spans roles of Superintendent's Representative on major rural road works projects, Construction Engineer for day-labor delivery of various road projects and timber bridges, bridge design and rural road maintenance
2	The proportion of projects that experience delay	70 to 90 percent of all projects would be completed within double the original scheduled time and almost no projects take longer than three times the original scheduled time.
3	Are preliminary estimations of project duration accurate	There are two parties who undertake preliminary estimations of project duration. In most Projects I have been involved in the Client sets the timeframe for delivery of the Contract. This is not the cause of delays. The contractor submits a program and by doing so, assumes responsibility for meeting the timeframe set by the Client. The second party to make preliminary estimations of project duration is the Contractor. It is common for the Tenderer not to do a detailed scheduling exercise during the tender preparation phase. And does not price to meet the schedule.
4	What proportion of Projects exceed their allocated budget.	For Major Projects there is generally a separately funded and well executed planning phase during which detailed estimates are developed before budgets are set. However for the majority of smaller projects parametric estimates are used and budgets set.
5	Accuracy of Preliminary Estimates	The accuracy of preliminary estimates is compromised by the lack of detailed planning done before budgets are set.
6	Methodology for preliminary Estimates	Preliminary estimates for budgetary purposes are generally parametric estimates. Detailed estimates are used in preparing to go to tender
7	Is cost overrun due to inaccurate initial estimation?	If the work or work process changes and if the estimate does not make adequate allowance for those changes then cost overrun will occur. Examples include Latent conditions, problems with the quality or supply of Principal Supplied materials, Client directed by the scope changes, inclement weather, industrial relations issues, lack of experience, lack of detailed scheduling, inadequate process control resulting in rework.
8	Causes of Cost overrun in Civil Projects	The key causes of cost overrun in projects that I have seen are (in decreasing order): • Poor scheduling and delivery planning by the Contractor • Rework - Poor Site management by the Contractor • Design omissions - Latent Conditions, unanticipated Environmental or Archaeological Issues, unidentified

		services, • Client directed changes of scope or additional scope • Inclement weather - wet weather or extreme heat • Slow Service relocations by Service Authorities
9	Relevance of nominated factors in causing cost overruns in Infrastructure projects in WA	a. Poor Feasibility Studies These lead to omissions in the document and in turn the estimate. I estimate that these lead to approximately half of the total cost overruns on projects and almost all of the Client borne cost overruns. b. Too many changes. I consider that this is a subset of Poor Feasibility studies. It is often difficult due to resource constraints to get full buy-in of the various Owner Disciplines in the Network Operations and Asset Management areas at the time project feasibility studies are being conducted. It is often only when project is being built that they see the needs and engage. These owner bodies then identify essential changes and this causes additional costs and often delays with their associated costs. c. Inflation I have not experience changes in rates of inflation that have dramatically affected cost overruns. Estimated Final Contract Value at the time of tender will have an allowance for escalation if the contract runs for more than 12 months. d. Foreign currency rate I am aware that Main Roads has experienced significant cost implications due to large changes in foreign supply material costs such as Steel and Bitumen when they represent a high proportion of the total contract cost. They are not frequent occurrences. e. Inadequate funding The Scope of the paper Deals only with Project Delays in the Delivery Phase While long delays may be experienced before a project is funded and endorsed for delivery due to lack of total funds, this is in the Pre Delivery phases of a project ie. In the process of developing and justifying projects (Needs Assessment, Analysis of options and Definition and Design of the preferred option). Delivery of projects are not embarked upon until funds are committed. It is not very common for Main Roads projects to experience delays in completion of a contract due to reductions in the funds committed to the Project during the Delivery Phase of Projects. Funding is allocated with a four year commitment. In the event that a cut in the level of funding during that four year period becomes necessary, then efforts are made to accommodate those cuts in projects for which contracts have not yet been awarded. This may be a bigger issue for agencies with smaller budgets, who do not have multiple projects proceeding in parallel and at different stages of development. f. Political or Economic instability

		I have not experienced either of these issues to a level where they have affected contract outturn costs.
10	What at the major factors that cause project delay?	The key causes of delay in projects that I have seen are (in decreasing order): • Inclement weather - wet weather or extreme heat • Poor scheduling and delivery planning by the Contractor • Design omissions - Latent Conditions, unanticipated Environmental or Archaeological Issues, unidentified services, • Client directed changes of scope or additional scope • Slow Service relocations by Service Authorities • Rework - Poor Site management by the Contractor • Inexperienced Contractor. Contractor competence of the site key personnel • Poor onsite scheduling.
11	How significant are each of the following factors.	a. Form of Contract The further that the Contract form is from the "Lowest Bidder Wins" principle the greater is the likelihood of reduced delays. The first rung of protection is the establish a prequalification system to enable the Client to accept only tenders from Tenderers with the demonstrated capability to deliver the works. The second rung is to introduce a value for money Assessment into the evaluation of tenderers and selection of the successful tenderer. This Value for Money (VFM) assessment will include Non-Cost criteria and Cost Assessment. The Non Cost Criteria will assess the tenderer's capability in terms of its experience and availability of suitable resources. If a relationship based contract is to be entered into then it will also include an assessment of the tenderer's ability to work with the client. A Preferred Proponent will be selected by combining the Non Cost assessment scores and the relative costs on a ratio that is deemed to suit the particular tender.
12	Delays caused by the Client's Ability to Pay	I cannot recall any example of this in Public Infrastructure projects that I have known of in Western Australia. The Client is the Government and the projects are not embarked upon unless there is certainty of funding
13	Suggestions for managing various types of Delay	Contractor experiencing rises in the cost of Materials. a) Purchasing the Material in advance and hence at a known cost. Or b) An Alternative mechanism to achieve this would be hedging using the futures market. Inadequate Funding Break to Project in to stand-alone deliverables that can become working assets as soon as they are complete. Stage the construction of the project so that when funds become restricted, subsequent stages are not commenced. Weather delays Projects can experience delays due to hot or cold weather and Wet or Dry weather. Risk Management by the Client and by the Contractor can ameliorate these influences. Design the project for construction in the weather conditions.

		Options such as rain shelters or high temperature concrete, b. optimize award times to the construction schedule to avoid the worst seasonal extremes of these influences. c. Modify the construction processes to mitigate these influences eg Temporary Roofs or Chiller plants, trimming batters to ensure runoff is not concentrated and cause Scour. doue d. Modify the Construction Schedule to avoid the worst extremes. Eg. Additional resources, night shifts,. Construction Process Scheduling. a. Form an expert team to review the risks and identify mitigation strategies. b. Get an expert Scheduler experienced in the risks and do more Scheduling. c. Ongoing review of the Schedule. Design Omissions . There are two key sources of these types of omission. Late scope changes by the Client and Latent conditions. a. Late scope additions and amendments The solution in this area is to do more planning. Ensure all client groups are thoroughly engaged in the Scoping and Design process. b. Latent conditions (Existing services, unsuitable material, and Environmental or heritage surprises) The solution in this area is to do more Investigation. Do a thorough risk analysis to identify Likely and possible threats and undertake targeted investigation. Slow Service Relocation by Service Authorities. If the Client is managing the Service Relocations. a. Client to assume responsibility and get it done early. b. Establish very close liaison with the Service Authorities. c. Pay the Service Authority to engage specific resources to manage your project. If the Contractor is managing Service Relocations a. Start early b. Proactive management of Liaison with the Service Authority. c. Involve them in your construction program to establish priorities d. Deal Locally. Rework a. Conduct Risk analysis to understand what impediments there are to successful processes and identify critical success factors. b. Establish a process that works. (this may require trial sections) c. Have the process under control

Interviewee 8 Table 5-3: Budgetary Officer in Iran

No	Question	Answer
1	Experience in Civil Projects budgetary?	I have been working in "plan and budgeting" organization for 21 years. As you know, public civil projects' funds are committed by this organization as a representative of the government. I can say that the process of developing and justifying projects will be discussed in this organization.
2	Factors cause delay in public civil projects	A majority of civil projects have problem in the beginning of the project I mean needs assessment stage. If a feasible needs assessment is applied, some of the civil projects do not need even to start. Therefore government can save their funds to allocate to the projects that really are necessary. I would like to say that by decreasing the quantity of the unnecessary projects and enhancing the quality of necessary projects, we can mitigate most of delays in civil projects due to shortage of budget.
3	Inadequate fund as a main delay factor in public sector?	One of the important issues in public sector projects is inadequate fund. Inadequate funds problem arises because of government's constraints financial resources for civil projects and unfortunately each organization by defining a project which sometimes it is unnecessary try to gain a share of these resources.
4	Why a majority of civil projects face cost overrun?	Comparing the delay in the civil projects funded by the government with those of the private sector, there are a few points that have to be observed: Firstly, in the private sector, it is the private client that is responsible for spending on the project. Naturally, the client will attempt to make the project as economically expedient as possible. This is not the case in the majority of the projects in the public sector. In such projects, the client is the government itself; and the representatives of the government in such projects do not pay for the project expenses out of their own pocket. Naturally, therefore, some of the project managers as a government representatives are not concerned with minimizing the project costs. The mismanagement and negligence of such managers lead to a higher cost in civil projects. Secondly, the absence of a strict punitive and deterrent mechanism leads to the fact that most such managers do not have to worry about the possible consequences of their mismanagement.
5	Why 100% found will not allocated?	In fact, sometimes due to some events, the government income is less than what expected. It might be due to decreasing in international oil price, decreasing in amount of oil importing, unrest in region and less tax payment. In this kind of situation, government will consider its first priorities. Therefore sometimes it leads to cut the civil projects funds.
6	To what extent civil projects funds rely on oil income?	Now it is 5 years that I am retired. When I was working in this organization 8o% of projects' funds relied on oil income. But during these five years the situation has worsened.
7	Cutting allocated budget to civil projects are due to shortage of government's oil income?	
8		

As observed above more than 20 key factors were identified over these interviews. To simplify the discussion this study categorises these factors in the table below.

Categorisation of delay factors:

A Categorisation of the main factors emphasised and repeated by a majority of interviewees is found to fall into SIX significant classes. In below table, financial issues, Poor feasibility studies, Contract related issues, Political issues and Shortage of material are considered as essential categories.

Table 5.4): Delay Factors Obtained from Interviews

	Factor	Financial issues	Poor feasibility studies	Contract related issues	Inter-party communication	Materials	Political Issues
1	Inadequate funding	*					
2	Inadequate fund allocation	*					*
3	Inadequate time for fund allocation	*					
4	inflation	*		*			*
5	Currency rate drop	*		*			*
6	Instability in economics	*		*			*
7	Oil price fluctuation	*		*			*
8	Material price fluctuation			*		*	
9	Poor initial estimation		*	*			
10	Too many changes order		*				
11	Re-work		*				
12	Poor understanding of client needs		*				
13	Lack of Detailed Plan		*				
14	Political instability						*
15	Lower bidder winner			*			
16	Contractor dispute			*			
17	Form of contract			*			
18	Tendering process			*			
19	Inexperienced contractor			*			
20	Poor communication between parties				*		
21	Approval timeline underestimate		*		*		
22	Shortage of Material					*	

In this research the results obtained and tabulated above from primary research were unsurprising.

The interview results echoed concepts derived from literature review.

In the case-study analysis section (5.2 below), this research observed the delay factors obtained from interview across, a real actual project towards a ranking of importance/ factor-share related to cost and time overrun in an actual construction job.

5-2) Case study

Introduction:

According to interviews result in chapter 5-1, the following factors were determined as key factors of delay in this Iranian case-study: Inadequate funds, excessive scope change, poor initial studies, inflation, Form of contract, Currency rate drop, Instability in Economics, Fluctuation in oil price, Shortage of labour, Political instability, Shortage of material and poor inter-party communication.

In this chapter, these factors will be examined relative to real construction project(s) as a case study.

General Information

This case-study project is a library for a public sector. The project has been designed 20 years ago but due to other commitments was not executed at that time (and shelved).

In 2009 the client decided to re-activate and fund and start this project.

The consultant reviewed the plan:

Tender documents were prepared and the project was awarded to a selected contractor.

General information: Library (Iran)

	Start date	**Finish date**	**Duration (months)**	**Building area(m2)**	**Project cost Million dollar**
Contract	**23/7/2009**	**21/10/2010**	**15**	**8,769**	**US$ 13.96m**
Actual	**23/7/2009**	**14/11/2012**	**39.5**	**8,769**	**US$ 30.52m**
excess			***24.5 months***		***US$ 16.6***

As tabulated above this project was faced with cost overrun and time overrun.

It is noted above that the project had a cost-blow-out of 16.6M and overran the expected completion date by two years.

This research investigated the key factors leading to delay and cost overrun in this project.

According to document analysis related to the cost and time blow-outs (Detailed in Appendix E) the main reasons for delay can be noted as

- changes in the scope of the project and also
- related client requests for variations altering functionality,
- Continual requests to achieve practical completion soonest, resulting in 'crash-cost' cost-overruns.

According to client, most of the changes in the project were required as a result of the consultant's initial inappropriate/ **poor feasibility study**.

This project was originally designed 20 years ago with an expectation that the consultant review the design carefully

- A lack of attention to changes in library space design during these years resulted in the client changes.
- Another major change in this project was Fire Protection Systems.
    - This system originally envisaged proved inappropriate for a large library with a lot of priceless ancient Persian books and texts thus
        - Fire protection system required change.
- No Value-Engineering was conducted to address fire-protection and the like at the early stages.

Case-study: Delay Factor Analyses

Document analysis and subsequent interview with experts involved in this project shows that:

1) The initial studies were not accurate; studies did not pay attention to all aspects of project namely.
    a. Changing the fire system protection in the middle of the project proved unacceptable:
    The consultant failed to consider functionality;
    This project has a very valuable book collection and thus very vulnerable to fire.
    Re-design of appropriate fire system protection was carried out retrospectively incurring cost and time.

    b. The reference section was situated at an underground level without any windows and no access for users:
    User appreciation proved unsuitable for modern library design;
    Changes lead to a huge excavation, changes in finishing floor, light design related fittings and fixtures retrospectively.

2) Tender documents were deemed of very poor quality:
    A lack of detailed plans was evident; disparities between bill of quantities and drawings arose.
    Poor quality tender documents lead to inaccurate estimates, higher margins in bids, claims and disputes.

3) The duration of the project in contract has been (under)estimated at 15 months: too short.
The construction schedule was unrealistic; work-task activity seasonal staging was ill-advised
In this region winter weather is inclement - very cold (mostly minus zero)
Staging of work-tasks failed to address (expected) inclement weather cycles
Major concrete works (foundation and the structure of the project) were scheduled for winter.
All days in winter had been (incorrectly) allocated as scheduled working days with no float or weather allowances factored-in.
In addition the workforce and project stakeholders was predominately Muslim and no allowance was made in the original schedule for Ramadan (the fasting Month)
Ramadan working hours were not factored-in decrease
Work-efficiency levels to reflect work-task performances during the fasting period were not factored-in.

4) Inaccurate initial cost estimation resulted from poor tender documents.
The actual cost of project was more than twice of the initial cost estimation.
Although this project used detailed Individual estimation, the initial estimation is not accurate
lacking detailed plans, unrealistic prices in unit rates in Bills of Quantities
'Official price/rates' were used -- much less than the subsequent actual market price
unpredictable inflation and Currency rate drops created major disparities between original and actual estimate.

5) Dispute and claim and counter-claim became by contractor became the norm
bidder offered a price according the drawings and specification which has been changed in execution phase.
Some items like excavation increased twice or more compare to the BQ attached to the contract.

6) Inadequate fund and inadequate allocation affected estimate greatly
The project faced shortage of budget (lack of finance) during what should have been the seasons most suitable for work (spring and autumn)
budget allocated and made available in winter months (which is very cold (minus zero) in this region and it is not suitable for work) were not used since interim valuations recorded limited work on site at that time.
Allocations pencilled in were subsequently unavailable and were 'swept' once the work was carried out resulting in no payments being forwarded.

7) Excessive changes were ordered/requested by the client.
Although client approved the original plan before starting the project, user needs had not been reviewed appropriately;
Client changes increased the cost of project dramatically
Changes for aesthetic resulted in project increases:
the external walls finishes were ordered from brick to granite retrospectively

8) Poor communication between parties occurred; communication paths failed to adhere to standard form of contract clauses, obligations and responsibilities related to scope change and the like.
   According to document analysed (and letters/messages of formal communication for the project), every time there was a need for the client's approval due to changes in the plan, the project was stalled and it took a long time for the project to restart.

9) According to the (chart x page 21) during Nov.2011 –Oct.2012 Iran's Currency rate experienced a dramatic drop.
   As mentioned (chapter 2) currency rate instability, when compared to international currencies, resulted significantly in increases in the price of the equipment thus the price estimated at the beginning of the project and project faced at the end, subsequently produced cost overruns;
   in this situation (variations in currency rate) might have reasonably allowed opportunity for contractor to claim, but the client disputed these as a result of ambiguous/limited contract-clause documentation related explicitly to *currency rate* variations.

10) In the project's standard form of contract a '*special clause insertion*' stated that if the Bills of Quantities items were *perceived* (over the duration of the contractor) to have increased or decreased by a maximum limit of 25%, then the parties must retain and honour the BQ original rates.
    In this case rates went beyond the 25% limit and thus the parties signed a supplementary contract (as detailed in Appendix E) which compounded cost/time blow-outs related to revised fit-for-purpose designs

Table 5-4-1 below summarises these project specific case-study time and cost overruns and delay factors
The table below identifies:

- the case-study specific problem-arising/ factor-of-delay
- the reason for this problem/ factor-of-delay
- the mitigating measure to address this problem/ factor-of-delay
- the effect of the problem/ factor-of-delay in terms of
  - Delay in months
  - Cost blowout in US$m
  - proportion in relative delay as a percentage of the overall time schedule
  - proportion of the relative cost increase as a percentage of the value

Table 5.4.1 Case-study Delay Variables: Summary

Item	**Problem**	**Reason**	**Mitigation Measure**	**Effect on Project**			
				Delay *Month*	*Cost* *US$M*	*Proportion relative delay %*	*Proportion relative to extra cost %*
1	Inappropriate fire system protection	Poor Feasibility studies	Re-Design Re-Work Delay(Inflation)	1	0.34	4.1	2.05
2	Design problem (No user access to reference section)	Poor Feasibility Studies (Misunderstanding of client needs)	Re-Design Re-work Delay (Inflation)	2	0.70	8.1	4.23
3	Addition to scope of the project	Poor Feasibility Studies (Misunderstanding of client needs	Addition to expenses Shortage of budget Delay (Inflation)	4	1.3	16.4	7.9
4	Poor tender document	Poor feasibility studies	Claim and Dispute	0	0.5	0	3.02
5	Poor initial time estimation	Unrealistic time scheduling	Claim and Dispute	0	0.1	0	0.6
6	Poor initial cost estimation	lack of detailed plan/unreal price	Claim and Dispute Inadequate Fund	0	0.1	0	0.6
7	Dispute and Claim	Form of contract	Add to Expenses Delay(Inflation)	3	1.36	12.3	8.2
8	Shortage of budget	Inadequate Fund	Delay(Inflation)	4	1.6	16.3	9.7
9	Re-work	Too many changes	Add to expenses Delay(Inflation)	3	2.20	12.3	13.28
10	Underestimate time for approval	Poor Communication between parties	Delay(Inflation)	2.5	1.30	10.2	7.85
11	Equipment bought more expensive than initial estimation	Currency Rate Drops	Add to Expenses	0	0.5	0	3.02
12	Rising in material price	Inflation (see below chart)	Add to Expenses	0	3.8	0	22.95
13	Fund allocated less than initial Fund	Oil fluctuation (Less income for Government)	Delay(Inflation)	2	1.10	8.1	6.6
14	Too cold to work	Unrealistic time scheduling	Delay(Inflation)	0.5	0.28	2	1.7
15	Not considered Holidays and religious belief	Unrealistic time scheduling	Delay(Inflation)	0.5	0.28	2	1.7
16	Clients changed their mind	Too many changes	Re-Design Re-work Delay(Inflation)	2	1.10	8.2	6.6
17			Total	24.5	16.56	100	100

Table 5.4.1 Case-study delay items summary

In this project it can be said that the Iranian library case-study reviewed faced with 2 significant shocks.

– Firstly the inflation rate dramatically increased (22-38.5) : a 175% increase (as Fig 5-1, 5-2, 5-3)

– Secondly the currency rate significantly (Fig 5-4) dropped in the time that project needed to be equipped and hence equipment bought from overseas was impacted upon by this factor resulting radically in a causal cost overrun in this project.

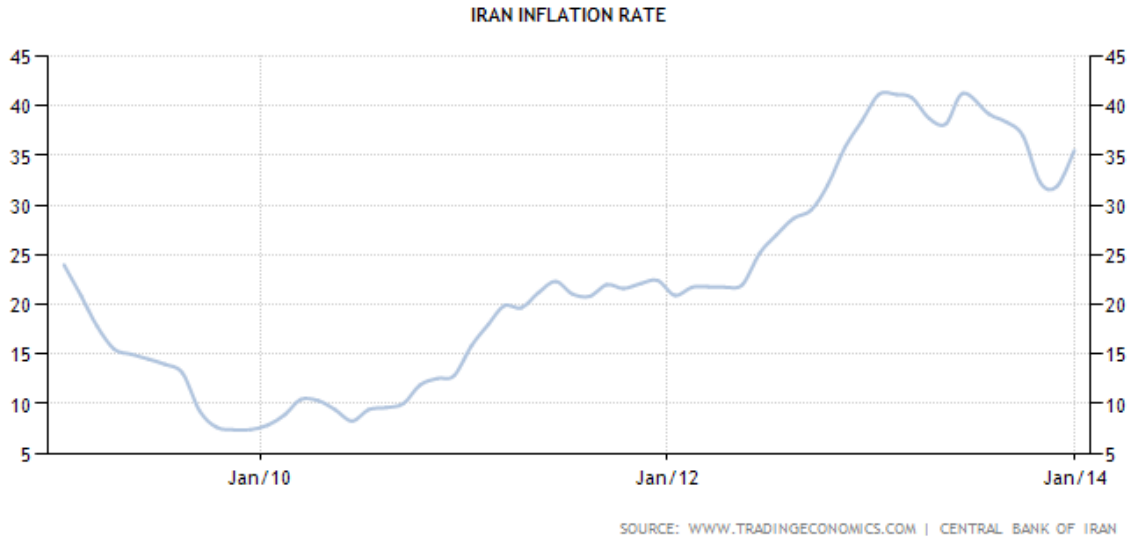


Figure 5-1 Iranian Inflation Rate during the course of Project

Figure 5-2 Iranian Inflation Rate during the course of Project (1)

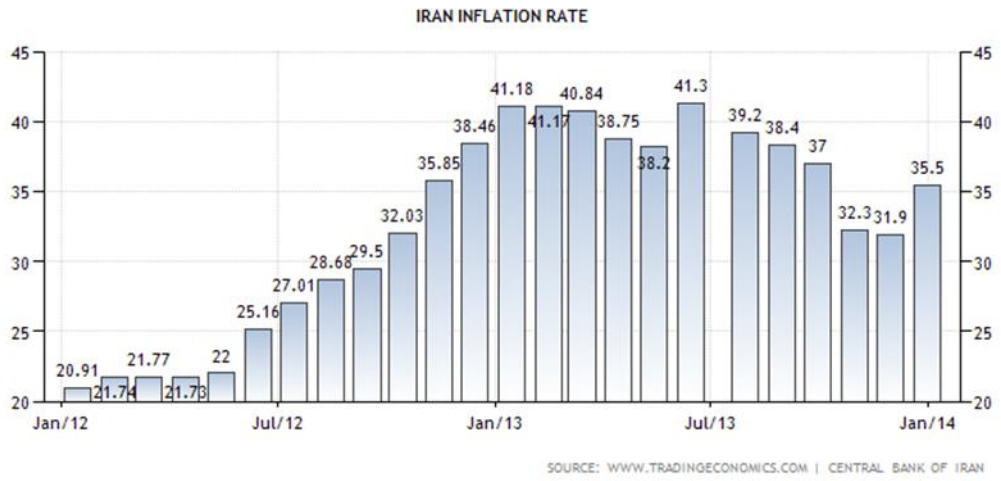


Figure 5-3 Iranian Inflation Rate during the course of Project(2)

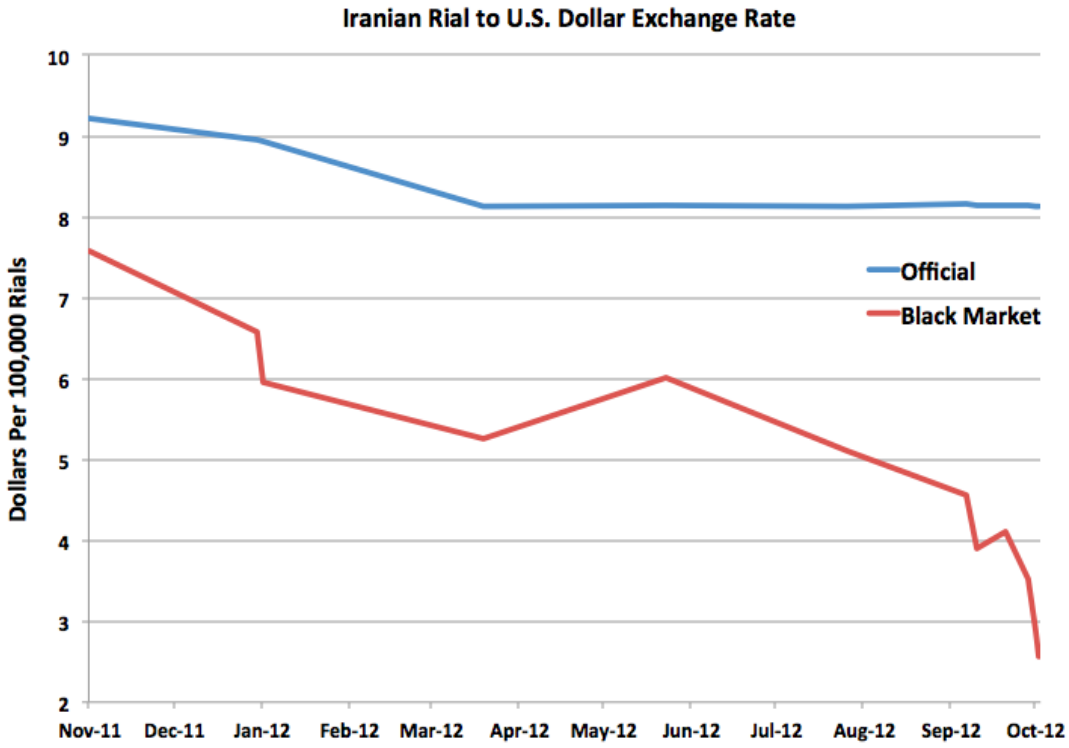


Figure 5-4 Iranian Exchange Rate

Figure 5-4 Iranian Exchange Rate

The figures above (Fig 5.1-4) show the extent to which inflation rates are unpredictable in this region and prone to dramatic fluctuation. Furthermore it shows that during course of this project the inflation range was (22-38.5) which had a significant impact on fluctuations in material prices. It is clear that the initial cost estimation had been done at the time when the inflation was about 22% but unpredictable inflation lead to poor cost estimation and inadequate fund allocation and availability.

Review of the case-study project for the Iranian Project detailed above allows further interpolation of the Delay factors specific to this location.

Table 5.4.2 below ranks the factors of delay in terms of respective contribution to timescale; inflation is accounts for the highest cost-blow-out (with time implication of '0' requiring intangible interpretation)

Delay Factors	*Items*** Relative to Table 5.4.1 Case-study Delay Variables: Summary*	Share in Time overrun %	Share in Cost overrun %
Poor Feasibility Studies	*1-2-3-4-6*	28.6	17.8
Inadequate Fund	*8-13*	24.4	16.3
Scope Changes	*9-16*	20.5	19.88
Form of Contract	*7*	12.3	8.2
Poor Communication	*10*	10.2	7.85
Unrealistic time Scheduling	*5-14-15*	4	4
Inflation	*12*	0	22.95
Currency Rate Drops	*11*	0	3.02

Table 5.4.2 : Weighting of the Delay Factors for a location-specific (Iranian) Building Project

*** re-statement of items (relative to Table 5.4.1 case-study delay variables: summary)*

Item	*Problem*	*Reason*
1	*Inappropriate fire system protection*	*Poor Feasibility studies*
2	*Design problem (No user access to reference section)*	*Poor Feasibility Studies /(Misunderstanding of client needs)*
3	*Addition to scope of the project*	*Poor Feasibility Studies / (Misunderstanding of client needs*
4	*Poor tender document*	*Poor feasibility studies*
5	*Poor initial time estimation*	*Unrealistic time scheduling*
6	*Poor initial cost estimation*	*Lack of detailed plan/unreal price*
7	*Dispute and Claim*	*Form of contract*
8	*Shortage of budget*	*Inadequate Fund*
9	*Re-work*	*Too many changes*
10	*Underestimate time for approval*	*Poor Communication between parties*
11	*Equipment more expensive than initial estimation*	*Currency Rate Drops*
12	*Rising in material price*	*Inflation (see below chart)*

13	*Fund allocated less than initial Fund*	*Oil fluctuation /(Less income for Government)*
14	*Too cold to work*	*Unrealistic time scheduling*
15	*Not considered Holidays and religious belief*	*Unrealistic time scheduling*
16	*Clients changed their mind*	*Too many changes*

Following-on from the Delay-ranking/weighting summary table above (Table 5.4.2), total-delay can be postulated as a function of its constituent variables, such that:

Where Average Inflation Rate: (22+38.5): 2 = 28.92

Then location specific delay for the public-sector building projects in the region are described as a function of:

Delay = Poor Feasibility Studies at the outset (28.6%) + Inadequate Funding measures (24.4 %) + Client's Scope Changes (20.5%) + Ambiguous forms of Contact (12.3%) + Inadequate Stakeholder Communication (10.2%) + unseasonable task scheduling (4%)

and

Cost Overrun = Inflation (22.95%) + Client's scope Changes (19.88%) + Poor Feasibility studies at the outset (17.8%) + Inadequate Funding measures (16.3 %) + Contact Ambiguity (8.2%) + Poor Stakeholder Communication (7.85%) + Unrealistic time scheduling (4%) + Currency Rate Drops (3.02%)

The case study results revealed that poor feasibility studies contribute a key role in time and cost overrun in this project. Due to high rate of inflation and instability in economic which sometimes lead to currency rate drop, mitigating preventable delay is very important issue in this region. This case study illustrates that by enhancing feasibility studies, a large proportion of delay in this project would be prevented.

In the following chapter, this research will focus on the categories and factors which have the most impact on civil projects delay in the Middle East.

CHAPTER 6 - DISCUSSION

This chapter discusses in more detail the delay factors identified as key variables in civil and construction projects and categorised earlier.

Building upon interview results this chapter presents detailed discussion and tabulates/pie-charts *delay* as a function of the variables of a Middle Eastern construction project.

6-1) Analysis of Interviews

6-1-1 financial issues

According to interview results in chapter 5, financial issues in civil projects in Middle East have a vital role in time and cost overrun. A majority of interviewees mentioned that inadequate funds play a significant part in civil projects delay.

When asked to explain more specifically which factors lead to inadequate funding, responses identified: Inadequate fund allocation, inflation, Fluctuation in oil price (shortage of government income), Currency Rate drops and instability in Economics as related to financial issues.

In the table below (6.1) interviewees answered the question of ranking the factors related to financial issues, indicating inadequate fund and inflation as the key factors of financial issues in construction projects in this region. The interviewees allocate 1 to most important factor and 7 to less important factor.

interviewee	sector	Inadequate fund	Fund allocation	inflation	Inadequate time fund allocation	Fluctuation in Oil price	Currency rate drop	Instability in economics	Most important factor
1	public	1	2	3	7	5	4	6	Inadequate fund
2	public	1	2	3	7	4	5	6	Inadequate fund
3	private	4	5	1	7	6	2	3	inflation
4	public	1	2	3	7	5	4	6	Inadequate fund
5	public	1	2	3	7	5	4	6	Inadequate fund
6	private	5	6	1	7	4	2	3	inflation

Table 6-1 Financial Issues ranking by variable

Table 6.1 shows public sector projects are perceived to be more likely to face inadequate funding and fund allocation issues than private sector.

In Figure 6.1 below one can consider factors such as inflation, fluctuation in oil price, currency rate drop and instability in economics as having a negative effect on funding of projects, and/or one can state that these factors cause inadequate funding in public projects.

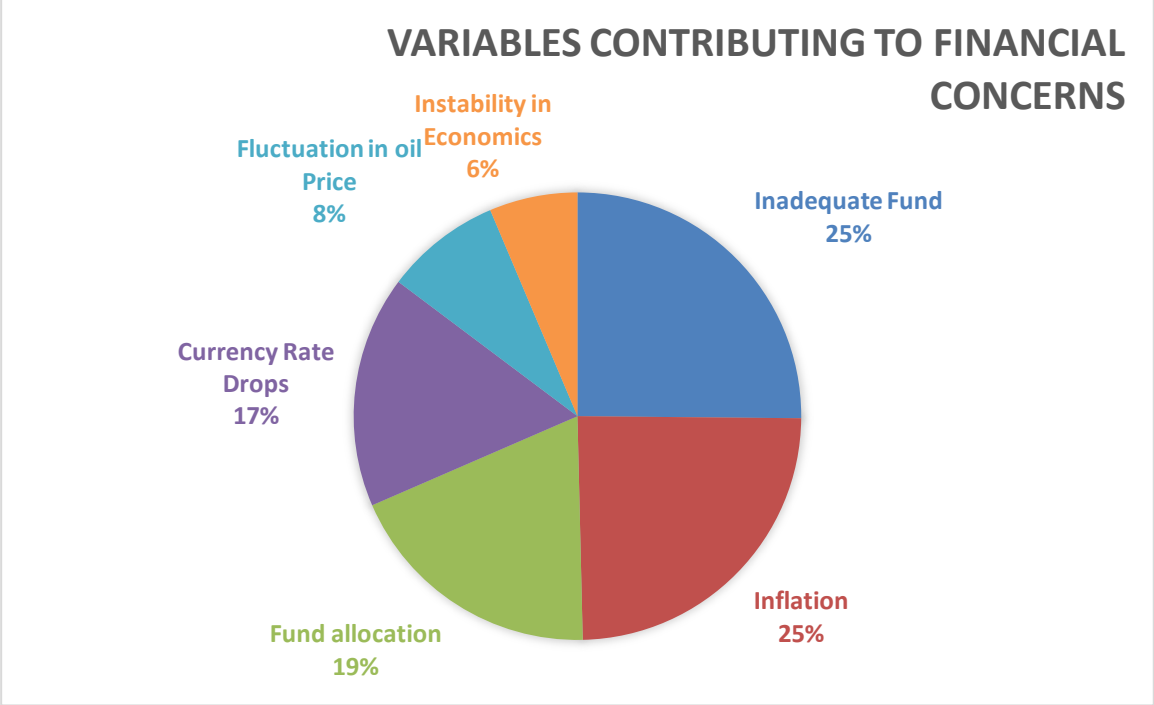


Figure 6-1 Variables contributing to Financial Concerns

6-1-2) Poor Feasibility Studies

A majority of the interviewees stated, despite the importance of initial studies, that the time allocated to studies' preparation is usually short and the studies are not carried out with satisfactory precision. As a result, numerous problems will occur at the construction stage. Some of these problems are preventable, if more attention and effort in feasibility studies is applied. It goes without saying that any changes at this stage are not expensive nor time consuming. Poor initial cost and time estimation, Lack of detailed plan, too many changes, poor understanding of clients' needs and unrealistic scheduling all relate to poor feasibility studies. The following section discusses these factors in more detail.

6-1-2-1) Poor initial estimation

4 out of 6 of interviewees answered that initial estimation most often (90%) are incorrect although they did indeed use detailed individual estimation. As the below table (Table 6.2) shows most of interviewees stated that inflation is the most important factor in poor cost estimation, while a minority believe that poor feasibility studies (such as lack of detailed plan, too many scope changes and poor estimation) are key factors in poor cost estimation. Tbale 6.2 below summarises these issues.

Interviewee	Sector	Estimation method	Estimation accuracy (%)	Factors lead to poor estimation	Most important factor
1	public	Detailed individual estimation	(10-20)%	Delay-inflation	inflation
2	public	Detailed individual estimation	10%	Unreal price in initial estimation-too many changes –lack of detailed plan	Lack of detailed plan
3	private	Parametric cost estimation	10%	Too many changes-Unpredictable inflation	inflation
4	public	Detailed individual estimation	20%	Inflation-too many changes poor estimation	inflation
5	public	Parametric cost estimation.	(20-30)%	inflation	inflation
6	private	Detailed individual estimation	10%	Poor estimation-inflation	Poor estimation

Table 6.2 Poor Feasibility studies

6-1-2-2) Excusive scope changes

In the table (6.1.2.2) below interviewees provided a ranking of the factors related to scope-changes; this table shows client changes as due to poor feasibility studies adding to (stemming from) client uncertainty.

interviewee	sector	Scope changes order (clients change their mind)	Poor feasibility studies	Poor understanding client needs	The most important factor
1	public	1	2	3	Too many changes order
2	public	2	1	3	Poor feasibility studies
3	private	2	1	3	Poor feasibility studies
4	public	1	2	3	Too many changes
5	public	2	1	3	Poor feasibility studies
6	private	2	1	3	Poor feasibility studies

Table 6.1.2.2 Scope change weighted variables

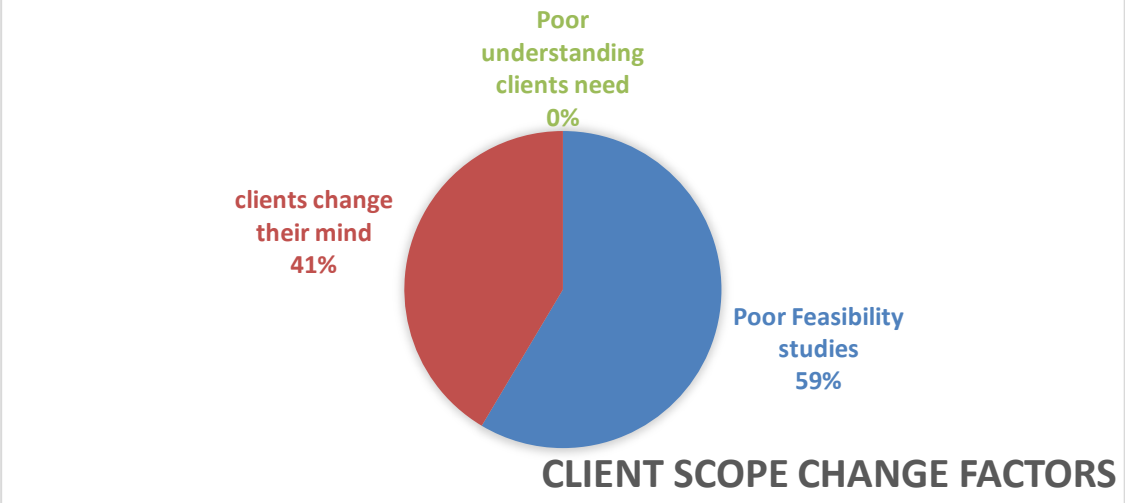


Fig 6-2) client Scope change factors

6-2) Contract related issues

According the interviews there are two important issues related to contract (as Fig 6-2 above):

1-Form of contract
2-Tendering process

As the table below (table 6.1.2.3) indicates, in the private sector contractors state the form of contract to be a key factor of dispute because of an inability to address the rise and fall in material prices and wages (fluctations) not considered properly in contracts due to unpredictable inflation to cover such variations.

Whilst in the public sector clients are worried about tendering process; instead of considering performance and capability of the contractors in tender process, lowest bidder is winner. Therefore unsuitable contractors win the bid and cause numerous problems in construction projects.

Given that interviewees state inadequate funds and lack of the allocation of the approved fund as key factors in delay in public sector, in this situation if the winning contractor is unexperienced or have financial problems, the problem will be exaserbated.

interviewee	Sector	Form of contract	Tender process	Most important factor
1	Public	2	1	Tender process
2	Public	2	1	Tender process
3	Private	1	2	Form of contract
4	Public	2	1	Tender process
5	Public	2	1	Tender process
6	private	1	2	Form of contract

Table 6.1.2.3 factors of dispute: tendering process *or* form of contract

6-1-4) Political instability

According to interviews, 'political instability' in national projects does not play a vital role, however it is deemed very important for international stakeholders. In Election years projects will receive promises of funding for (larger more public) public-sector ventures.

International sanction issues (currently in place in Iran) cause go-ahead/resoucring concerns particularly causing problems in larger projects when in the plant and equipment purchase of suitable civil engineering and construction equipment from overseas.

6-1-5) Shortage of labour

Shortages of labour (in Iran rather than the wider Middle east region) are argued by respondents to have limited influence over delay in construction projects – albeit that some interviewees mention (instead of shortage of labour shortage) basic materials and equipment unavailability (*see 6-1-4 above*) causing delay in certain projects.

However as mentioned in Chapter 3 above (Cordesman 1999; et al) a consensus amongst the sample group argue that the Southern Persian Gulf states (in contrast to Northern Persian gulf states) are *very* dependent on foreign labour and due to unresponsive (national) immigration policies these problems can be exacerbated.

6-1-6) Ranking the key factors in Construction Project Delay

Qualitative semi-structure-interview data-gathering towards primary research information sought the sample group to rank *each and every* factor (identified from secondary research literature review and subsequently from iterative primary data-set analysis) in terms of its influence upon construction project delay (in the Middle East).

The results shown in the table 6.4 below identify the importance ranking of the key factors of Delay in Construction Projects

Figure 6-3 charts the key delay factors in construction projects in the Middle East, based upon qualitative primary data gathered from the sample panel of expert practitioners.

Interviewees	Form of contract	Inadequate fund	Excessive scope change	Poor initial studies	Fluctuation in oil price	Political instability	Currency rate drop	Instability in economic	Shortage of labour	inflation	Poor parties communication	Shortage of materials
Interviewee 1	4	1	2	5	6	9	7	8	10	3	12	11
Interviewee 2	5	1	2	3	7	10	6	8	9	4	12	11
Interviewee 3	5	1	2	4	8	10	7	6	9	3	12	11
Interviewee 4	8	1	3	4	7	9	6	5	10	2	11	12
Interviewee 5	9	1	3	2	8	10	7	4	6	5	11	12
Interviewee 6	3	1	7	2	6	9	4	8	10	5	12	11

Table 6-4- Ranking the key factors of Delay

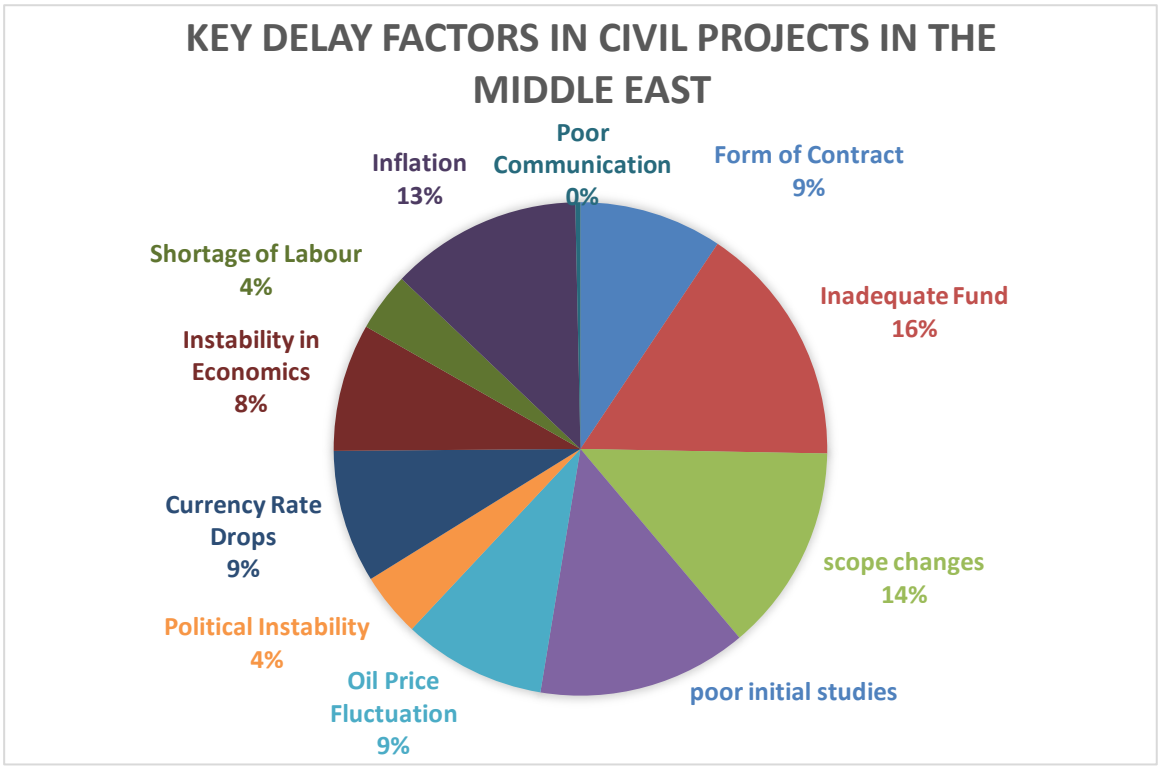


Figure 6-3: Key Delay Factors in Construction projects in the Middle East

Given Table 6.4 and Figure 6.3 above, ranking of the factors responsible for delay in construction project in the Middle East can be itemised in order as:

1 - Inadequate fund
2 - Scope changes
3 - Poor initial studies
4 - Inflation
5 - Form of contract
6 - Currency rate drop
7 - Instability in Economics
8 - Fluctuation in oil price
9 - Shortage of labour
10 - Political instability
11 -Shortage of material
12 - Poor parties' communication

6-2) Comparing factors from secondary and primary research:

The table below aligns the results of the primary research data gathered alongside the secondary data-set garnered from literature and find them to be very similar, notwithstanding additional factors identified via qualitative semi-structured interview highlighting the variables of poor inter-party communication and supply-chain issues related to the shortage of material.

Factors	**Factors of Delay identified via Secondary Research**	***Importance Ranking of Delay Factors via Primary Research***
1	Oil fluctuation	*Inadequate funding*
2	Geopolitical risk	*Scope changes*
3	Currency rate drop	*Poor initial feasibility studies*
4	Shortage of labour	*Inflation*
5	Form of contract	*Form of contract*
6	inflation	*Currency Rate Drops*
7	Instability in Economics	*Instability in Economics*
8	Too many changes	*Oil fluctuation*
9	Poor cost estimation	*Shortage of labour*
10		*Political instability*
11		*Shortage of material*
12		*Poor parties communication*

Table 6-5 Comparing secondary and primary research results related to delay factors

6-3) Results Reflection/ International Funding Body Iteration

Interviews carried out with experts in civil engineering and construction projects in Iran found the majority stating *inadequate funding* as a key factor of delay in civil projects in public sector,

In order to ascertain a wider understanding related to *inadequate funding*, iterative interviews were undertaken with an expert in budgetary issues for Iranian public sector projects. Similarly towards comparing the main delay factors in civil projects in public sector in Middle East countries with markets locally, a West Australian expert practitioner was sought towards triangulation.

While inadequate fund and inflation are very significant factors in cost and time overrun in civil projects in Iran, local Australian expert option solicited, argued that 'funds contractually committed to the Delivery Phase of Projects were honoured' and that 'allowance for matters such as escalation over the term of the contracts does not present problems'.

This compares sharply with interviewees in Iran who stated that sometimes 100% of a contractually approved fund might be reneged-upon due to (Iranian) government funding shortfalls.

West Australian representative expert opinion argued that whilst *inflation* and *instability* in the economy are not factors of delay in Australia, scope change and poor feasibility does occur in Australia and lead to delay. Due to high rate of inflation in Middle East countries such as Iran which inflation rate is between (20-30) % and due to currency rate drops, time overrun and cost overrun and ultimately shortage of budget can lead to a 'complete stop' of projects.

Qualitative, iterative semi-structured interviews with an Iranian expert–practitioner senior budgetary officer in Iran, argues that the *main* delay factor in civil projects in Iran arises *before* starting the projects. The pre-delivery stage of a project is argued to be crucial, with accurate needs assessment benefit/cost analysis is essential to inform decision go-ahead, towards optimistic of national budgets, such that when in reality the national budget is less than expected, government will (as alluded to) retrospectively remove approved project funding.

Comparing delay in projects funded by the Iranian government with those of the private sector it is argued by the respondent that the Iranian private sector is more economically expedient, whilst public-sector projects are more function orientated, which alongside an absence of strictly upheld standard form of contract clauses that enforce punitive and deterrent mechanisms, leads to the fact the public-purse/public-sector projects often experience blow-outs.

6-4) Limitation of the research

Whilst the results generated and discussed above are deemed reliable and robust, limitations might be stated as:

1- The small group of interviewees may be deemed a limitation, albeit that different parties from the (Iranian) construction industry (clients, contractors and consultants, managers and budget holders) were involved, with a sample size of eight suggested by Creswell (2006) as adequate.

2- Case-study documentation whilst successfully illustrative might have been enhanced with increased access to further historical record.

3- A limitation of this research is that, as the research specifically targets country-specific respondents (from Iran), such as a sample might be deemed exclusive. This is acknowledged, albeit with a caveat that current events (Vincent 2015; Bishop 2015) related to issues of Northern Persian States' participation within the wider international community, add relevance perhaps to the civil engineering and construction study at hand.

7- CONCLUSION AND RECOMMENDATION

7.1) Conclusion:

As discussed in chapter 6, primary data from qualitative semi-structured interview research results alongside case study (and document) analyses confirm that inadequate funding, inflation, poor feasibility studies and excessive scope changes are the key factors of delay in this region. One can say that inadequate funding most often occurs due either to inflation or because of poor feasibility-studies/poor early cost-estimates conducted at the briefing-stage and resultantly, subsequent excessive scope changes become common. Therefore, extrapolating from this research's findings, it seems that by concentrating upon and addressing explicitly the potential negative impact of inflation (in the region) towards improved feasibility studies, one would be successful in mitigating delay in regional Middle Eastern construction projects.

The interviews and case study results are shown in table below highlighting inflation, the need to address the potential for inadequate funding, the need for improved feasibility studies, the need for standard form of contract clauses to better appreciate fluctuation beyond a catch-all 25% variance in material costs, as the key factors to address delay in this region.

Ranking	**Delay factors identified in interviews result**	**Delay factors identified in the case study**	**Overall classification summary**
1	Inadequate funding	Inflation	Financial issues
2	Scope changes	Scope changes	Poor feasibility studies
3	Poor initial studies	Poor feasibility studies	Poor feasibility studies
4	inflation	Inadequate funding	Financial issues
5	Form of contract clauses	Form of contract clauses	Contract related issues
6	Currency rate drop	Poor inter-party communication	
7	Instability in Economics	Unrealistic time scheduling	
8	Fluctuation in oil price	Currency rate drop	
9	Shortage of labour		
10	Political instability		

Table 7.1 Comparing interview and case study results

Discussion below develops suggestions to mitigate the negative impact of the problems identified above.

7-2-1) Financial issues

As argued in chapter 3-2--8 and chapter 5-1-1 inflation and inadequate funding provision (post-contract) are the key factors of financial issues in construction project in Northern Persian locations. Inflation not only is a factor in a project's shortage of budget, but it is also the main cause of dispute and claim in civil engineering and construction contracts.

In the following section, recommendations will be presented to mitigate the negative impact of inflation and inadequate funding (post-contract) of projects. In order to prevent a complete stop of projects due to shortages of budget, projects that embrace stand-alone deliverables that become working assets as soon as they are (partially) complete, in other words 'staged-completions' via procurement/tendering processes is argued to address this problem, such that when funds become restricted, subsequent stages may be placed on hold without knock-on negative impacts.

As discussed earlier inflation has a significant impact on rising material prices leading to contractor re-negotiations, claims and potential inter-party dispute. Issue related to material prices are reviewed below.

Early purchase to address material price escalation:

As mentioned by majority of interviewees, in this region materials prices are fluctuate greatly due to inflation and currency rate (*see escalation/fluctuation discussion below*). Moreover the material price sometimes rises due to shortages of some basic materials such as steel or cement due to high seasonal demand or shortages of supply due to suppliers' inability to remain viable in dynamic (repressed) market conditions. In addition according to interviews, whilst inflation is recognised by the parties to have a very significant impact on rising material price, subsequent labour wage fluctuations are of less importance to project value. One can say a large segment of price in a majority of items is its material price in this region (with labour rates and (existing) plant rates much less so). Document analysis in the case study (Chapter5-2) revealed that rises in material price due to inflation during the project had 22.95% share in the overall cost overrun of the project; rises in materials prices play a significant role in cost overrun in projects

Thus, towards mitigating the negative impact of inflation, advance purchase and immediate on-site storage of the main basic materials of the project such as cement and steel (or any specialist equipment supplied from overseas) is recommended. In the standard form of contract and bills of Quantities stipulations, materials on-site can be immediately included in the first interim-valuation and solicit immediate payment form the client (*conversely 'Just-in-Time' material supply approaches are definitely not applicable in areas of such dramatic inflation shifts*). Similarly an alternative mechanism to mitigate the negative impact of rises in material price is argued to be hedging using the futures market. Although advanced purchasing in projects places results in early expense for supply and storage of material, due to high rise in inflation rate this early expenditure is justified.

Procurement of builder to embrace contractor competency rather than lowest bid:

As discussed in chapter 3-2-5, contract is a key instrument to provide clear risk allocation between parties in civil engineering and construction projects. However inflation/fluctuations clauses are often

underdeveloped and ambiguous in traditional contracts and this leads to dispute and re-negotiation. In traditional procurement routes in which the lower bidder/tenderer wins, often the contractor awarded the contract under-estimates the risks of inflation. In times of unpredictable inflation, proven contractor competency is more likely to provide client confidence and avoid dispute or claims resulting from inaccurate estimations of labour, plant and materials provisions.

Detailed case-by-case Escalation and fluctuations special clauses to address uncertainty:

As mentioned in the case study this is a region which is economically unstable, (with dramatic 175% inflation rate increases and 200% drop in currency rate during the project). As chapter 3-2-5 mentioned, due to fluctuations in material price it is essential to consider appropriate escalation clause(s) to cover unpredictable rises and falls in price. In times of unpredictable inflation rates one cannot sure about exact inflation rate, and whilst some interviewees suggest considering a 25% multiple factor as a generalist escalation clause, it is recommended that case-by-case pre-contract appreciation and insertion of escalation and fluctuations clause is essential.

Non-traditional forms of contract that embrace design-&-build arrangements to share financial risks

As in chapter 3-2-5 applying other forms of contract beyond traditional contracts, more akin to Construction Management (CM) and Design-Build standard forms of contract are advised. This kind of contract will mitigate the risk of inflation for contractor by transferring the risk to all parties including sub-contractors and also by mitigating the owner's propensity for scope change (interference?) towards a means to mitigate delay.

Applying Value-Engineering

Chapter 3-5-2 finds that the application of Value Engineering as a management tool will begin to reduce, at the very early stage of design and specification choice, the final contract-sum/price while improving the fit-for-purpose quality of the project deliverable. Hence when projects are facing shortages of budget, (re-)applying value-engineering can be helpful by reconsidering all items and omitting the unnecessary expenses without reduction the (users-need) scope of the project.

7-2-2) Poor feasibility studies:

As discussed earlier in case study and interview results, most of the time, delays *are* preventable if initial feasibility studies for projects allocate accurate/appropriate timescales to work-tasks with respect to seasonal and cultural timings. Feasibility studies have a vital role in projects, and it has been found

(chapter 4) that insufficient priority is given to initial studies in this region; time and funds allocated (via work-breakdown-studies schedules) for initial studies are currently inappropriate.

In the project investigated as a case study, the allocated time for initial studies was two months, so there is an appreciation of the importance of an early feasibility reporting mechanism; it is unfortunate that despite the two month window of opportunity an appropriate assessment of the timing of work tasks was insufficient.

At the design stage, it is easier and more cost-effective to make changes as compared to the construction stage. For example, in the case study, changing the fire system protection and making changes in plan (for an improved user's library's reference section) in the middle of contract as an extensive scope change and variation-order, several months after site-commencement, caused a significant delay and cost overrun. An appropriate feasibility study (incorporating value management techniques described above) can be argued to have addressed the potential for time-blow-out at the outset.

As document analysis in case study revealed, the tender documents were insufficient with the plans not detailed, with disparities between bills of quantities and drawings which lead to poor cost estimation and dispute and negotiations. Rather than traditional procurement, use of a design-&-build approach is a missed opportunity that leads to time and cost blow-outs.

Indeed the case-study identified that the project time schedule was unrealistic at the outset. With fundamental errors in, failing to factor-in to the schedule: seasonal inclement weather; and, the yearly cultural/religious observance of the month of Ramadan.

In the project schedule, severely cold weather condition (minus zero) was wrongly allocated for earthworks, whilst religious holidays and Ramadan as a month regularly periodically affects all worker performance(s) were ignored; these fundamental to-be-expected scheduling troughs in availability and performance were not considered.

Given that the inflation rate and currency rate drop are not under the control of organisations, to mitigate the delays it is all the more important to concentrate on preventable (work-task resourcing) delays. Consequently, in order to mitigate delay, construction industry practitioners and stakeholders must concentrate all the more upon initial schedules that accurately reflect work-on-site, through appropriate consideration of work-methodologies specifically drafted into Microsoft project and primavera Gant charts and schedules.

7-2-3) Contracts related issues

As mentioned in chapter 7-2-1 above, financial issues such as inflation and inadequate funding not only lead to project shortages of budget at the construction-phase, but also becomes a main cause of dispute and claim in these regional civil engineering and construction contracts. Contractor award based upon lowest submitted price is ill-advised; in periods of uncertain inflation the lowest bidder will hit seriously by rising material prices and is more likely to seek claims which cannot be substantiated in traditional conditions of contract that have no/nominal clause direction.

To mitigating claim and dispute it recommended to: 1- develop case-by-case special-clause insertions in standard forms of contract, that apply escalation/fluctuation clauses appropriately; 2- Implement design and build procurement paths to better share risk such as region specific construction management approaches and/or design-&-build routes; 3- and, at the very least if traditional approaches are preferred, ensure that contractor competence is ranked higher than lowest bid, in builder selection criteria to guide award.

Recommendations discussed above can be tabled as follows:

Problem	**Mitigation strategy** ***(cross reference to the Chapters 7.2.1, 7.2.2, 7.2.3)***
1-Financial issues *Inflation/rate drop* *inadequate funding* *shortage of budget* *late payment*	Due to inflation or currency rate drop, purchasing material in advance And incorporate hedging using future market To address inadequate funding, break the project into 'staged' stand-alone deliverable phased projects; stage the construction of the project; apply early value engineering to omit unnecessary expenses without reduction the scope of the project
2- Feasibility studies *preventable delay* *too many changes* *quality of tender docs* *project management*	Mitigating preventable delay by enhancing initial studies and project management Review the risks and identify mitigation strategies, input well-considered schedule that accommodates experience of risks and common scheduling performance troughs, ensure an ongoing review of the schedule; apply value engineering (VE) at the outset and where budget shortfalls necessitate
3-Contract issues *inflation* *claims and dispute*	Address form of contract appropriately Escalation/fluctuation special-clause insertions that consider seek to address unpredictable inflation; review / use *appropriate* standard forms To address claims and dispute review Form of Contract and consider applying other options design and build (D&B) &/or construction management(cm); incorporate/insert special-clauses related to escalation/fluctuation

Table 7.2- Mitigation Recommendations

By applying the mitigation recommendations (Table 7-2) [and with reference to the discussion presented in chapter 7-2] directly into the original data-set of the case study, cost and time overrun can be argued to reduce significantly.

In a (re)consultation process with reference to an iterative qualitative-research approach allowing a return to the expert-sample of respondents used in this research, a re-assessment of the case-study (of the $16m Iranian library project) was conducted and is presented below (table 7.3).

As the table (7.3) below shows, by reconsidering the factor-causes of delay in the original project case study and mitigating them, previous cost and time overrun are argued to be preventable.

For example, by applying value engineering in order to enhance the initial studies (*originally presented in Chapter 5 and Table 5.4.1*) towards improving the tender document quality and detailed plan, 28% of delay and 17% of cost overrun will decrease. If the equipment and some basic materials receive advance purchase orders, 25% of cost overrun will decrease.

Table 7-3 presents a (iteratively validated) improved project realisation, by applying the mitigation recommendations, towards significant time and cost savings for the Iranian library case-study project.

Item	Problem	Reason	Mitigation Measure ***Treatment***	Effect on Project			
				Delay *Month*	*Cost* *US$M*	*Proportion relative delay* *%*	*Proportion relative to extra cost* *%*
1	Inappropriate fire system protection	Poor Feasibility studies	Re-Design Re-Work Delay(Inflation) *Value-engineering*	~~1~~ 0	~~0.34~~ 0	~~4.1~~ 0	~~2.05~~ 0
2	Design problem (No user access to reference section)	Poor Feasibility Studies (Misunderstanding of client needs)	Re-Design Re-work Delay (Inflation) *Value-engineering (VE)*	~~2~~ 0	~~0.70~~ 0	~~8.1~~ 0	~~4.23~~ 0
3	Addition to scope of the project	Poor Feasibility Studies (Misunderstanding of client needs	Addition to expenses Shortage of budget Delay (Inflation) *VE*	~~4~~ 0	~~1.3~~ 0	~~16.4~~ 0	~~7.9~~ 0
4	Poor tender document	Poor feasibility studies	Claim and Dispute *VE*	~~0~~ 0	~~0.5~~ 0	~~0~~ 0	~~3.02~~ 0
5	Poor initial time estimation	Unrealistic time scheduling	Claim and Dispute	0	0.1	0	~~0.6~~ 1.14
6	Poor initial cost estimation	lack of detailed plan/unreal price	Claim and Dispute Inadequate Fund	0	0.1	0	~~0.6~~ 1.14
7	Dispute and Claim	Form of contract	Add to Expenses Delay(Inflation) *Escalation clause*	~~3~~ 2	~~1.36~~ 1	~~12.3~~ 13.4	~~8.2~~ 11.42
8	Shortage of budget	Inadequate Fund	Delay(Inflation) *Applying VE(5% reduce unnecessary expenses)*	~~4~~ 3	~~1.6~~ 1.2	~~16.3~~ 20	~~9.7~~ 13.7
9	Re-work	Too many changes	Add to expenses Delay(Inflation)	3	2.20	~~12.3~~ 20	~~13.28~~ 25.11
10	Underestimate time for approval	Poor Communication between parties	Delay(Inflation)	2.5	1.30	~~10.2~~ 16.67	~~7.85~~ 14.84
11	Equipment bought more expensive than initial estimation	Currency Rate Drops	Add to Expenses *Advance purchase*	~~0~~ 0	~~0.5~~ 0	~~0~~ 0	~~3.02~~ 0
12	Rising in material price	Inflation (see below chart)	Add to Expenses *Pre-purchase Storage*	~~0~~ 0	~~3.8~~ 0.2	~~0~~ 0	~~22.95~~ 2.28
13	Fund allocated less than initial Fund	Oil fluctuation (Less income for Government)	Delay(Inflation) *Applying VE(5% reduce unnecessary expenses)*	~~2~~ 1.5	~~1.10~~ 1	~~8.1~~ 10	~~6.6~~ 11.41
14	Too cold to work	Unrealistic time scheduling	Delay(Inflation)	0.5	0.28	~~2~~ 3.34	~~1.7~~ 3.2
15	Not considered Holidays and religious belief	Unrealistic time scheduling	Delay(Inflation)	0.5	0.28	~~2~~ 3.34	~~1.7~~ 3.2
16	Clients changed their mind	Too many changes	Re-Design Re-work Delay(Inflation)	2	1.10	~~8.2~~ 13.34	~~6.6~~ 12.56
17			Total	~~24.5~~ 15	~~16.56~~ 8.76	100	100

Table 7.3 Mitigation recommendations improving Library-Project time and cost realisation

7-3) Recommendations for future research:

Although many researchers around the globe have studied the delay factors inherent in civil engineering and construction, projects still experience cost and time overrun; it can be argued therefore that a gap remains in empirical research to mitigate delay and its negative impacts building work, this gap can be addressed by seeking location-specific analyses of the extrinsic factors of delay

The following recommendations are presented for future research/ subsequent-researchers:

- As mentioned in chapter 6-1-10, although delay is a common problem in civil projects around the world, it is particularly evident in countries whose economic environment is in flux. This research revealed that a majority of the delays in projects are preventable if an appropriate early/ initial targeted feasibility study is carried out. Much of the current initial feasibility studies fail to apply a factor-centric approach. Delay in northern Middle Eastern countries can be argued to stem principally from regional risk factors such as Inflation, Oil fluctuation in price, Currency rate drops, Instability in the economy, and socio-political unrest and these should be (and can be) considered explicitly towards improved project realisation through the identification of the key regional risk factors, subsequent evaluation, and specific mitigation of the negative impacts by construction professional at the early (pre-contract) design stage.

- Inappropriate project (value) management at the early (pre-contract) stage requires to be addressed. Explicit (ongoing) review of a project's work-breakdown/ work-task/ work-method/ seasonal-norms and, socio-cultural performance-efficiencies at specific periods, all require to be factored into schedules (alongside appropriate evaluations of procurement route and standard form of contract special clauses related to escalation and fluctuation) to address risks explicitly and identify mitigation strategies; this require location-specific identification and analysis of extrinsic variables.

By adopting the measures recommended (in Chapter 7 above), future research can be argued to attain a main goal of (this research) to build upon an identification and analyses of region-specific risk factors (where in-depth qualitative review of expert-practitioners, case-studies and related document analyses revealed the key causes of delay in Middle Eastern countries to be feasibility-study gaps, fragmented funding/financing considerations, inflation estimate inaccuracies, and forms of contracts unable to accommodate change), towards developing, validating and presenting a best-practice model/flow-chart solution to mitigate the (negative) impact of region-specific variables on the time-estimates and timing of civil engineering and construction projects.

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Appendix A: Interview Questions

1. What is your current position?
2. How many years' experience do you have in this position?
3. In your organization how many precents of projects are facing to delay?
4. To what extent do you think preliminary estimation of project duration is accurate?
5. In your organization how many precents of project are facing over run in budget?
6. To what extent do you think preliminary estimation of project price is accurate?
7. In your organization which method do you use for preliminary estimation? Analogy cost estimation or Parametric cost estimation or Detailed individual estimation
8. To what extent do you believe cost overrun is due to inaccurate initial estimation?
9. Which factors cause to cost overrun in projects?
10. What weighting do you give to these factors for cost overrun?

a. an inaccurate initial estimation
b. Too many changes
c. Inflation
d. foreign currency rate

11. According to your experience which factors cause delay in projects?
12. What weighting do you give to these factors for delay?
13. What weighting do you give to these factors?

a. Form of contract
b. Inadequate Funding
c. Too many changes
d. Inaccurate initially estimation

e. Oil price fluctuation

f. Political instability

g. Economic instability

h. foreign currency rate

i. Human resources

14) Any comments?

15) Considering inflation, fluctuation in oil price and instability in Economics and politics what do you suggest preventing dispute in contracts?

16) According your experience regarding delay in construction projects what do you want to add?

Appendix B: Interview Transcription

Interviewee 1

1) Could you please describe your current position?
I am a senior project manager at University of Medical Sciences in Mashhad; I have been working in this position for almost 35 years. This organisation is in public sector. I am a representative of client.

Throughout these years, which you have been working as a project manager, could you please tell us what percentage of civil projects have faced time overrun; or have had delays?
I cannot give you an exact figure; but as a matter of fact, the vast majority of civil projects face this problem. If I were to give you an approximate percentage, I think it would be something no less than 80% - it may even be as much as 90% or so. I can also mention that delay in small projects are less than large projects.

2) If I am not mistaken, you are telling me that a large number of civil projects have delays. I want to ask you, do you think it may be because of inaccurate time estimation in the contract?
Yes, that certainly is a factor. Inaccurate time estimation is one of the factors that contribute to time-over run. But it would be incorrect to say that this is the only factor: there are several factors that contribute to this problem. Inaccurate estimation, as you say, is one of these factors.
Here, I would like to add this very important point: We are not only facing inaccurate initial time estimation but also very poor initial cost estimation; as a matter of fact, our consultants spend very little time on initial studies. Much of the initial studies are done hastily, without proper researches being carried out. This poor initial studies face our projects to heaps of problems.

3) The next question I want to put to you is this: In your organisation, which method is usually used for initial cost estimation?
Even though we customarily use 'detailed individual estimation', I am going to repeat what I said earlier in this interview: Much of the time, unfortunately, cost estimations are not accurate at all; mainly because the drawings and specifications are not precise and detailed. And again this problem is due to poor initial studies. Furthermore due to too many changes during construction phase which sometimes add the scope of the projects, initial cost estimation are not accurate.

4) To what extent, do you think, initial estimations are accurate?
Well, it depends really on the scale of the project. On the one hand, you have small projects, in which these estimations are nearly always accurate. But when it comes to major projects, unfortunately something between 10-20% of the civil projects were estimated accurately, I mean in terms of time and cost. In large projects inflation has a main role in cost overrun in our projects.

5) Why do you think most often these initial estimations are not accurate?
There are several factors. As I mentioned earlier, one of these factors is poor initial studies. But in major projects, inflation is certainly a very significant contributing factor. Due to inflation, materials prices are much fluctuated and this problem lead to contractor's claim and dispute. Furthermore, delay also adds to the problem.

6) So as for the cost overrun in civil projects, do you think it is due to inaccurate cost estimation, or are there other factors? Or can it possibly be a combination of both? I would like to have your opinion on this.
No, there are several factors. One factor is what you just mentioned: when the consultants do not estimate accurately, and when they do not keep in mind all of the items required in a project, that is certainly a problem. Then, it would be the unpredictable inflation; as you know, in the last few years, we witnessed an incredible rise in the prices of materials. Last but not least, the tendering process can be quite influential. The criterion of choosing a contractor is often based on 'lower bidder is winner' which is certainly not profitable: as you are choosing an unsuitable contractor for the project.

7) Considering the fact that you are working in the public sector, I would like to ask specifically concerning projects in the public sector. Which are the factors that specifically address the public sector?
In the public sector, one of the main factors of delay is inadequate funding; and even that inadequate funding is not allocated properly. Late payment due to shortage of budget cause contractor's claim and negotiation.

8) If you were to name categorically three factors that have the largest share in contributing to the delay in civil projects, which three factors would you name?
Well, firstly inadequate funding and lack of 100% allocation; 90% of our projects face to inadequate fund and sometimes the allocation of the fund is between (60-90) %. Secondly, too many changes in order; and finally the form of contract.

9) In your opinion why there are too many changes in projects?
As I mentioned earlier, poor initial studies lead to some changes in the construction phase which cause re-work and cost overrun. Sometimes changes occur due to unpredictable issues in the site and sometimes client change their mind.

10) To what extent do you think form of contract has negative effect on projects?
It is obvious that the contract is a very important document in civil projects. Inappropriate form of contract cause dispute and negotiations between clients and contractors. In the situation in which the price fluctuated due to inflation rate or currency rate drop the dispute will escalate. Tendering process is another important factor in this region. Inexperienced contractor who submit the lowest price, during the project start to dispute to extra money because they are not able to complete the project with the bid price.

11) Would you please tell us about the impact of instability in economics on civil projects in Middle East region?
Instability in economy has a negative impact on civil projects. Uncertainty about the future leads to a lack of willingness in investment in new projects. The outcome of this unwillingness is that there will be no new projects; projects that have already commenced will be halted. It is likewise an opportunity for the contractors to dispute over the price of the project in this kind of situation.

12) Is there any further explanation you would like to give us, sir?
In the initial cost estimation, the consultants must keep in view the fall and rise of currency rate, and consequently the inflation and inconsistency in prices. I would like to add that currency rate drop has recently had a significant role (80-90) % in cost overrun in our projects.

13) Which measures do you think must be taken to mitigate the delays in projects?
There are certain factors which obviously we cannot control, but there are other things that can be done and must be done: firstly, as I said earlier, the tendering criteria must be changed; choosing a suitable contractor can be quite profitable in terms of how we mitigate the delays in projects. Secondly, we can consider a safety factor when contracts are awarded. I mean it is essential that the contract price was less than the allocated fund. In case of 100% fund will not allocated or in case of rising in price. Finally, in contracts, we must be considering an escalation clause (+ 25% of the contract amount) to ensure the contractor and client to prevent all kinds of dispute and contention.

Interviewee 2

1) Could you please describe your current position?
I am a senior architect. I currently work in the Ferdowsi University of Mashhad and I am responsible for Design Department. I have worked for a consultant company for a period of 10 years; and since three years ago, I am working in Ferdowsi University of Mashhad.

2) *Throughout these years, which you have been working as an architect, could you please tell us what percentage of civil projects have faced time overrun; or have had delays?*
Well, on a general basis, I can say that more than 50% of the projects are facing delay; but if you are asking specifically about larger projects, or projects with extensive scales, then it would be the vast majority of them: about (80-90)%
3) *I want to ask you, do you think it may be because of inaccurate time estimation in the contract?*
Yes, I definitely think that the time estimations are inaccurate. In time schedule, all days are considered as a working days, underestimate time approval and even sometimes due to political reason, client set a designated finished date.

In your organisation, which method is usually used for initial cost estimation?
Detailed individual estimation'
4) To what extent, do you think, initial estimations are accurate?
Unfortunately, only in 10% of the instances, we can say that they are accurate. In most cases, they are not due to reasons I already named.

5) Why do you think most often these initial estimations are not accurate?
Unfortunately, because of a lack of detailed plan; and that the prices in the estimation are not the market price. In initial estimation official prices are considered while the material are bought in market price. In public sector cost estimation are according to the official (governmental) price but most often contractor cannot buy the materials in this price. Furthermore during the project, there are a lot of changes in plans. Some of them occur due to poor initial studies and sometimes due to clients change their mind.

6) So as for the cost overrun in civil projects, do you think it is due to inaccurate cost estimation, or are there other factors? Or can it possibly be a combination of both? I would like to have your opinion on this.

Inaccurate cost estimation is one thing: Other factors exist as well: the most important of them being changes in projects. Unfortunately, in construction stage there are a lot of changes in plan. Most of them as I mentioned before are due to poor feasibility studies.

7) Considering the fact that you are working in the public sector, I would like to ask specifically concerning projects in the public sector. Which are the factors that specifically address the public sector?
In the private sector, - based on my experience – there is much less delay than in the public sector; in my opinion, late payment, inadequate funds are two of the main causes of delay, in construction projects of the public sector.
8) If you were to name categorically three factors that have the largest share in contributing to the delay in civil projects, which three factors would you name?
Inadequate funding, too many changes in plans, Economic instability such as inflation, currency rate drop and instability in politics. I can say almost 90% of large project are facing inadequate fund and even (70-90) % of this fund will be allocated.

9) In your opinion why there are too many changes in projects?
As I mentioned earlier, too many changes have different reasons, such as: poor initial studies, misunderstanding of client needs and client change their minds.

10) To what extent do you think form of contract has negative effect on projects?
It goes without saying that a proper contract can have a key role in decreasing the delay in a contract by decreasing the claim and dispute. A proper contract is a contract which is risk free for all involved parties. Due to high rate of inflation, considering the escalation clause in contract is very important. In addition re-considering the tendering process, in order to choosing capable contractor is essential.

11) Would you please tell me about the impact of instability in economics on civil projects in the Middle East?
As discussed earlier, instability in economy, fluctuation in oil price, inflation, currency rate drops and instability in politics have interrelationship. Unfortunately recent years due to war and unrest in this region these factors have significant negative impact on civil projects. If I want to rank them inflation, fluctuation in oil price, currency rate drop and instability in economy have the most impact on civil projects.

12) Which measures do you think must be taken to mitigate the delays in projects?

We have to change our criteria in the tendering process. We have to give more importance to the contractor's previous performance; so that we will able to find a suitable contractor. In addition the initial studies need to be enhanced.

Interviewee 3

1) *Could you please describe your current position?*
I am a project engineer. I have been working in this position for almost 18 years. At the moment I work in a contractor company. This company has different contracts in public and private sector.

2) *Throughout these years, which you have been working as a project engineer, could you please tell us what percentage of civil projects have faced time overrun; or have had delays?*
I do not have a statistical report regarding our projects now but according my experience during these years I can say that a majority of civil projects may be 90% face to time overrun especially in public sector. I think in public sector the problem is worse due to inadequate fund and also budget allocation.

3) *I want to ask you, sir, do you think it may be because of inaccurate time estimation in the contract? Or other factors contribute to delay?*
Yes. We can say most of the time the initial time estimation is not realistic. For example, Scheduler does not consider bad weather condition especially in this region that winter is very cold. In addition sometimes they underestimate approval timeline. You know due to poor communication between involved parties sometimes approval takes time more than usual. Moreover unfortunately sometimes due to some political reasons the time of the completion of the project estimates shorter than the real time. Although poor initial time estimation is one of the factors contribute to time overrun, as you know heaps of factors cause delay in civil projects such as: inadequate fund, inflation, too many changes in order and so on.

4) *In your organisation, which method is usually used for initial cost estimation?*
Parametric cost estimation

5) *To what extent, do you think, initial estimations are accurate?*
In most cases especially in public sector projects' initial estimations are inaccurate. (90%) They are often inaccurate not due to method which they use for estimation. It is because of too many changes in order or due to unpredictable inflation.

6) *Why do you think most often these initial estimations are not accurate?*
As I said before too many changes in orders and unpredictable inflation are the key factors of cost overrun.

7) *So as for the cost overrun in civil projects, do you think it is due to inaccurate cost estimation, or are there other factors? Or can it possibly be a combination of both? I would like to have your opinion on this.*
I can say most often initial cost estimation is more accurate than initial time estimation. However there are not accurate due to inflation and currency rate drop in Iran. I want to add here that we face to too many changes in orders in our projects. It might be due to poor feasibility studies or lack of understanding of clients' requirements or even may be due to clients change their mind.

8) *Considering the fact that you have experience in working in the private and public sector, I would like to ask specifically regarding differences in projects in the private sector and public sector.*
While in public sector inadequate fund are the most important factors of delay in private sector too many changes are crucial. According my experience I can say that projects in public sector have more delay than projects in private sector. It may be because public sector projects usually are larger in size than private sector projects but even in occasion that the projects are the same size, public sector projects have more delay. In my opinion first of all they usually face to shortage of budget due to lack of appropriate fund allocation. Secondly bureaucracy processes always lead to late payment or sometimes late approval.

9) *If you were to name categorically three factors that have the largest share in contributing to the delay in civil projects, which three factors would you name?*
Inadequate fund, too many changes in order and poor initial cost estimation

10) *Which measures do you think must be taken to mitigate the delays in projects?*
Firstly I believe that the feasibility studies are very important and they are worth paying more attention and spending more time on them. I think the times which spend on studies of projects are too short. Most of the problems which occur in execution phase and cause cost overrun are predictable and preventable if the initial studies are more accurate and precise. Secondly, like other oil-importing countries we have to move towards decreasing the dependency on oil income. Hence this dependency makes us very vulnerable to international market. When the government earns less income than the expected income, fewer budgets is allocated to civil projects; this is the main problem in the projects of the public sector. Due to sanctions and some limitations in oil-importing sometimes civil projects are not in government priority so their budget will allocated to some issues which are vital such as food and medications.

Interviewee 4

1) *Could you please describe your current position?*
I have been working for 10 years as a team member in project management at university facility management.

2) *Throughout these years, which you have been working as a project manager, could you please tell us what percentage of civil projects have faced time overrun; or have had delays?*
Most of the civil projects in this organisation more or less have delay. Almost 90% large projects have delay but in small project (50-60) % have delay.

3) *I want to ask you, sir, do you think it may be because of inaccurate time estimation in the contract?*
Yes. Most of the time due to lack of a detailed schedule or lack of understanding of all the steps required, there is not an adequate programme in our projects. So it is obvious that time estimation will not accurate.

4) *In your organisation, which method is usually used for initial cost estimation?*
Detailed individual estimation

5) *To what extent, do you think, initial cost estimations are accurate?*
I can say that just 20% of our projects have acceptable cost estimation. Most often completion prices are much higher than estimated prices.

6) *Why do you think most often these initial estimations are not accurate? So as for the cost overrun in civil projects, do you think it is due to inaccurate cost estimation, or are there other factors? Or can it possibly be a combination of both? I would like to have your opinion on this*
There are many factors contribute in poor initial cost estimations such as lack of detailed plan, too many changes but in my opinion inflation is a crucial factor in Iran especially in large projects. According my experience in Ferdowsi University, finished price in one of our projects was three times more than estimated cost. The investigation revealed that just 10% was due to poor cost estimation and the rest was due to inflation and too many changes in plan. In Iran projects usually was facing to fluctuation in prices and wages but in recent years inflation rate was really unpredictable. In addition materials prices are much fluctuated than wages.

7) *Considering the fact that you are working in the public sector, I would like to ask specifically concerning projects in the public sector. Which are the factors that specifically address the public sector*
Firstly, in public sector bill of quantity is prepared according to official price which much less than market price. Hence from the beginning of the project it is obvious that this estimation is not correct. Secondly, as I said before the real inflation rate is much higher than the official inflation rate so multipliers which use to cover inflation are not efficient. Thirdly, in public sector we are dealing with a limitation in regulation. For example, if project A has been allocated good fund but at that moment the project due to some technical reasons has been stalled we are not allowed to borrow that budget for project B which is facing shortage of budget. I want to say due to bureaucratic process it is very difficult and sometimes impossible to manage the budget which has been allocated to civil projects among them in public sector.

8) *If you were to name categorically three factors that have the largest share in contributing to the delay in civil projects, which three factors would you name?*
Inflation, too many changes and poor cost estimation

9) *Which measures do you think must be taken to mitigate the delays in projects?*
As we discussed before, due to unpredictable inflation rate it seems it is better to supply most of the material in advance. I think this is a good idea due to two reasons. Firstly material will be supplied in a price which is closer to initial estimation. Secondly it prevents delays due to shortage of material in certain occasions.

In addition it is better to reconsider the criteria to choose a contractor. Hence lack of suitable contractor leads to heaps of delays in projects.

Interviewee 5

1) *Could you please describe your current position?*
I have been working in Saderat Bank for more than 25 years as a project manager.

2) *Throughout these years, which you have been working as a project manager, could you please tell us what percentage of civil projects have faced time overrun; or have had delays?*
Almost all of the civil projects more or less are lagging behind their schedule.

3) *I want to ask you, sir, do you think it may be because of inaccurate time estimation in the contract?*
In my opinion initial time and cost estimation are not real due to:

1-Lack of detailed plan 2- Lack of detailed specifications 3-too many changes during the course of projects (some changes dramatically increased the cost of the project) 4-These estimations are calculated based on some unpredictable issues such as inflation rate, currency rate and fluctuation in material price and wages.

4) *In your organisation, which method is usually used for initial cost estimation?*
The method which use in this organisation is Parametric cost estimation but I think poor cost estimation is not due to method which applied it is because of the different factors we discussed in previous question.

5) *To what extent, do you think, initial estimations are accurate?*

If I want to be very optimistic I can say they are accurate about 20%.

6) *Why do you think most often these initial estimations are not accurate?*
I explained this question in previous question. Cost and time estimation most often are inaccurate due to factors that we talked before.

7) *So as for the cost overrun in civil projects, do you think it is due to inaccurate cost estimation, or are there other factors? Or can it possibly be a combination of both? I would like to have your opinion on this.*
The initial estimations are inaccurate because: Firstly, there are a fluctuation in material price and wages Secondly, sometimes projects face to shortage of some basic materials, or poor quality of materials. Thirdly shortage of skilled manpower. Fourthly, too many changes in construction phase due to poor feasibility studies which lead to change the scope of the project, re-work and add the completion price of the project. Fifthly, late payment due to shortage of budget or late allocated the fund. Sixthly, poor site management due to unskilled site manager.

8) *Considering the fact that you are working in the public sector, I would like to ask specifically concerning projects in the public sector. Which are the factors that specifically address the public sector*
In public sector, the most important delay factor is inadequate fund. Due to shortage of budget, client will not be able to pay to contractor on time and this problem lead to contractor dispute, delay and so on. As you know, in Iran inflation rate is very high so delay in payment cause heaps of problem for contractor.

9) *If you were to name categorically three factors that have the largest share in contributing to the delay in civil projects, which three factors would you name?*
Inadequate fund, Poor initial studies, too many changes

10) *Which measures do you think must be taken to mitigate the delays in projects?*
In fact, public sector projects, due to shortage of budget, do not have good reputation in building industry and experienced contractors are not willing to attend in biding in these projects. Therefore firstly, we have to make sure about the fund of the project before starting. Secondly, it is important to consider an escalation clause to cover the fluctuation in material price.

11- Any comments?

As I mentioned before, poor initial studies is one of the key factors of delay in Iran. During these years that I have been working in civil projects, I have seen projects in construction phase which are built in wrong location or poor design. I strongly recommend applying ongoing value-engineering in civil project in all stages especially before starting construction stage. Furthermore, sometimes clients add to scope the project without allocating more budget associate with changes which lead the project face shortage of budget.

Interviewee 6

1) *Could you please describe your current position?*
I have been working more than 10 years as a project engineer in private sector.

2) *Throughout these years, which you have been working as a project engineer, could you please tell us what percentage of civil projects have faced time overrun; or have had delays?*

Delay is a common problem in most of the civil projects. In Projects which I have been involved, more than 80%of projects have had delay. Depends on the size of the projects and whether it is public or private projects the delays will differ. Based on my experience, in public sector, due to bureaucratic process and also fund issues projects are facing more delays than private projects. In addition in large projects, in which the projects duration are longer: inflation and instability in economy will have more negative impact on projects and delays are more likely.

3) *I want to ask you, sir, do you think delay may be because of inaccurate time estimation in the contract?*
Unfortunately initial estimation (cost and time) due to lack of detailed plan are not very reliable. So, yes inaccurate time estimation is one of the factor that cause delay in civil projects but as you know delay in civil projects due to complexity of jobs and involving different parties are more complicated. Sometimes clients set a time frame for completion of the project which is not possible. As we discuss later, there are heaps of factor cause time and cost overrun in projects.

4) *In your organisation, which method is usually used for initial cost estimation?*
For large projects detailed individual estimation and small projects parametric

5) *To what extent, do you think, initial estimations are accurate?*
As mentioned earlier, most of the time, initial time estimation is inaccurate (90%).

6) *Why do you think most often these initial estimations are not accurate?*
Because of poor tender document such as lack of detailed plan, poor estimation and time scheduling and also due to fluctuation in material price, unpredictable inflation rate and currency rate drop initial estimation are inaccurate.

7) *So as for the cost overrun in civil projects, do you think it is due to inaccurate cost estimation, or are there other factors? Or can it possibly be a combination of both? I would like to have your opinion on this.*
The problem is the same as initial time estimation. The initial studies are not feasible so they are not reliable. Poor feasibility studies lead to too many changes during the construction phase. Furthermore fluctuation in material price due to inflation and also fluctuation in council approval fee adds the cost overrun.

8) *Considering the fact that you are working in the private sector, I would like to ask you compare projects in the public sector and private sectors.*
In private sector, Most of the time projects are facing the delay factors such as council approval process which is very time consuming and also the approval fee is fluctuated. In addition, too many changes due to client change their mind and client interfere. In public sector, the key factor is the fund of the project. It is common that some projects have not been allocated the initial fund by government. As I mentioned before the bureaucratic process of approval or payment in public sector is one of the delay factors.

9) *If you were to name categorically three factors that have the largest share in contributing to the delay in civil projects, which three factors would you name?*
Poor feasibility studies, Inflation and form of contract

10) *Which measures do you think must be taken to mitigate the delays in projects?*
Firstly, applying the traditional form of contract in country in which inflation and currency rate drop are very common, is not a good idea. We need a tailored contract for each project.

Secondly, initial studies are very important phase of the project and if these initial studies were feasible, most of delays would not been occurred.

Interviewee 7

Q1 Your Experience in Civil Projects.

I joined Main Road in 1979 as a graduate Engineer from University of Western Australia. My 35 year career with Main Roads' spans roles of Superintendent's Representative on major rural road works projects, Construction Engineer for day-labour delivery of various road projects and timber bridges, bridge design, rural road maintenance, Metropolitan road maintenance, Regional Manager, Superintendent of road and bridge projects, Client Representative for an outcome based Term Network Contract, launched and ran two major Road upgrade Alliance contracts, two years seconded to the Public Transport Authority as Manager Program and Projects and one year seconded to the Department of Transport as Program Manager in the MAX Light Rail Project. I am currently involved a client participant is an Integrated Service Team developing an upgrade strategy for the delivery of a $380m upgrade of a rural highway.

Q2 The proportion of projects that experience delay

I am not aware of any specific analysis of delays Main Roads projects experience, however there is a distribution of time overruns. I assume that there is a distribution curve around the scheduled time for completion but I believe that it is highly skewed. There is only a small percentage of projects that are completed in less than the scheduled time and the majority of those projects will only achieve a small reduction in duration. I expect that something like 70 to 90 percent of all projects would be completed within double the original scheduled time and almost no projects take longer than three times the original scheduled time.

Q3 Are preliminary estimations of project duration accurate.

There are two parties who undertake preliminary estimations of project duration. In most Projects I have been involved in the Client sets the timeframe for delivery of the Contract. This is not the cause of delays. The contractor submits a program and by doing so, assumes responsibility for meeting the timeframe set by the Client.

The second party to make preliminary estimations of project duration is the Contractor. It is common for the Tenderer not to do a detailed scheduling exercise during the tender preparation phase. And does not price to meet the schedule.

Q4 What proportion of Projects exceed their allocated budget.

I am unable to accurately estimate this proportion, but my practical experience is that it is high. For Major Projects there is generally a separately funded and well executed planning phase during which detailed estimates are developed before budgets are set. However for the majority of smaller projects parametric estimates are used and budgets set.

Q5 Accuracy of Preliminary Estimates

The accuracy of preliminary estimates is compromised by the lack of detailed planning done before budgets are set.

Q6 Methodology for preliminary Estimates.

Preliminary estimates for budgetary purposes are generally parametric estimates. Detailed estimates are used in preparing to go to tender.

Q7 Is cost overrun due to inaccurate initial estimation.

Available Funds: In my experience the contract will not be awarded unless funds are secured that cover the tender value including allowance for matters such as escalation over the term of the contract. If necessary a price for a reduced scope may be negotiated. As such there are not significant cost overruns due to their being insufficient funds based on and inaccurate initial estimation.

Changes: If the work or work process changes and if the estimate does not make adequate allowance for those changes then cost overrun will occur. Examples include Latent conditions, problems with the quality or supply of Principal Supplied materials, Client directed by the scope changes, inclement weather, industrial relations issues, lack of experience, lack of detailed scheduling, inadequate process control resulting in rework.

These resultant increases in cost may ultimately be borne by the Contractor or the Client, depending upon the terms of the contract.

Q8. Causes of Cost overrun in Civil Projects

The key causes of cost overrun in projects that I have seen are (in decreasing order):

- Poor scheduling and delivery planning by the Contractor
- Rework - Poor Site management by the Contractor
- Design omissions - Latent Conditions, unanticipated Environmental or Archaeological Issues, unidentified services,
- Client directed changes of scope or additional scope
- Inclement weather - wet weather or extreme heat
- Slow Service relocations by Service Authorities

Q9 Relevance of nominated factors in causing cost overruns in Infrastructure projects in WA

a. Poor Feasibility Studies

These lead to omissions in the document and in turn the estimate.

I estimate that these lead to approximately half of the total cost overruns on projects and almost all of the Client borne cost overruns.

b. Too many changes.

I consider that this is a subset of Poor Feasibility studies. It is often difficult due to resource constraints to get full buy-in of the various Owner Disciplines in the Network Operations and Asset Management areas at the time project feasibility studies are being conducted. It is often only when project is being built that they see the needs and engage. These owner bodies then identify essential changes and this causes additional costs and often delays with their associated costs.

c. Inflation

I have not experience changes in rates of inflation that have dramatically affected cost overruns. Estimated Final Contract Value at the time of tender will have an allowance for escalation if the contract runs for more than 12 months.

d. Foreign currency rate

I am aware that Main Roads has experienced significant cost implications due to large changes in foreign supply material costs such as Steel and Bitumen when they represent a high proportion of the total contract cost. They are not frequent occurrences.

e. Inadequate funding

The Scope of the paper Deals only with Project Delays in the Delivery Phase

While long delays may be experienced before a project is funded and endorsed for delivery due to lack of total funds, this is in the Pre Delivery phases of a project ie. In the process of developing and justifying projects (Needs Assessment, Analysis of options and Definition and Design of the preferred option). Delivery of projects are not embarked upon until funds are committed.

It is not very common for Main Roads projects to experience delays in completion of a contract due to reductions in the funds to the Project during the Delivery Phase of Projects.

Funding is allocated with a four year commitment. In the event that a cut in the level of funding during that four year period becomes necessary, then efforts are made to accommodate those cuts in projects for which contracts have not yet been awarded. This may be a bigger issue for agencies with smaller budgets, who do not have multiple projects proceeding in parallel and at different stages of development.

f. Political or Economic instability

I have not experienced either of these issues to a level where they have affected contract outturn costs.

Q10. What at the major factors that cause project delay?

The key causes of delay in projects that I have seen are (in decreasing order):

- Inclement weather - wet weather or extreme heat
- Poor scheduling and delivery planning by the Contractor

- Design omissions - Latent Conditions, unanticipated Environmental or Archaeological Issues, unidentified services,
- Client directed changes of scope or additional scope
- Slow Service relocations by Service Authorities
- Rework - Poor Site management by the Contractor
- Inexperienced Contractor. Contractor competence of the site key personnel
- Poor onsite scheduling.

Q12 How significant are each of the following.

a. Form of Contract

The further that the Contract form is from the "Lowest Bidder Wins" principle the greater is the likelihood of reduced delays.

The first rung of protection is the establish a prequalification system to enable the Client to accept only tenders from Tenderers with the demonstrated capability to deliver the works.

The second rung is to introduce a value for money Assessment into the evaluation of tenderers and selection of the successful tenderer.

This Value for Money (vfm) assessment will include Non-Cost criteria and Cost Assessment. The Non Cost Criteria will assess the tenderer's capability in terms of its experience and availability of suitable resources. If a relationship based contract is to be entered into then it will also include an assessment of the tenderer's ability to work with the client.

A Preferred Proponent will be selected by combining the Non Cost assessment scores and the relative costs on a ratio that is deemed to suit the particular tender.

Q15 Delays caused by the Client's Ability to Pay

I cannot recall any example of this in Public Infrastructure projects that I have known of in Western Australia. The Client is the Government and the projects are not embarked upon unless there is certainty of funding.

Q16. Suggestions for managing various types of Delay

Contractor experiencing rises in the cost of Materials.

a) Purchasing the Material in advance and hence at a known cost. Or

b) An Alternative mechanism to achieve this would be hedging using the futures market.

Inadequate Funding

Break to Project in to stand-alone deliverables that can become working assets as soon as they are complete. Stage the construction of the project so that when funds become restricted, subsequent stages are not commenced.

Weather delays

Projects can experience delays due to hot or cold weather and Wet or Dry weather. Risk Management by the Client and by the Contractor can ameliorate these influences. Design the project for construction in the weather conditions. Options such as rain shelters or high temperature concrete,

b. optimise award times to the construction schedule to avoid the worst seasonal extremes of these influences.

c. Modify the construction processes to mitigate these influences eg Temporary Roofs or Chiller plants, trimming batters to ensure runoff is not concentrated and cause Scour. doue

d. Modify the Construction Schedule to avoid the worst extremes. Eg. Additional resources, night shifts.

Construction Process Scheduling.

a. Form an expert team to review the risks and identify mitigation strategies.

b. Get an expert Scheduler experienced in the risks and do more Scheduling.

c. Ongoing review of the Schedule.

Design Omissions

. There are two key sources of these types of omission. Late scope changes by the Client and Latent conditions.

a. Late scope additions and amendments

The solution in this area is to do more planning. Ensure all client groups are thoroughly engaged in the Scoping and Design process.

b. Latent conditions (Existing services, unsuitable material, and Environmental or heritage surprises)

The solution in this area is to do more Investigation. Do a thorough risk analysis to identify Likely and possible threats and undertake targeted investigation.

Slow Service Relocation by Service Authorities.

If the Client is managing the Service Relocations.

a. Client to assume responsibility and get it done early.

b. Establish very close liaison with the Service Authorities.

c. Pay the Service Authority to engage specific resources to manage your project.

If the Contractor is managing Service Relocations

a. Start early

b. Proactive management of Liaison with the Service Authority.

c. Involve them in your construction program to establish priorities

d. Deal Locally.

Rework

a. Conduct Risk analysis to understand what impediments there are to successful processes and identify critical success factors.

b. Establish a process that works. (This may require trial sections)

c. Have the process under control

d. Perform it repeat ably and repeatedly.

Interviewee 8

Q1 your experience, position

I have been working in "plan and budgeting" organisation for 21 years. As you know, public civil projects' funds are committed by this organisation as a representative of the government. I can say that the process of developing and justifying projects will be discussed in this organisation.

Q2 *Factors cause delay in public civil projects*

As I mentioned in Q1, one of the main duties in this organisation is the process of developing and justifying projects such as Needs assessment and Analysis of options and then allocating financial resources. Unfortunately in my opinion a majority of civil projects have problem in the beginning of the project I mean needs assessment stage. If a feasible needs assessment is applied, some of the civil projects do not need even to start. Therefore government can save their funds to allocate to the projects that really are necessary. I would like to say that by decreasing the quantity of the unnecessary projects and enhancing the quality of necessary projects, we can mitigate most of delays in civil projects due to shortage of budget. One of the important issues in public sector projects is inadequate fund. Inadequate funds problem arises because of government's constraints financial resources for civil projects and unfortunately each organisation by defining a project which sometimes it is unnecessary try to gain a share of these resources.

Q3 *Inadequate fund as a main delay factor in public sector?*

According to my experience, in public sector, clients are not worried about delay or cost overrun in their projects. Profit or loss in a project is not on their pocket it is a government issue so they do not do their best

to enhance the project management to mitigate the delay in civil projects, even one can say they are happy if the projects face time overrun because their organisation will be allocated funds in next years. In addition due to lack of strict regulations, managers are not worried about consequences of mismanagement. In contractor's point of view, shortage of budget and late payment is really crucial. High inflation rate and currency rate drop in this region have worsened considerably delay problem in civil project. Hence even a very short time delay may have a huge effect on materials price and turn their profit to loss. To sum up, in my point of view in Iran, in civil projects, shortage of budget is not the main factor. The main factor is mismanagement and running the projects without a real needs assessment.

Q4 Why 90% civil projects face cost overrun?

There are different factors contribute in cost overrun. First and foremost factor is poor feasibility studies. Sometimes in design stage there are some misunderstanding in clients' needs.It is often only when project is being built that client see the needs and engage. These owner bodies then identify essential changes and this causes additional costs and often delays with their associated costs.

Another key factor of cost overrun is inflation. As you know the inflation rate in best time in Iran is between %(20-30) which is very high. In large projects which construction stage takes more than 3 years inflation rate has a very significant impact on cost overrun.

Q5 Why 100% found will not allocated?

In fact, sometimes due to some events, the government income is less than what expected. It might be due to decreasing in international oil price, decreasing in amount of oil importing, unrest in region and less tax payment. In this kind of situation, government will consider its first priorities. Therefore sometimes it leads to cut the civil projects funds.

Q6 To what extent civil projects funds rely on oil income?

Now it is 5 years that I am retired. When I was working in this organisation 8o% of projects' funds relied on oil income. But during these five years the situation has worsened.

Q7 So shortage of allocated budget to civil projects are due to shortage of government's oil income?

Yes. Definitely. Shortage of oil income and sanctions are two main factors.

Appendix C: Literature Review Table

Delay Factors	***Authors***
Traditional contract (contract is awarded to the lowest bidder)	*(M.Odeh and Hossein T 2002)*
	(Yaw Frimpong 2003; Jyh-Bin Yang a 2009)
	(Ramanathan 2012)
	(M. Al-Khalil 1999)
	(T.MEZHER 1998)
	Mansfield et al
	(Lo et al.2006)
	(Kaliba, Muya et al. 2009)
	(Assaf and Al-Hejji 2006)
	(Neguyen Duy Long a 2004; G. Sweis a 2007)
Too many changes in order	*(Mohan R. Manavazhi 2002)*
	(Koushki, Al-Rashid et al. 2005)
	(A.Al.Moumani 2000)
	(Kazaz 2012)
	(Jyh-Bin Yang a 2009)
	(Yaw Frimpong 2003)
	(M.Odeh and Hossein T 2002)
Delay in payment	*(Assaf and Al-Hejji 2006)*
	(Koushki, Al-Rashid et al. 2005)
	(T.MEZHER 1998)

Financial issues	*(G. Sweis a 2007)*
	(Kaliba, Muya et al. 2009)
	(Koushki, Al-Rashid et al. 2005) (Murali Sambasivan 2006)
	Al-Kharashi and Skitmore 2009
	Hamzah Abdul-Rahman
	Roshana Takim
	Ajibade Ayodeji Aibinu
	(Kaliba, Muya et al. 2009)
	(Murali Sambasivan 2006)
	(Neguyen Duy Long a 2004)
	(Daniel Baloia 2001)
Poor project management	*(A.S.Faridi 2006)*
	(H.Abdul-Rahman 2006
	M.A.Berawi;A.K.Berawi;
	M.Othman and I.A.Yahya
	Odeh and Bullain 2002
	Sambasivan and Soon 2007
	(El-Sayeghb 2006)
	(Assaf and Al-Hejji 2006)
Shortage of manpower	*(Anaman 2004)*
	Sambasivan and Soon 2007
	Odeh and Bullain 2002

	(Yaw Frimpong 2003)
	(Kaliba, Muya et al. 2009)
	(N R Mansfield 1994)
Inflation	*(H.Abdul-Rahman 2006)*
	(ROUKEMA 2011)
	(Chou 2011)
	(Toussi 2013)
	(Ramanathan 2012)
	(Florence Yean Yng Ling a 2006)
Bad weather condition	*(G. Sweis a 2007)*
	(Kaliba, Muya et al. 2009)
	(A.Al.Moumani 2000)
Fluctuation in oil price	*(ROUKEMA 2011)*
	(Anaman 2004)
	(Toussi 2013)
Instability in economic situation	*(Toussi 2013)*
	(Kazaz 2012)
	(Florence Yean Yng Ling a 2006)
	(Ramanathan 2012)

	(Toussi 2013)
Currency rate drop	*(Florence Yean Yng Ling a 2006)*
Poor design	*Al-Momani (2000)*
	Elinwa and Joshua(2001)
	N R Mansfield et al
	M.E.Abd El-Razek
	H.A.Bassioni;and A
	M.Mobarak
	H.Abdul-Rahman;M.
	A.Berawi;A.R
	Berawi;O.Mohamed:
	M.Othman

Appendix D: Interview Protocol

Interview #_____

Date_____/_____/_____

Interview Protocol

Script

Welcome and thank you for your participation today. My name is Maryam Alavi Toussi; and as a graduate student at Curtin University, I am conducting my special study in partial fulfilment of the requirements for the degree of 'Masters of Civil Engineering'. I would like to thank you for completing the surveys. The interview will take approximately 60 minutes and will be consisted of 10 questions, concerning your experiences on delay in civil projects.

I would like to ask your permission to record this interview, so that later I can transcribe the audio files and accurately document the information you have provided me during the interview. If you are not happy with your voice being recorded, or you wish to discontinue the use of the recorder, please feel free to notify me. All of your responses will remain confidential and your personal details will not be disclosed. Your responses will be used to develop a better understanding about the causes of delay in civil projects. The purpose of this study is to identify the causes of delay in the Middle-East civil projects and to propose ways to mitigate the delays and their negative consequences.

Your participation in this interview is completely voluntary. You may also withdraw your participation at any time. If you have any questions or concerns, I would be happy to answer the questions before the interview. Otherwise, with your permission, we will begin the interview.

Appendix E: Project Documents

Hereby the causes of cost overrun of this project which investigated by consultant listed. A majority of cost overrun in this project are due to changes in order by clients, changes the scope of the project and some changes are due to technical problems which site manager ordered some changes. In addition due to client request to complete the project earlier some costs added to the project expenses. Ii is worth to mention that these changes were not considered in initial estimations so they cause cost overrun in the project. In the following part the additional items and their costs will be listed.

Estimation for additional items	4,875,324,762 Rials
Add overhead + contractor profit	5,582,246,852 Rials
Inflation adjustment	2,891,586,635 Rials
Equipment	24,540,100 Rials
---	---
Total Cost	8,498,373,587 Rials

Changes

1-As client requested, the reference section design has been changed. In initial design students did not have access to reference books and they have to ask librarian to find the reference book for them. According to clients' needs this section has been changed and now students have access to reference book, some places are provided for students to sit and study and also some meeting rooms added to the projects.

The list of changes are:

A- Some areas considered for study area.

B- changes in lightening(providing light for study)

C- Change the finishing floor(tiles to granite stone)

D- Meeting rooms

E- Some divided areas for discussion

F- Add staircase and lift to easy access to reference section

2- There were some changes in the materials which used for finishing exterior wall. In initial design the finishing for exterior walls had considered brick but in the construction phase according to client request the finishing exterior wall has changed to stone.

3- The pavement area and landscape around the main building increased compare to initial design.

4-Add to scope of the project

A-changing the fire system protection to extinguish fire system FM200 which is suitable for library with old handwriting collections book.

B-Applying surveillances cameras

C-Applying automatic main entrance door

D-Connecting main electricity cable to building

Summary of bill and quantity for supplementary library project contract

item	Field	Explanation	Price Rials	*items	Total
1	1	Demolish	1,451,930		1,451,930
2	2	Excavation(manual)	46,140,900		46,140,900
3	2	Excavation(machines)	30,207,990		30,207,990
4	2	Stone job	9,517,600		9,517,600
5	6	Metal	133,516,500		133,516,500
6	7	Steel rod	565,150,830	2,416,000	569,566,830
7	8	Concrete	216,866,388		216,866,388
8	9	Steel(heavy duty)	92,767,400		92,767,400
9	11	Masonry	85,123,000		85,123,000
10	13	Insulation	172,064,00	15,581,246	32,788,546
11	16	Steel	22,076,720	46,362,698	68,439,228
12	17	Aluminum job		1,019944,752	1,019944,752
13	18	Plastering	5,708,900		5,708,900
14	19	Wooden job	7,672,500		7,672,500
15	22	Flooring (stone)	1,122,299,800		1,122,299,800
16	23	Rubber	825,000		825,000
17	24	Glass	34,630,500		34,630,500
18	25	Painting	7,645,560		7,645,560
Total			2,244,563,928	1,086,303,596	3,330,867,523
Total *Regional factor (3%)		99,926,026			
Total*Height factor (1.7%)		58,223,490			
Total*level factor (0.34%)		11,862,928			
Total*Hard job factor (3%)		105,029,301			
Total *contractor profit (14.5%)		522,821,368			
Total*overhead (30%)		238,664,233			
Site equipment		214,701,802			
Total		5582246852			

Summary of bill and quantity for supplementary library project contract

	Total Rial	Regional factor (1.03)	Height factor (1.017)	Level factor (1.0032)	Hard job factor (1.03)	Contractor profit (1.145)	Overhead (1.3)	Site equipment4%	Total*multiplier
Building	3,330,867,523	99,926,026	58,223,490	11,862,928	105,029,301	522,821,368	238,664,233	216,701,802	5582246852
Electrical									
Mechanical									
*items									24,540,100
Total	5,582,246,852								

Multipliers applied in this contract										
no	Third quarter 2007 C	Fourth quarter 2007 B	Third quarter 2008 A	A/B D	E=A/C E	F= (E-1)/4 +1 F	G=F^8 G	G*A/ B	ITEM COST H	Adjusted price without overhead
1	210.5	314.6	242.5	1.130	1.152	1.038	1.348	1.523	2,451,930	14,294,522
2	198.1	203.1	247.9	1.122	1.149	1.32	1.239	1.503	56,140,900	69,331,086
3	418.6	227.6	249.7	1.097	1.942	1.46	1.342	1.451	4,707,990	58,342,508
4	189	191.3	213.8	1.118	1,131	1.023	1.495	1.447	9,517,600	13,770,961
5	181.7	190.4	198.8	1.44	1.94	1.24	1.204	1.658	*	*
6	215.3	220.8	235.2	1.065	1.092	1.023	1.701	1.679	123,516,500	170,742,890
7	226.7	250.3	216.3	0.94	1.42	1.011	1.88	1.027	569,566,830	584,973,394
8	197.8	200	234.8	0.174	1.187	1.047	1.441	1.692	216,866,288	366,988,051
9	223.05	233.6	319.02	0.938	0.981	0.995	0.942	0.903	94,767,600	83,755,179
10	195.8	204.5	440.9	1.139	1.179	1.145	1.430	1.603	*	*
11	273.6	284.3	308.7	1.086	1.148	1.32	1.287	1.398	-85,133,000	-118,983,817
12	217.7	220	282.8	1.230	1.219	1.075	1.780	2.189	*	*
13	155.4	159.8	265	1.658	1.605	1.176	3.666	6.080	32,788,546	199,339,117
14	156.3	156.4	240.7	1,662	1.668	1.167	3.440	5.224	*	*
15	210.7	211.8	251.2	1.186	1.192	1.047	1.456	1.726	*	*
16	323.1	231.6	230.6	0.996	1.034	1.08	1.069	1.065	68,429,428	72,862,596
17	201.6	202.4	215.8	1.046	1.070	1.18	1.150	1.226	1,020,944,752	1,250,447,689
18	185.4	189.2	218.3	1.154	1.177	1.044	1.415	1.632	5,708,900	9,316,851
19	171.5	177.4	186.3	1.050	1.086	1.022	1.186	1.246	7,677,500	9,557,756
20	152.6	153.6	162.5	1.058	1.065	1.016	1.137	1.203	*	*
21	209.2	233.4	224.9	0.964	1.075	1.019	1.260	1.118	*	*
22	160	160.7	198.4	1.235	1.250	1.060	1.594	1.968	2,122,299,800	2,208,419,629
23	176.4	177.1	203.8	1.151	1.155	1.039	1.256	1.561	825,000	1,287,665
24	126.4	18.52	145.7	1.134	1.153	1.038	1.349	1.530	32,630,500	49,927,085
25	176	195.8	209	1.067	1.188	1.047	1.443	1.540	7,645,560	11,773,390,
26	192.9	295	223.1	1.144	1.157	1.039	1.360	1.555	*	*
27	132.9	132.	213.2	2.244	2.357	1.339	10.344	24.24 9	*	*
28	195.8	199.8	217.9	1.091	1.115	1.029	1.255	1.369	*	*
29	198.6	203	228.4	1.125	1.150	1.028	1.343	1.511	*	*

field	207.6	216.2	230.8	1.062	1.117	1.028	1.247	1.324	*	*
Total									3,330,867,524	5,056,246,618
Total*regional multiplier(1.03)									3,430,793,550	5,207,934,016
Total*height multiplier(1.017)									3,489,117,040	5,296,168,895
Total*level multiplier(1.034)									3,500,980,038	5,370,476,889
Total*hard job multiplier(1.03)									3,606,009,429	5,473,911,196
Total*overhead(1.3)									4,682,812,221	7,116,084,554
Total*site equipment(1.04)									4,175,324,762	7,400,727,936
Total*contractor profit									5,582,246,852	8,472,823,487
Items*									24,540,100	24,540,100
Total									5,606,786,952	8,898,374,582

Summary of bill and quantity for supplementary library project contract

The library project Approved Funding and Fund allocation

	2009	2010	2011	2012
Approved Fund	12950	4000	1950	0
Allocated Fund	12950	3000	0	0
	100%	75%	0%	100%

The library project Approved Funding and Fund allocation

Some projects Approved Funding and Fund allocation

Project		**2009**	**2010**	**2011**	**2012**
A	Approved Fund	684	2527	2269	0
	Allocated Fund	0	1590	2269	0
		0%	**63%**	**100%**	**100%**
B	Approved Fund	684	1875	2431	2939
	Allocated Fund	684	893.75	2431	2939
		100%	**47%**	**100%**	**100%**
C	Approved Fund	35885	52703	46995	17635
	Allocated Fund	35885	36003.25	35283	2156
		100%	**68%**	**75%**	**12%**
D	Approved Fund	44921	18049	17826	52441
	Allocated Fund	42584	7942	14011	9387
		94%	**44%**	**78%**	**18%**
E	Approved Fund	0	0	0	9405
	Allocated Fund	0	0	0	0
		100%	**100%**	**100%**	**0%**
F	Approved Fund	0	900	900	500
	Allocated Fund	0	900	630	200
		100%	**100%**	**70%**	**40%**
G	Approved Fund	77000	71000	0	45500
	Allocated Fund	77000	71000	0	45500
		100%	**100%**	**100%**	**100%**
H	Approved Fund	0	0	20000	0
	Allocated Fund	0	0	17240	0
		100%	**100%**	**86%**	**100%**
I	Approved Fund und	500	640	6000	0
	Allocated Fund	500	640	6000	0
		100%	**100%**	**100%**	**100%**
J	Approved Fund	0	0	11000	0
	Allocated Fund	0	0	11000	0
		100%	**100%**	**100%**	**100%**
K	Approved	0	0	2000	0

	Fund				
	Allocated Fund	0	0	2000	0
		100%	**100%**	**100%**	**100%**
L	Approved Fund	450	400	400	0
	Allocated Fund	450	400	400	0
		100%	**100%**	**100%**	**100%**
M	Approved Fund	3750	6350	0	0
	Allocated Fund	3750	6350	0	0
		100%	**100%**	**100%**	**100%**
N	Approved Fund	1580	1620	0	0
	Allocated Fund	1580	1620	0	0
		100%	100%		
O	Approved Fund	450	400	242	72
	Allocated Fund	450	400	242	72
		100%	100%	100%	100%
P	Approved Fund	0	5000	0	0
	Allocated Fund	0	5000	0	0
			100%		
Q	Approved Fund	0	500	0	0
	Allocated Fund	0	500	0	0
			100%		
R	Approved Fund	4000	0	0	0
	Allocated Fund	4000	0	0	0
		100%			
S	Approved Fund	2000	5703	9345	0
	Allocated Fund	2000	5190	7815	0
		100%	**91%**	**83%**	**100%**
T	Approved Fund	9000	30000	19350	0
	Allocated Fund	9000	20948.25	19023	0
		100%	70%	98%	
U	Approved Fund	**12950**	**4000**	**1950**	**0**
	Allocated Fund	**12950**	**3000**	**0**	**0**
		100%	**75%**	**0%**	**100%**

V	Approved Fund	985	7000	16350	17635
	Allocated Fund	985	865	8445	2156
		100%	**12%**	**51%**	**12%**
W	Approved Fund	4000	6000	0	0
	Allocated Fund	4000	6000	0	0
		100%	**100%**	**100%**	**100%**
X	Approved Fund	35921	18049	10826	34241
	Allocated Fund	34134	7942	8456.3	0
		95%	**44%**	**78%**	**0%**
Y	Approved Fund	9000	0	7000	13300
	Allocated Fund	8450	0	5554.7	9387
		93%	**100%**	**79%**	**70%**
Z	Approved Fund	0	0	0	4900
	Allocated Fund	0	0	0	0
		100%	**100%**	**100%**	**0%**